



Research Paper 07/08

February 2008

AN OVERVIEW OF INNOVATION IN NORTHERN IRELAND

This paper provides a background to the concept of innovation, presenting a picture of Northern Ireland's innovation landscape, drawing on a number of papers which provide recommendations for the region's future direction.

Research Papers are compiled for the benefit of Members of The Assembly and their personal staff. Authors are available to discuss the contents of these papers with Members and their staff but cannot advise members of the general public.

SUMMARY OF KEY POINTS

Innovation can be defined as the “bringing out” of invention, or its successful adaptation. Innovation is relative in the sense that what is innovative in one region or company may be an accepted process or product in another.

There are three main types of innovation: product, process and organisational. These may be incremental or radical. Barriers to innovation are both external and internal, with SMEs facing particular barriers related to their size.

56% of Northern Ireland firms were involved in some form of innovative activity between 2002 and 2004, with larger firms being more likely to innovate. Firms in the production and construction sector are more likely to innovate than those in the distribution and services sector.

Total R&D spend in Northern Ireland, in 2005, was £302.4m, of which £142.6m (47%) was spent by business, 146.2m (48%) by the Higher Education sector and the remainder, £13.6m, was other government expenditure.

Compared to the rest of the UK, Northern Ireland performs on a par with Scotland with the same percentage of innovation active firms in both regions. Product innovation is less significant for Northern Ireland's enterprises than elsewhere in the UK, whilst firms in Northern Ireland are more likely to be involved in process innovation.

The public sector, private sector and academia all have an important role to play in encouraging the growth of an innovative economy.

Cost factors are the greatest perceived barrier to innovation in Northern Ireland, with direct innovation costs considered to be the greatest barrier to innovation across enterprises of all sizes.

Northern Ireland makes most use of its University/HE sector as a source of innovation information. Despite this, levels of university-business collaboration remain low. Only 2 % of R&D spend by the Northern Ireland's Universities is derived from UK businesses (compared to 5.5% across the UK).

In Northern Ireland the number of graduates of working age increased by 36% between October 2001 and October 2006, from 135,000 to 183,000, equivalent to 17% of the total working age population. The main subject area for degree holders is business and administration (23% or 41,000) followed by the science subjects (18% or 32,000). Furthermore, the employment rate for graduates in Northern Ireland is above the UK average (88% Northern Ireland, 87% elsewhere in the UK).

The service sector along with the retail and wholesale sector are the biggest employers in Northern Ireland. R&D makes up 0.24% of the labour market in Northern Ireland.

Improving awareness levels, targeting cross-border support programmes, introducing new funding models, creating the desire to capitalise, transferring knowledge and equipping a new generation have all been cited as ways of encouraging future innovation and growth in the science base.

CONTENTS

1	Introduction	1
2	Innovation – Background.....	1
2.1	What is innovation?.....	1
2.2	Types of innovation.....	2
2.3	Levels of Innovation	3
2.4	Barriers to Innovation	3
3	Northern Ireland’s Innovation Performance	4
3.1	Northern Ireland R&D Expenditure 2005	6
4	Northern Ireland’s Innovation Challenge.....	7
4.1	Constraints on Innovation in Northern Ireland	8
5	The Commercialisation of Research in Northern Ireland.....	9
6	Northern Ireland – Workforce Skills	10
7	Steps to improve levels of innovation and strengthen Northern Ireland’s science base.....	12

1 INTRODUCTION

On the 12 February 2008, the Minister of Finance and Personnel announced Northern Ireland's innovation fund for 2008 -2011. The fund amounts to £90 million over the three year budgetary period. The fund is made up of £27 million of indigenous funds, £25 million from HM treasury and €60 million from the Republic of Ireland¹.

The size of the fund reflects the importance placed upon innovation as an economic driver. The Programme for Government states, as a key goal:

Securing £120m of private sector investment commitments in innovation and 300 companies engaging in R&D / innovation for the first time by 2010/11².

There has been a perceived reluctance, amongst Northern Ireland's firms to become active in innovation. Invest NI have commented, for example, that:

People tell us that they don't 'do' innovation, as though it's a game only large companies can play. But innovation is not a bolt-on. It should not be restricted to a research and development lab. It has to be integral to everything a company does³.

This paper provides a background to the concept of innovation, presenting a picture of Northern Ireland's innovation landscape, drawing on a number of papers which provide recommendations for the region's future direction. The paper makes extensive use of the Community Innovation Survey 2005 a report based upon an EU designed methodology, which provides the most comprehensive review of regional innovation in the UK and Northern Ireland. The next edition of the report is due in April of this year.

2 INNOVATION – BACKGROUND

2.1 WHAT IS INNOVATION?

Joseph F. Coates in a paper on Future Innovations and Technology identifies two distinct meanings of the term innovation, stating:

The first meaning is that of invention creation or discovery, to bring something truly new and useful. The other meaning is adoption of what is new to you, whether you are an individual or an organisation⁴.

This definition is useful in two ways. Firstly it demonstrates that although invention is intrinsic to innovation it is not its only component. Innovation involves a "bringing out" of invention, or its successful adaptation. Secondly, the definition points to a degree of relativity in regard to the adaptation of innovative ideas and technology. There is what could be termed a dissemination of innovation as new ideas spread on an international, national or regional level. The offshoot of this is the notion that what may be an innovative idea in one country, region or even company might be an already adopted innovation in another.

2.2 TYPES OF INNOVATION

Typically, three specific innovation areas are identified by commentators, Product, Process and Organisational. Although, in many cases the three areas will be interrelated it is useful to look at each in turn to demonstrate the scope of what may be considered an innovative approach to business.

Product Innovation

Product innovation can range from minor improvements in a firm's existing products to revolutionary billion pound developments. Hewitt-Dundas and Roper identify four types of product innovations⁵:

1. New Products - Introduced to the market for the first time this category would include radical product developments or those based on new patents or technologies;
2. Transfer Products – Products newly introduced but which had previously been made elsewhere (again highlighting the relative nature of innovation). This might include products being manufactured under licence or whose introduction depends on the purchase of new machinery;
3. Technically Improved Products – Products that were being produced previously and which have since been modified to improve their technical performance;
4. Design Improved Products – Product that were being produced previously and have since been modified to improve their fashion or aesthetic appeal.

Success in product innovation is deemed to require a *strategic* as opposed to a *reactive* approach. A strategic approach involves *conscious attempts to identify and address specific market niches, move towards higher value-added markets or... to establish technological leadership*⁶.

Process Innovation

In business a process is simply the method by which something is produced. Process innovation is the employment of a new invention or way of working in such a way as to transform the characteristics of the production method with a view to increasing value⁷. It is again possible to sub-divide process innovation into separate categories:

1. New Processes – New or improved equipment associated with production methods recently introduced into a firm;
2. Improved Processes – New or improved methods which were being used previously, but which have since been modified or improved;
3. Replacement Processes – New or improved equipment associated with slightly improved or unchanged production methods from an earlier period⁸.

Organisational Innovation

Organisational Innovations involve changes to management structures, management systems or ways of working. Organisational changes are closely related to both product

and process innovations, with both of the latter necessitating changes to the former. This is not to say that organisational innovations cannot exist in isolation. A number of historical examples of organisational innovations are listed below, given the relative nature of innovation a number of these may still be considered innovative in certain contexts⁹:

- Robotics – the application of robotic systems within an organisational structure. Their systems typically include a combination of sensory and complex manipulation devices or features;
- Automated Materials Handling (AMH) – Automated – remote or computer-controlled – materials handling systems. These may transfer material from stores to production areas or between stages of the production process;
- Total Quality Management (TQM) - TQM is an approach to improving the competitiveness, effectiveness and flexibility of a whole organisation. A way of bringing everyone into to the process of improvement;
- Quality Circles – Groups of staff who meet regularly to discuss quality-related work problems so that they may examine and generate business solutions. The circle is empowered to promote and bring improvements to fruition;
- 20% time – A working practice employed by certain software and web design firms enabling engineers to spend one day a week working on projects that aren't necessarily in their job descriptions. The idea behind the concept is to build a culture of innovative thought by encouraging the pursuit of personal projects¹⁰.

2.3 LEVELS OF INNOVATION

To this list of three key categories of innovation it is arguably possible to add further proliferations of the concept, namely:

- Business Model;
- Marketing;
- Service;
- Supply Chain;
- Financial; and
- Social.

It is possible to further categorise innovations of all types by the degree of impact they have within their particular field. In this sense we have¹¹:

- Incremental Innovations –the results of linear progressions were each innovation can, to some extent, be predicted from the innovations that preceded it. Such innovations see the refinement of existing ideas and technologies;
- Radical Innovations – the outcome of discontinuous change – resulting in fundamental changes to practice and markets, or their replacement.

2.4 BARRIERS TO INNOVATION

Barriers to Innovation may be classed as either internal or external, with the former appearing on a micro-level and the latter being more associated with macro-economics. Furthermore, it is arguable that, to a degree, all barriers to innovation may be considered

“perceptual” barriers, where the significance placed upon them is largely due to the perceptions of a firm’s manager and employees¹². What follows is a brief outline of external and internal barriers.

External

Market Related – includes: market risk, market failure, supply and demand deficiencies, a lack of appropriate skills in the labour market, a lack of innovative users, etc.

Government Related – includes: policies designed to correct market failure, standards imposed by national or supra-national bodies, bureaucratic procedures, policy communication, regulatory frame work, intellectual property frame work, tax systems, lack or suitable institutions or the inadequate performance of existing one, etc.

Other – may be divided into technical, societal and inter-organisational.

Technical – includes: standards, changes, the risk of technological obsolescence or picking the wrong technology.

Societal – includes: norms and values, attitudes towards science, socio-economic change, and the existence or lack of a culture of entrepreneurship.

Inter-organisational – refers to cooperation between firms on a regional, national or international level.

Internal

People – includes, at individual and group level (with a possible separation between management and employees): bias (towards a type of work or product), motivation, skills, vested interests (and conflicts there of), and personal goals (conflicting with company goals). Management specific: occupied with current projects, adoption of a conservative attitude, not tolerant of failure and an aversion to risk.

Structural – affects the behaviour of an organisations members, includes: inadequate communication flows, inappropriate incentive systems, obstruction from departments, centralisation of power, rigid hierarchical system, lack of time, organisation of work, lack of delegation and specialisation, cultural inertia and internal politics.

Strategy – goals, complacency, reluctance to abandon a certain present for an uncertain future, inability to form networks, resource related (lack of funds, lack of machinery) and lack of R&D strategy.

Disadvantages Facing Small Firms

Small firms, because of their size and limited capital levels face particular disadvantages when they attempt to innovate, namely: resource gaps, no economies of scale, skill limitations and an inability to match wage rates, career opportunities and job security with larger companies.

3 NORTHERN IRELAND’S INNOVATION PERFORMANCE

The UK Innovation Survey 2005, which covers the three-year period 2002-2004, is the most current and comprehensive report on regional innovation performance currently

available. The report forms part of the wider European Community Survey (CIS) and is the fourth such survey; its predecessor was published in 2001.

The report outlines the percentage of companies partaking in innovative activity over the three-year period by company size and innovation type, as presented in Table 1¹³. Enterprise size is based upon the European Union definition of a SME, where a small enterprise consists of 50 or fewer employees; a medium enterprise has 50 to 250 employees; and a large enterprise employs 250 people or more.¹⁴

The table shows that almost 56% of Northern Ireland enterprises were actively engaging in innovation over the period 2002-2004. The split between SMEs and larger companies follows expected patterns with a greater proportion of larger companies spending on and engaging in innovative activity. Approximately one fifth of SMEs engaged in product innovation making it the most common form of innovative activity amongst companies of that size. The most marked difference between SMEs and larger companies occurred in process innovation, with over two fifths of larger firms using new or significantly improved methods of production etc, compared to less than one fifth of SMEs. The greater percentage of larger firms with “ongoing or abandoned activities” might suggest a great tolerance of risk and failure amongst firms of that size compared to SMEs.

Table 1: Enterprises that were innovation active by type of activity, 2002-04¹⁵

(percentage of all enterprises)

	Size of Enterprise		
	SMEs	Large	All
Innovation Active	55.7	66.6	55.9
Product Innovator	20.2	37.6	20.6
Process Innovator	18.9	43.2	19.4
Innovation -related expenditure	54.1	65.3	54.4
Ongoing or abandoned activities	6.2	14	6.4

Table 2, by presenting innovation activity by industry type, further dissects Northern Ireland's innovation activity. It is evident from the table that a larger proportion of respondents in the production and construction sector (63%) were innovation active compared to those in the distribution and services sector. It is also apparent that while there was little disparity in the innovation levels of SMEs and large enterprises in the distribution and services sector, within the production and construction sector larger firms were considerably more active, with large firms in the manufacturing sector being the most active¹⁶.

Table 2 Innovation activity by industry

(percentage of all enterprises)

	Size of Enterprise		
	SMEs	Large	All
Production & Construction Sector	62.5	87.2	63.2
Manufacturing	72	88.7	72.7
Mining & Quarrying	51.9	-	51.9
Construction	D	D	51.4
Electricity, gas & water supply	D	-	D
Distribution & Services Sector	52.3	54.3	52.3
Real estate, renting & business activities	73.6	66.7	73.3
Financial intermediation	D	D	69.7
Transport, storage & communication	55.1	-	55.1
Whole sale & retail trade; repair of motor vehicles, motorcycles & personal/household goods	46.5	40.9	46.4
Hotels & Restaurants	50.5	37.5	40.5
All industries	55.7	66.6	55.9

Key

D – disclosive figures

- = no enterprises responded in this sector/size group

3.1 NORTHERN IRELAND R&D EXPENDITURE 2005¹⁷

Total R&D spend in Northern Ireland, in 2005, was £302.4m, of which £142.6m (47.2%) was spent by business, 146.2m (48.3%) by the Higher Education sector and the remainder, £13.6m, was other government expenditure.

There was a rise of £29.7 million (10.9%) in cash terms and a rise of £24.5 million (8.8%) in real terms in Northern Ireland total R&D expenditure between 2004 and 2005 (from £277.9m to £302.4m).

For the third consecutive year in 2005 Northern Ireland Higher Education accounted for a greater share of total R&D expenditure (48.3%) than the Business sector (47.2%).

Northern Ireland Business, Higher Education and other Government R&D expenditure rose in real terms, by £15.9 million (12.6%), £7.6 million (5.4%) and £1.0 million (8.2%) respectively.

In cash terms total business R&D expenditure in 2005 was £142.6 million, up £18.3 million (14.7%) on the previous year.

Within company expenditure (intramural), a subset of business R&D expenditure, increased by 17.8% in cash terms in Northern Ireland from £115.5 million to £136.1 million – corresponding to a UK spending increase of 4.6% during the period.

There was an increase (6.6%) in R&D expenditure by the Manufacturing sector from £82.8 million in 2004 to £88.3 million in 2005. A larger increase occurred in the Services and Other sector with R&D expenditure increasing by 30.8% from £41.5 million to £54.3 million in the same period.

3.2 REGIONAL INNOVATION

Table 3 presents a picture of regional variations in innovation. The figures have been gathered from the UK Community Innovation Survey 2005 and the Republic of Ireland Community Innovation Survey 2005. Both surveys cover the same time period and are compiled using the same methodology¹⁸.

Compared to the rest of the UK, Northern Ireland performs on a par with Scotland with the same percentage innovation active firms in both regions. Product innovation is less significant for Northern Ireland enterprises than elsewhere in the UK, whilst firms in Northern Ireland are more likely to be involved in process innovation. Fewer firms in the Republic of Ireland are actively involved in innovation, but of those firms who do partake in innovative activity a greater proportion have embarked on in both process and product innovation, with process innovation being the most popular form of innovative activity.

Table 3 Innovation by region, percentage of all enterprises

	NE Eng	NW Eng	Yorks & Humber	E Mid	W Mid	E Eng	Ldn	SE Eng	SW Eng	Wales	Scot	NI	Rol
Innovation Active	57	58	58	57	55	55	57	60	57	57	56	56	52.2
Product Innovator	25	24	25	27	24	26	27	28	25	24	22	21	37.9
Process Innovator	16	15	15	16	17	17	16	16	16	16	16	19	42.7
Innovation - related expenditure	54	55	56	53	53	52	53	56	55	55	53	54	-
Ongoing or abandoned activities	8	8	10	9	10	11	10	13	11	8	10	6	-

- = figure unavailable

4 NORTHERN IRELAND'S INNOVATION CHALLENGE

Think, Create, Innovate, Northern Ireland's Regional Innovation Strategy identifies the key challenges facing stakeholders in three broad sectors in seeking to create an innovative economy:

Private Sector - R&D activity in Northern Ireland is concentrated in a small number of large firms. The involvement of small firms in research is likely to be at a low level or very specialised - they are more usually concerned with "incremental" innovation, the small gradual changes in the design and manufacture of their products, processes and services. In an increasingly knowledge-based economy however, small firms also have the opportunity to use their creativity and innovative impulses to reach world-wide markets and to complement the research and development efforts of the larger companies in Northern Ireland, particularly those that are foreign owned and use Northern Ireland very successfully as a research base for their world-wide markets.

Academia - Universities carry out high quality, world-class research thus creating new knowledge but they also, and increasingly, transfer the new knowledge into real products and processes. It is crucial that the results of such research are transferred from the science base to companies and into wider society to improve the quality of life for all. However, the output of the Further and Higher education establishments that will have the greatest impact on the creation of a knowledge-based economy in Northern Ireland are the young men and women that receive world class education and training and then contribute to the creative and innovative culture that is needed to underpin the Northern Ireland economy and society. It is deemed important that the whole spectrum of basic research with government and industry being responsible for delivery of funding.

Public Sector - Government is both a funder of research and a consumer of research results notably in respect of the fulfillment of statutory and other responsibilities in the areas of health, social wellbeing, environment, energy and agriculture amongst others. Government also funds research capacity in the Universities. Government Departments are in the process of reviewing and designing their own individual research, development and innovation strategies that will complement and support this strategy and create greater transparency and co-ordination amongst Departmental activities. Government also has the responsibility to create the environment, stimulate investments and improve the co-ordination of policy and the linkages between public and private research, development and innovation. It can also act as an exemplar both in terms of innovative policy and practice and through greater commercialisation of public sector research.

4.1 CONSTRAINTS ON INNOVATION IN NORTHERN IRELAND

The UK Innovation Survey 2005 collected information on what businesses in Northern Ireland considered to be the greatest internal and external constraints to innovation. Table 3 details the percentage of respondents who gave a 'high' rating to each category of constraint. The two barriers considered to be most constraining to all enterprises, namely cost and regulatory barriers, are both external barriers.

The responses identify cost factors to be the greatest perceived barrier to innovation, with direct innovation costs considered to be the greatest barrier across enterprises of all sizes. The availability of finance was perceived to be a slightly bigger problem amongst large enterprises than SMEs, while the cost of finance is of bigger concern to SMEs than their larger counterparts. The perceived risk involved in innovation activity was of almost equal concern to large and small business. The impact of UK and EU regulatory frameworks were of significant concern to all enterprises, but appear to be a greater constraint to SMEs.

Table 4 Enterprises regarding potential barrier to innovation as 'high'

(percentage of all enterprises)

Barrier		Size of Enterprise		
		SMEs	Large	All
Cost Factors	Direct Cost too high	14.2	14.2	14.2
	Excessive perceived economic risk	13	13.1	13
	Cost of Finance	12.2	7.7	12.1
Knowledge Factors	Availability of finance	9.6	10.2	9.7
	Lack of Qualified personnel	5.6	6.1	5.6
	Lack of information on markets	3.3	2.7	3.3
	Lack of information on technology	2.4	1.4	2.4
Market Factors	Market dominated by established	6.4	6.4	6.4
	Uncertain demand for innovative goods or services	5.9	4	5.9
Other Factors	Need to meet UK Government regulations	8.8	5.8	8.7
	Need to meet EU regulations	7.7	6.8	7.7

5 THE COMMERCIALISATION OF RESEARCH IN NORTHERN IRELAND

The commercialisation of intellectual property for Northern Ireland's university research base is cited as a key priority in the Department for Enterprise, Trade and Investment's Draft Corporate Plan for 2008 - 2011¹⁹. Exploiting the Northern Ireland's educational research base is deemed to be a major driver of future productivity growth and a major contributor to economic and social well being²⁰.

Further to this, the Regional Innovation Strategy for Northern Ireland highlights:

The two universities in Northern Ireland carry out some genuinely world-class research and development work (evidenced by their scoring of 21 units at either 5 or 5 in the most recent Research Assessment Exercise), and indeed they have earned strong brand reputations nationally and internationally as a result.*

Table 5, again sourced from the 2005 UK Innovation Survey, presents regional statistics on sources of information for innovation by region amongst those firms actively engaging in innovation. The figures show that Northern Ireland has exploited its University and Higher Education (HE) research base to a greater degree than any other UK region. The figures also demonstrate that, as a source of innovation information the University/HE research base contributes least of all sources listed, suggesting it could be better utilised in the future.

Despite, this apparent reliance on the University/HE sector as a source of information commentators have pointed to certain deficiencies in the link between business and the research base. Levels of university-business collaboration remain low. Only 2.2% of R&D spend by the Northern Ireland's Universities is derived from UK businesses (compared to 5.5% across the UK). It appears that despite research excellence in industry-focused areas such as engineering, built environment and biomedical studies, firms aren't taking full advantage of this²¹.

Relative to investment in R&D, universities in Northern Ireland are the least efficient of the 12 UK regions in the number of patent applications and non-software licences granted and in their intellectual property income from large commercial organisations. The universities perform slightly better in terms of income from small and medium-sized firms and the number of spin outs (7th and 8th place respectively)²².

Table 5 Source of information for innovation, by region (innovation active firms)

(percentage of all enterprises)

Source	NE Eng	NW Eng	Yorks & Humber	E Midland	W Midland	E Eng	Ldn	SE Eng	SW Eng	Wales	Scot	NI
Within your enterprise or enterprise groups	80	80	82	81	80	82	84	82	81	78	80	79
Suppliers	86	86	86	88	84	88	84	87	87	86	87	88
Clients or customers	84	84	88	87	86	86	87	87	89	85	89	86
Competitors	73	75	80	78	76	76	79	80	81	77	81	80
Consultants or private labs	47	45	47	49	48	48	55	49	46	49	52	50
Universities of other HEIs	34	28	27	33	28	28	28	28	26	35	34	35
Gov or public research institutes	31	28	29	30	29	29	31	31	28	34	37	39
Conferences, trade fairs, exhibitions	57	62	65	66	61	61	67	67	63	62	70	67
Scientific, trade and technical publications	59	60	61	67	64	64	64	64	65	61	68	63
Professional and industry associations	62	65	65	66	63	63	69	68	72	60	70	66
Technical, industry or other services standards	61	64	63	66	64	64	63	65	67	60	67	64

6 NORTHERN IRELAND – WORKFORCE SKILLS

The Regional Innovation Strategy, which aims to *create a culture and environment within which Northern Ireland will prosper by using its knowledge, skills and capacity to innovate*, recognises as one of its underlying building blocks:

... the continuing emphasis on skills issues - from the long tail of underachievement in schools, to the importance of key skills needed by the business community and the value of a continuing supply of high calibre graduates from the universities²³

In Northern Ireland the number of graduates of working age increased by 36% between October 2001 and October 2006, from 135,000 to 183,000, equivalent to 17% of the total working age population. The main subject area for degree holders is business and administration (23% or 41,000) followed by those in the science field (18% or 32,000).

Furthermore, the employment rate for graduates in Northern Ireland is above the UK average (88% Northern Ireland, 87.3% elsewhere the UK)²⁴.

In December 2005, an analysis of Labour Force Survey (LFS) data by DETI revealed a higher incidence of graduates working in the public rather than the private sector (53% and 47% respectively). In contrast, there was a higher preponderance of non-graduates working in the private sector (75%) rather than the public sector (25%)²⁵.

Table 6 provides an overview of the Northern Ireland labour market as of 2005 based upon Standard Industrial Classification (SIC). It is evident from the figures that the Service sector is by far the largest employer within the region, followed wholesale and retailing. The service sector is an area where innovation could occur, especially process innovation. A detailed breakdown of the figures also reveals that the number of people actually employed in R&D was 1,652, making up 0.24% of the total labour force (683,054 excluding agriculture)²⁶.

Table 6 Northern Ireland Census of Employment September 2005 Employee Jobs

SIC2003 BUSINESS DESCRIPTIONS	ALL EMPLOYEES
AGRICULTURE, HUNTING , FORESTRY & FISHERY	12,995
MINING AND QUARRYING	2,060
MANUFACTURING	87,697
ELECTRICITY, GAS AND WATER SUPPLY	2,706
CONSTRUCTION	38,339
WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES, MOTORCYCLES AND PERSONAL/HOUSEHOLD GOODS	118,924
HOTELS AND RESTAURANTS	41,980
TRANSPORT, STORAGE AND	28,822
FINANCIAL INTERMEDIATION	17,940
REAL ESTATE, RENTING AND BUSINESS	68,191
PUBLIC ADMINISTRATION AND DEFENCE;	59,944
EDUCATION	72,598
HEALTH AND SOCIAL WORK	110,780
OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICE ACTIVITIES	32,439
SERVICES	551,618

Source Northern Ireland Census of Employment September 2005²⁷.

7 STEPS TO IMPROVE LEVELS OF INNOVATION AND STRENGTHEN NORTHERN IRELAND'S SCIENCE BASE

A recently published Mapping Study of Research and Technology Development (RTD) Centres by Intertrade Ireland has made a number of recommendations regarding the future of R&D and Innovation in both Northern Ireland and the Republic of Ireland. The study suggests that cross-border cooperation is key to growing the research and technology base. Specifically, the report recommends that work be done to²⁸:

- Improve awareness levels;
- Target cross-border support programmes; and
- Introduce new funding models.

InvestNI have also made a number of recommendations as to how to promote innovation and science development within Northern Ireland. They conclude the following steps should be taken²⁹:

- Creating the desire to capitalise - by motivating businesses to take risk and have the ambition to grow;
- Transferring knowledge - by stimulating networking between businesses but also promoting collaboration between industry and science, to ensure the transfer of technology and knowledge;
- Equipping a new generation - to meet the needs of a global marketplace Northern Ireland must ensure there is a next generation of skilled employees waiting to take up the innovation challenge.

¹ <http://www.niassembly.gov.uk/record/reports2007/080212.htm>

² <http://64.233.183.104/search?q=cache:3P5IKgnHBwcJ:www.pfgbudgetni.gov.uk/pfg241007new.pdf+Northern+Ireland+Innovation+programme+for+government+2008-2011&hl=en&ct=clnk&cd=1&gl=uk>

³ <http://www.nesta.org.uk/informing/articles/investni.aspx>

⁴ Joseph F Coates, Future Innovations and Technology, The International Handbook of Innovation Larisa V. Shavinina eds, Oxford : Pergamon, 2003, p1073

⁵ N Hewitt-Dundas and S Roper: Business Innovation in Ireland, Oak Tree Press, Dublin, 1998, p7

⁶ *Ibid*

⁷ <http://processinnovation.blogspot.com/2007/09/logical-definition-of-process.html>

⁸ Hewitt-Dundas et al p8

⁹ *Ibid* p 10

¹⁰ <http://googleblog.blogspot.com/2006/05/googles-20-percent-time-in-action.html>

¹¹ http://www.open2.net/money/radical_innovation.html

¹² A Hadjimanolis, The Barriers to Innovation, Future Innovations and Technology, The International Handbook of Innovation Larisa V. Shavinina eds, Oxford : Pergamon, 2003, p560

¹³ <http://www.detini.gov.uk/cgi-bin/downdoc?id=2197>

¹⁴ http://ec.europa.eu/enterprise/enterprise_policy/sme_definition/index_en.htm

¹⁵ <http://www.detini.gov.uk/cgi-bin/downdoc?id=2197>

¹⁶ *Ibid*

¹⁷ <http://www.detini.gov.uk/cgi-bin/downdoc?id=2587>

¹⁸ <http://www.berr.gov.uk/files/file31569.pdf> & http://www.forfas.ie/publications/forfas060920/forfas060920_innovation_survey_webopt.pdf

¹⁹ DETI Corporate Plan 2008 – 2011, p17

²⁰ *ibid*, p11

²¹ Dr Nola Hewitt-Dundas, ‘Where do we go from here?’, Ulster Business, April 2006.

²² *ibid*

²³ <http://www.detini.gov.uk/cgi-bin/downutildoc?id=14>

²⁴ <http://www.detini.gov.uk/cgi-bin/downdoc?id=3278>

²⁵

http://www.prospects.ac.uk/cms/ShowPage/Home_page/Main_menu_Research/Labour_market_information/Graduate_Market_Trends_2006/Destinations_of_graduates_from_Northern_Ireland_Spring_06_/pllkjefX

²⁶ <http://www.detini.gov.uk/cgi-bin/downdoc?id=2661>

²⁷

<http://monitor.isa/536978900/558629760T0802151502291339416.txt.binXMysM0dapplication/vnd.ms-excelXsysM0dhttp://www.detini.gov.uk/cgi-bin/downdoc?id=2772>

²⁸

<http://www.intertradeireland.com/module.cfm/opt/29/area/Publications/page/Publications/down/yes/id/377>

²⁹ <http://www.nesta.org.uk/informing/articles/investni.aspx>