

# **Innovation, Best Practice Adoption and Innovation Networks**

## **A Comparison of Northern Ireland and the Republic of Ireland**

**December 2003**

Stephen Roper (Aston Business School), Nola Hewitt-Dundas (Queen's University  
Belfast) and Margaret Savage (NIERC)



## Contents

Chapter 1 - Context and Introduction .....	9
1.1 Introduction.....	9
1.2 Context.....	10
1.3 Summary .....	14
Chapter 2 - Product and Process Innovation in Manufacturing Firms.....	16
2.1 Introduction.....	16
2.2 Innovation Measures .....	16
2.3 Manufacturing Innovation 2000 to 2002 .....	17
2.4 Changes in Innovative Activity .....	25
2.5 Adoption of Best Practice Techniques.....	25
2.6 Innovation and Strategic Planning .....	29
2.7 Summary .....	33
Chapter 3 - Service Sector Innovation .....	34
3.1 Introduction.....	34
3.2 Innovation Measures .....	34
3.3 Service Innovation in Northern Ireland and the Republic of Ireland.....	34
3.4 Innovation and Strategic Planning .....	36
3.5 Summary .....	40
Chapter 4 - Innovation Networking in Manufacturing .....	42
4.1 Introduction.....	42
4.2 Innovation Links in the Manufacturing Sector .....	43
4.3 Nature of Product and Process Development Links .....	49
4.4 Location of Innovation Partners.....	54
4.5 Summary .....	57
Chapter 5 - Innovation Networks in the Service Sector .....	59
5.1 Introduction.....	59
5.2 Innovation Networks.....	59
5.3 Nature of Innovation Links with Service Firms .....	63
5.4 Location of Service Firms' Innovation Partners .....	67
5.5 Summary .....	69
Chapter 6 - Key Points and Policy Implications .....	70
6.1 Key Empirical Results .....	70
6.2 Policy Implications .....	71
Appendix 1: Survey Data and Methods .....	73
A1.1 Introduction.....	73
A1.2 Sampling Frames.....	73
A1.3 Survey Methodology and Response.....	75
A1.4 Non Response .....	77
A1.5 Sample Weights .....	77
Appendix 2: Manufacturing Questionnaire .....	80

Appendix 3: Services Questionnaire.....	85
Appendix 4: Additional Tabular Material - Manufacturing .....	89
Appendix 5: Additional Tables – Services .....	132

## **Executive Summary**

### ***Background***

1. This report outlines the key results from a survey of the innovation activity of manufacturing and tradable services businesses in Northern Ireland and the Republic of Ireland. The survey covers businesses' innovation activities over the period 2000 to 2002.
2. The period covered by the IIP4 (i.e. 2000 to 2002) was a particularly difficult period for many manufacturing companies, in particular, with slowly growing international and domestic markets, problematic exchange rates and continuing competitive pressure from low cost producers. This might be expected to have a distinct negative influence on firms' willingness to invest in innovation. (Section 1.2)

### ***Manufacturing Innovation***

3. Over the 2000 to 2002 period, 53.8 per cent of manufacturing plants in Northern Ireland introduced new or improved products compared to 56.7 per cent in the Republic of Ireland. On average around 25 per cent of plants' sales came from newly introduced products with another 20-25 per cent from improved products.
4. Few significant differences in product innovation rates are evident for individual sectors, sizebands or ownership groups. This suggests 'structural' factors are important in shaping the overall innovation rates, with the Republic of Ireland having a larger proportion of its manufacturing plants in more product and process intensive sectors.
5. Over the same period 50.1 per cent of Northern Ireland manufacturing plants and 53.9 per cent of Republic of Ireland plants introduced new or improved processes. Evidence from a series of new indicators suggests that the quality of process innovation was superior in the South, particularly in larger, externally-owned firms.
6. Comparisons of the 2000-02 results with the earlier survey covering 1997-99 suggest that the proportion of product and process innovators has fallen in both Northern Ireland and the Republic of Ireland. In addition in both areas there has been a fall in the proportion of sales derived from new products transferred from other production sites. Both falls probably reflect the broader economic situation over the 2000 to 2002 period in contrast to the more buoyant climate of 1997-99.
7. Just over half of all manufacturing plants in Northern Ireland (54.4 per cent) and in the Republic of Ireland (59.9 per cent) had a formal plan for the development of the business over the next three years or more. Such plans typically included targets for new product development but were less likely to include specific targets for R&D investment.

### ***Tradable Services Innovation***

8. From 2000 to 2002, tradable services innovation in Northern Ireland and the Republic of Ireland was very similar. 49.4 per cent of tradable services businesses in Northern Ireland and 52.7 per cent in the Republic of Ireland introduced new or improved services. On average around 25 per cent of sales were derived from new services and 18 per cent from improved services.
9. Reflecting the situation in manufacturing more closely, a higher overall proportion of service sector firms in the Republic of Ireland have formal strategic plans, a difference being driven largely by the greater frequency of strategic planning among larger Southern businesses.
10. Among those firms which do have strategic plans there is again a marked similarity in the objectives specified, North and South. Service development emerges as a priority with fewer firms specifying formal targets for R&D investment or joint ventures. To achieve their targets firms also perceive similar challenges North and South centring on people and skills, strategy development and improving efficiency.

### ***Innovation Links in Manufacturing and Services***

11. A similar proportion of manufacturing plants in NI and ROI have innovation links at 36.9 per cent and 37.7 per cent respectively. NI service firms were significantly less likely to have external innovation links (42.3 per cent of firms) than ROI service firms (53 per cent)
12. Smaller manufacturing plants and service firms are less likely to have innovation links than larger plants or service firms. Externally-owned manufacturing plants and service firms in both NI and the ROI are significantly more likely to have external innovation links.
13. Manufacturing plants tend to have a slightly broader network of collaborators than service firms with on average 2.9 different partners compared to 2.3 for service firms.
14. Producer-user collaboration is the most common form of external links as part of innovation activity in both manufacturing plants and service firms.
15. NI manufacturing plants and service firms were significantly more likely to have innovation links with their clients or customers than ROI manufacturing plants. NI manufacturing plants were also significantly more likely to be collaborating with university labs than ROI manufacturing plants.
16. In general, the extent of local collaboration on innovation is similar in Northern Ireland and the Republic of Ireland. NI manufacturing plants local collaboration on innovation with other group plants, government labs and universities is stronger than that found in the Republic of Ireland.
17. ROI service firms appear to be more embedded in the ROI economy in terms of significant higher proportion of firms with local innovation links to other

group companies, competitors, government labs and private research institutes than that for NI service firms.

18. NI manufacturing plants engage in cross border innovation links to a much greater extent than ROI plants (with the exception of use of consultants, government labs and universities).
19. Both NI manufacturing and service firms are more strongly linked into partners in GB than their ROI counterparts.
20. Without exception, ROI manufacturing plants are more likely to have innovation partners in other EU countries than NI plants. In addition, ROI manufacturing plants are also more likely to engage in innovation links outside the EU than NI plants.

### ***Policy Priorities***

21. Overall, it is difficult to draw any clear implications about the efficacy of policy North and South from our survey results. Economic conditions during 2000 to 2002 seem to have dominated any positive policy effect.
22. Continuing policy challenges remain, however, notably:
23. Innovation indicators generally remain lower for smaller and indigenously-owned manufacturing firms and both groups must remain priority areas.
24. The quality of process innovation in Northern Ireland is a concern, particularly as firms continue to face intense cost pressures from low-cost producers.
25. Levels of tradable services innovation in Northern Ireland are in line with those in the Republic of Ireland but here again issues arise with smaller firms.
26. Levels of innovation networking in Northern Ireland compare relatively well with the Republic of Ireland, a positive result. It remains the case, however, that only around 38 per cent of manufacturing plants had innovation links. Increasing the overall proportion of firms having such contacts will remain important.
27. Our results also emphasise the areas which firms themselves see as developmental priorities over the next three years. For small plants, both North and South, development priorities are productivity, marketing, customer service and people/skills with less attention focussed on supply chain development.
28. For larger plants, customer service, productivity and people/skills remain important development areas but marketing was mentioned much less often. Supply chain development was seen as important by larger externally-owned plants.
29. Finally, given the overall similarities between the levels of innovation activity in Northern Ireland and the Republic of Ireland, it may be worth considering

whether it may be more appropriate to use more challenging benchmarks in future studies. Core UK regions (or parts thereof) provide possible candidates although international comparisons may also be of value.



# Chapter 1 - Context and Introduction

## 1.1 Introduction

This report outlines the key results from a survey of the innovation activity of manufacturing and tradable services businesses in Northern Ireland and the Republic of Ireland. The survey covers businesses' innovation activities over the 2000 to 2002 period and provides representative results for each area, industry and company sizeband. Comparisons are also possible between externally and locally-owned businesses in Northern Ireland and the Republic of Ireland.

For manufacturing plants, the survey is the fourth in a series of representative surveys of Northern Ireland and Republic of Ireland firms' innovation activity which have been conducted every three years since 1993<sup>1</sup>. Taken together these four surveys offer a unique picture of the development of innovation activity throughout Ireland over the last 12 years<sup>2</sup>. Tradable Services are included in the current survey for the first time.

The key aims of the IIP4 survey were: to contribute to the performance measurement needs of Invest NI (as reflected in the Performance Information Framework); and, to help to measure progress towards the long-term targets specified by the Northern Ireland Economic Development Forum. More specifically, the survey was designed to:

- (a) Provide a 2002 baseline against which future developments in innovation activity - broadly defined - in Northern Ireland can be compared.
- (b) Allow a detailed comparison of innovation activity and business process development among Invest NI client companies and comparable NI and Republic of Ireland firms.
- (c) Highlight key developments in Northern Ireland firms' innovation activity since 1999 and help Invest NI to identify strategic priorities.
- (d) Provide the first ever results on innovation in the tradable services sector and a comparison with the Republic of Ireland.
- (e) Contribute to our understanding of long-term developments in the profile of innovation activity in Northern Ireland in comparison to the Republic of Ireland.
- (f) Provide the basis for potential comparisons with other regions elsewhere in the UK and beyond.

The IIP4 was a postal survey which relates to firms' innovation activity over the three year period from 2000 to 2002. Direct comparisons are therefore possible with earlier waves of the IIP, each of which covers a three-year period.

The period covered by the IIP4 (i.e. 2000 to 2002) was a particularly difficult period for many manufacturing companies, in particular, with slowly growing international

---

<sup>1</sup> Previous surveys are documented in Roper et al. (1996), Roper and Hewitt-Dundas (1998) and Roper and Anderson (2000).

<sup>2</sup> These surveys also constitute a 'panel' in which the innovation activities of individual manufacturing plants can be traced. For short, the survey is therefore referred to as the Irish Innovation Panel Wave 4 - or IIP4.

and domestic markets, problematic exchange rates and continuing competitive pressure from low cost producers. This is a marked contrast with earlier periods when international markets were growing more strongly and market conditions, particularly in the Republic of Ireland, were more positive. It is also important to recognise that the growth of the 1990s, and the subsequent downturn have influenced individual sectors in very different ways. For example, the recent downturn has impacted primarily on globalised, high-tech sectors with a more limited impact on domestically oriented food and furniture producers. These temporal and sectoral contrasts inevitably shape firms' willingness – and ability – to invest in innovation, and provide the context within which the IIP4 survey was conducted. In Section 1.2 we therefore review briefly the growth of output in the Northern Ireland and Republic of Ireland manufacturing sectors. Following sections of the report are organised as follows:

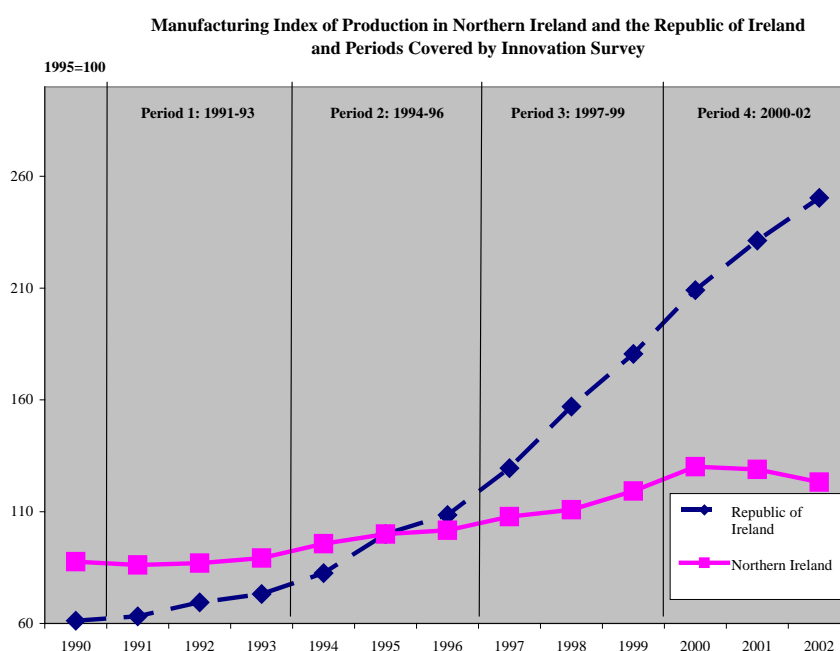
- Chapter 2 compares the level of innovative activity in Northern Ireland and the Republic of Ireland over the 2000 to 2002 period from the IIP4 survey for manufacturing firms and examines the development of the level of innovation activity through time.
- Chapter 3 compares the level of innovative activity of tradable services activity in Northern Ireland and the Republic of Ireland for 2000 to 2002 from the IIP4 survey.
- Chapter 4 examines the level of innovation linkages between local companies manufacturing and between local firms and other change agents such as the universities. Chapter 5 repeats the same type of analysis for tradable services firms.
- Chapter 6 concludes by highlighting the main findings of the IIP4 survey and the strategic and policy issues it suggests.

Survey methodology, sampling etc. are described in Annex 1 and the survey questionnaires are included in Annex 2 (manufacturing) and Annex 3 (services). Annex 4 includes a detailed set of cross-tabulations from each question on the survey form.

## **1.2 Context**

As indicated above the IIP4 survey is the fourth survey of innovation activity throughout the island of Ireland conducted by NIERC and its research partners over the last decade. Each survey inevitably reflects the economic conditions covering the period to which it relates and this has to be taken into account in evaluating the survey results. This is particularly important in comparisons of the level of innovative activity between time periods. Figure 1 below illustrates the time periods covered by the different waves of the Irish Innovation Panel and the index of production for manufacturing for Northern Ireland and the Republic of Ireland.

**Figure 1**



Sources: DETI, CSO.

For Northern Ireland the period from 1991-99 was marked by steady output growth for manufacturing as a whole, with much more rapid growth evident in the Republic of Ireland. This, of course, reflects the very rapid expansion of output in the high-tech sectors in the Republic of Ireland, itself largely a consequence of inward investment and re-investment. This means that – in general terms - the first three waves of the IIP reflect a largely expansionist situation with manufacturing output growing, overall, in both areas. Since late-2000, however, the situation has looked very different. In Northern Ireland in particular, manufacturing output has fallen, while the rate of growth of output in the Republic of Ireland has slowed considerably. This reflects the global downturn in high-tech industry and its impact on other related sectors. The IIP4, which reflects firms' innovation activity over the 2000 to 2002 period, therefore relates to a very different set of economic circumstances.

While the impression created by Figure 1 does suggest the general climate against which the IIP4 was undertaken it hides important sectoral variations. O'Malley and Roper (2003), for example, have suggested that during the 1990s marked differences existed between the performance of individual sectors, North and South. In particular, they concluded that sectors could be divided into three groups on the basis of their comparative productivity performance over the 1998-2000 period:

- A group of mature industries, where inward investment has been limited, and productivity levels are broadly similar, North and South. This group includes textiles, wood and wood products, paper, pulp and paper products, rubber and plastics, basic metals, fabricated metal products, machinery and equipment, electrical machinery, motor vehicles and other transport equipment, and recycling.
- Another group of mature industries in which significant differences are observed between Northern and Southern productivity, with the advantage being

predominantly with Southern firms. This group includes furniture, clothing and non-metallic mineral products. Food, drink and tobacco also falls into this group although differences in data definitions, North and South, make any accurate assessment difficult.

- High-tech industries where inward investment has been a dominant influence and levels of productivity appear significantly higher in the Republic of Ireland than in Northern Ireland. This group includes: printing and the production of recorded media (including software), chemicals and chemical products (including pharmaceuticals), office machinery and equipment, medical, precision and other instruments, radio, television and communications equipment.

**Figure 2: Index of Production by Industry for Mature Sectors with Similar Productivity: Northern Ireland and the Republic of Ireland**

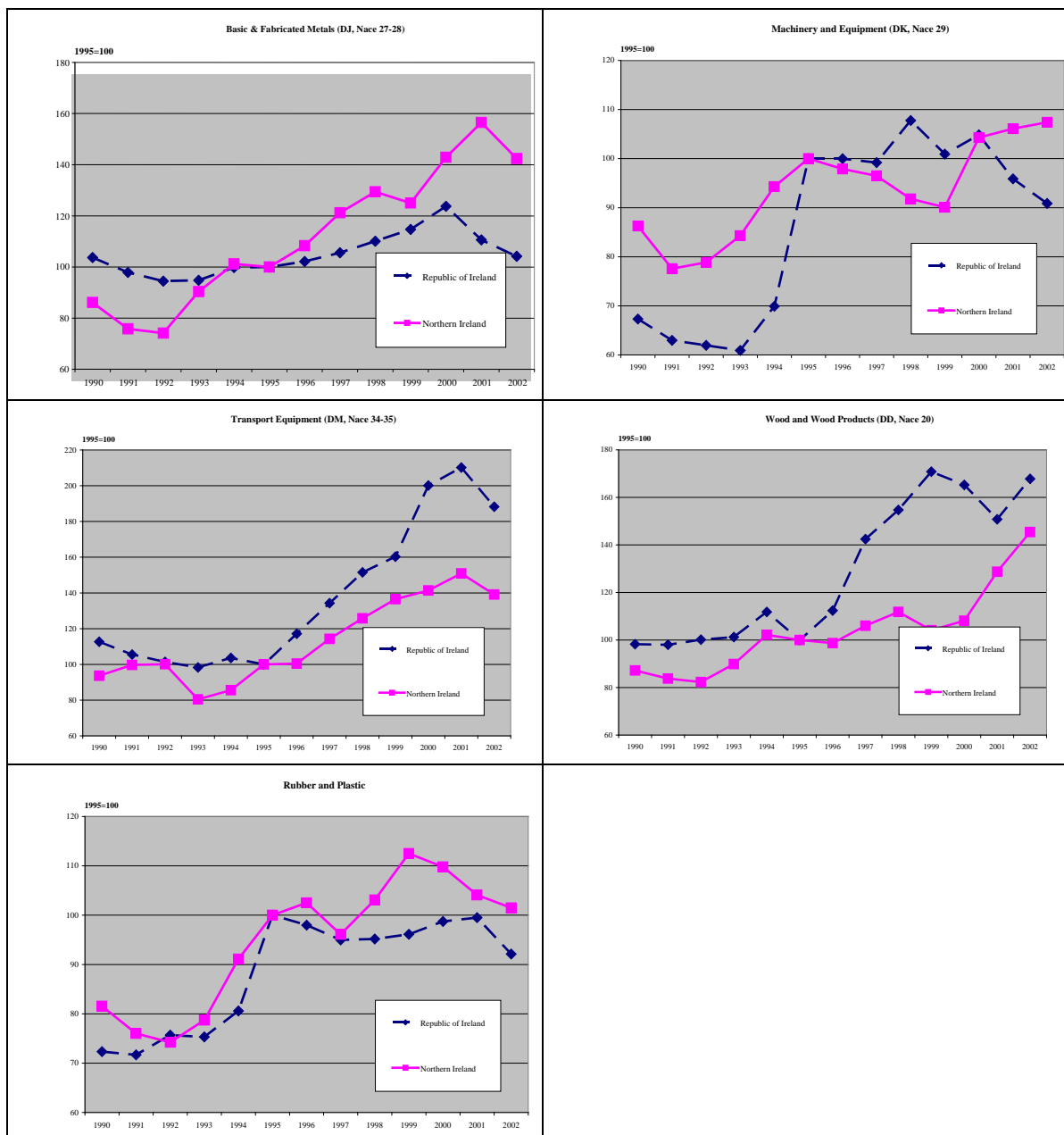
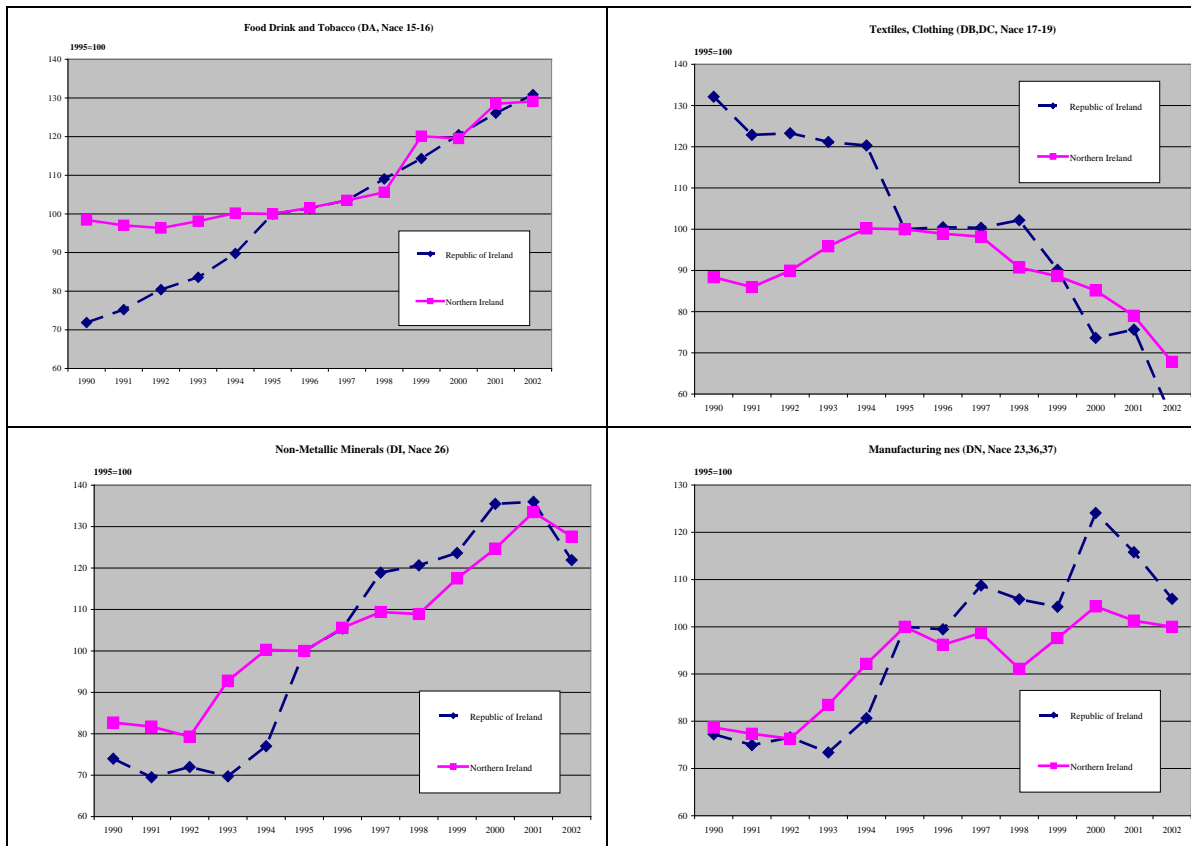


Figure 2 gives the index of production for the first group of maturer sectors with similar productivity, North and South. Growth in output is evident since the mid-1990s in basic and fabricated metal products, transport equipment and wood and wood products. In transport equipment and wood and wood products faster output growth to 2000 was evident in the Republic of Ireland, although employment in the Southern transport equipment sector is relatively small. Output in wood products – related largely to construction – has continued to grow through 2001 and 2002 while output in transport equipment has fallen in both Northern Ireland and the Republic of Ireland. Output in basic and fabricated metals grew faster in the North to 2000, but like transport equipment output has fallen, North and South since 2000. In rubber and plastics and machinery and equipment output volumes have been volatile but are now around their 1995 levels both North and South. Output in both sectors has been flat or declining since 2000.

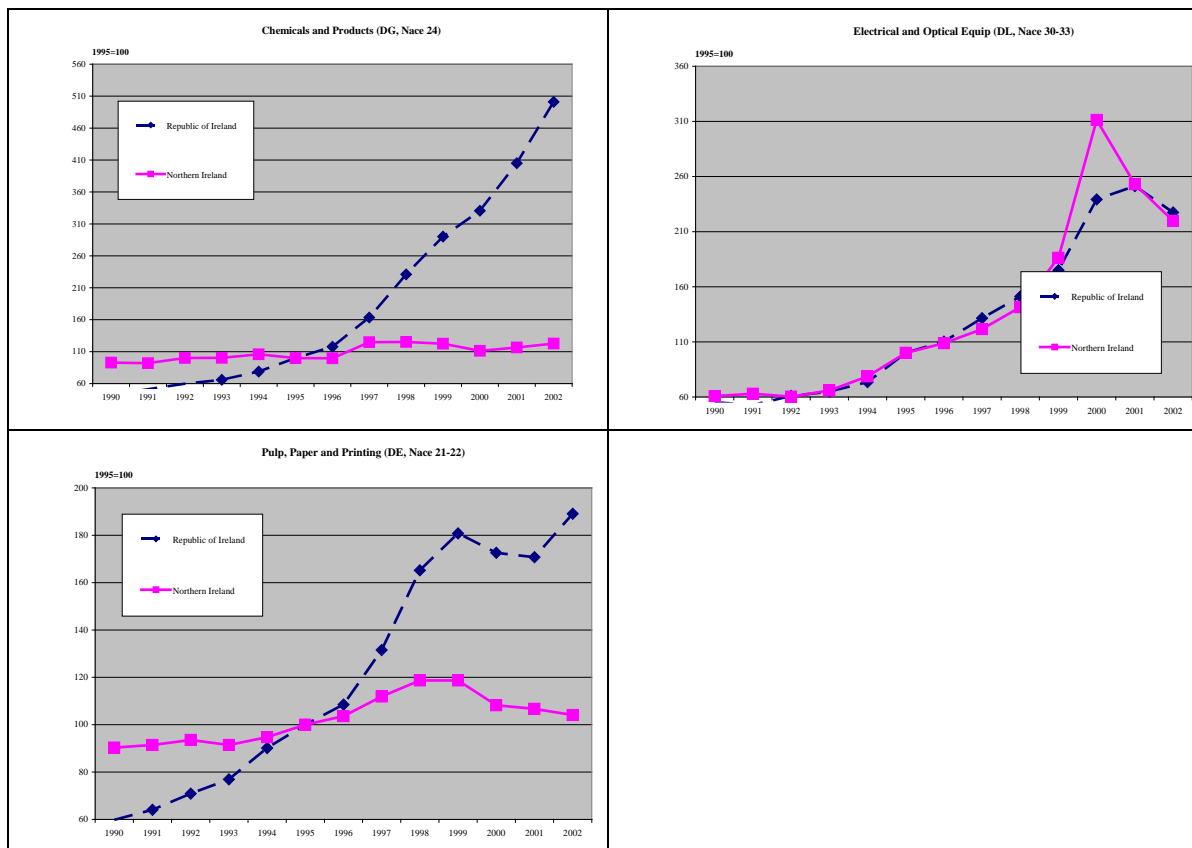
For the second group of sectors with higher Southern productivity we might have expected faster output growth if Southern firms were more competitive. Instead, however, as Figure 3 suggests increases (food, non-metallic minerals and manufacturing nes) and falls (textiles) in output in these sectors were very similar through to 2000.

**Figure 3: Index of Production by Industry for Mature Sectors with Higher Southern Productivity: Northern Ireland and the Republic of Ireland**



The final group of sectors relates to those industries where there has been significant inward investment and re-investment in the Republic of Ireland over the last decade. In chemicals, which includes pharmaceuticals, output in the Republic of Ireland increased dramatically in the Republic of Ireland from 1995 to 2000, an increase which was sustained through 2001 and 2002. In Northern Ireland, chemicals output remained stable through the latter half of the 1990s and also held up well through 2001 and 2002. Paper and printing exhibits a similar growth trend from 1995 to 2000, with significantly faster growth in the Republic of Ireland. Since 1999, output growth both North and South has been more limited. Unlike the other two sectors, the growth trend in the electrical and optical equipment sector was very similar in Northern Ireland and the Republic of Ireland through to 1999. Since 2000, output falls have been more marked in Northern Ireland.

**Figure 4: Index of Production by Industry Sectors with Higher Southern Productivity and Significant Inward Investment: Northern Ireland and the Republic of Ireland**



### 1.3 Summary

Cross-sectional surveys such as the IIP4 inevitably reflect the economic and policy context in which they are undertaken. The IIP4 which relates to firms' innovation activity during 2000, 2001 and 2002 therefore reflects the general difficulty of the international economic climate over this period as well as the more sectorally specific impact of the high-tech downturn. The index of production in particular suggests that in marked contrast to the remainder of the 1990s, this was a period of falling

industrial output in Northern Ireland and a marked slowdown in total manufacturing output growth in the Republic of Ireland. In Northern Ireland from 2000 to 2002, for example, output was either essentially flat or fell in each sector with the single exception of the construction related wood and wood products sector. Similarly in the Republic of Ireland, output falls in the majority of sectors over this period are masked by sustained growth in the chemical and pharmaceutical sector.

The implication is that investing in innovation from 2000 to 2002 was markedly less enticing for firms in most industries, North and South, than in previous periods. Compared to earlier waves of the IIP we might therefore rationally expect the IIP4 to suggest lower levels of innovation activity in the majority of industries, sizebands and ownership groupings.

## Chapter 2 - Product and Process Innovation in Manufacturing Firms

### 2.1 Introduction

In this Chapter we consider the product and process innovation activities of manufacturing plants in Northern Ireland and the Republic of Ireland over the 2000-2002 period. We focus on four main questions:

- How did the level of product and process innovation activity in Northern Ireland and Republic of Ireland plants compare over the 2000-2002 period? (Section 2.3)
- How did the level of product and process activity during 2000-2002 compare to the earlier 1997 to 1999 period? (Section 2.4)
- How did the adoption of a range of best practice techniques vary between Northern Ireland and the Republic of Ireland over the 2000 to 2002 period? (Section 2.5)
- Looking forward, how completely were the various dimensions of innovation activity factored into firms' strategic development plans? (Section 2.6)

Section 2.7 provides a brief summary of the key points.

### 2.2 Innovation Measures

Innovation relates to the market application of existing knowledge and has been defined as *'the commercial application of knowledge or techniques in new ways or for new ends. It may involve radical innovation or incremental innovation. In each case the innovator achieves a competitive advantage, at least until another company catches up or goes one better'*.

The suggestion is that innovation is a business activity that is stimulated by, and changes, a firm's market position. As, such innovation may or may not be linked to significant technological advance. This view of innovation differs significantly from the traditional view which typically stresses the technological content and impetus for product and process changes. This difference of view is important in terms of the measurement of innovation activity. If innovation is regarded as a technologically defined process then technological criteria can be employed in defining innovations. If innovation is seen instead as a business process with uncertain technological content, a less restrictive definition – or set of definitions – may be appropriate.

To capture the various dimensions of innovative activity from the radical to the incremental the IIP4 focuses on a number of definitions of innovative activity associated with changing products and processes and the commercial success of these product and process changes. These reflect the choice of key indicators in the Invest Northern Ireland PIF and wider targets specified by the EDF.



In terms of *product innovation* the IIP4 measures:

- The proportion of plants introducing new or improved products and processes over the 2000 to 2002 period, variations in these measures between Northern Ireland and the Republic of Ireland and between plant sizebands, sectors and ownership categories.
- The intensity of innovation activity measured by the number of new or improved products per plant over the same period.
- The percentage of sales derived from products reflecting different types of innovation activity: new products not previously manufactured elsewhere; products previously made elsewhere but now being made for the first time in the Northern Ireland or Republic of Ireland plant; products whose technical performance has been enhanced; and, products whose aesthetic appeal only has been enhanced.

A similar hierarchy of measures is examined for *process innovation*:

- The proportion of plants introducing new or improved processes during the 2000 to 2002 period.
- The proportion of plants introducing; (a) new processes not in use elsewhere; (b) new processes not in use elsewhere in the country; and (c) new processes not in use in the plant's industry.

In addition to these generic process indicators we also consider a range of measures related to the adoption of specific best practice techniques by plants in Northern Ireland and the Republic of Ireland. The group of best practice techniques we consider can be divided into two groups related to production technologies and organisational approaches. Six production-related techniques are considered including the use of Computer Numerically Controlled machinery (NC/CNC), robotics, automated material handling, computer aided design (CAD), and Computer Integrated Manufacturing (CIM). Four organisational techniques are also considered relating to quality assurance schemes (e.g. ISO9000), total quality management (TQM), quality circles and the use of just-in-time inventory control (JIT).

### **2.3 Manufacturing Innovation 2000 to 2002**

Over the 2000 to 2002 period 53.8 per cent of Northern Ireland manufacturing plants introduced new or improved products, a slightly but statistically significantly lower percentage than that in the Republic of Ireland (Table 2.1). In terms of innovation intensity - reflected in the number of product changes made - however, Northern Ireland was slightly ahead of the Republic of Ireland. This difference was not statistically significant, however.

Similarly small and statistically insignificant differences were also evident in the composition of plants' sales. Plants in both regions were deriving very similar

proportions of their sales (19.7-20.3 per cent) from products which they had introduced to the market over the last three years. Around 12-16 per cent of sales were derived from products whose performance had been technically enhanced and another 8.3-8.9 per cent from aesthetically enhanced products (Table 2.1).

**Table 2.1: Key Product and Process Innovation Indicators for Manufacturing Plants: 2000-2002**

	Northern Ireland		Republic of Ireland	All Plants
<b>A. Product Innovation</b>				
Product Innovation during 2000 to 2002 (% of plants)	53.8	*	56.7	55.8
Number of new/improved products 2000-02	27.7		21.8	23.6
Sales from newly introduced products (mean %)	20.3		19.7	19.9
Sales from new products previously made elsewhere (mean %)	5.5		4.6	4.8
Sales from technically improved products (mean %)	12.8		16.0	15.1
Sales from aesthetically improved products (mean %)	8.3		8.9	8.7
<b>B. Process Innovation</b>				
Process Innovation during 2000 to 2002 (% of plants)	50.1	*	53.9	52.7
Introduced new process not in use elsewhere (% plants)	23.1	**	30.5	28.3
Introduced new process not in use in country (% plants)	19.4	**	37.3	32.0
Introduced new process not in use in industry (% plans)	18.5	**	24.1	22.5

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent.

The proportion of plants introducing new or improved processes over the 2000 to 2002 period was slightly lower than the percentage of product innovators in both Northern Ireland and the Republic of Ireland (Table 2.1). Relativities were the same, however, with a significantly higher proportion of process innovators in the Republic of Ireland compared to Northern Ireland. Perhaps more important, however, are more strongly significant differences in the ‘quality’ of process innovations being made in the Republic of Ireland compared to Northern Ireland. For example, 30.5 per cent of plants in the Republic of Ireland reported introducing new production processes not in use anywhere else compared to 23.5 per cent in Northern Ireland. Similarly 24.1 per cent of plants in the Republic of Ireland reported introducing production methods new to their industry compared to 18.5 per cent in Northern Ireland (Table 2.1).

These ‘all manufacturing’ averages, however, hide significant variation between plants of different sizes, sectors and ownership types. Table 2.2, for example, highlights the much higher proportion of product and process innovators among larger plants as well as the higher number of product changes made by larger plants. Other key points are:

- For plants with more than 20 employees the proportions of product and process innovators are higher in the South, although in neither case is the North/South difference statistically significant.
- For plants with 10-19 employees, the proportion of product and process innovators is greater in the North, although again the North/South differential is again insignificant. (This is a marked change from previous innovation surveys and is discussed in detail below).

**Table 2.2: Key Product and Process Indicators for Manufacturing Plants 2000-02: By Plant Sizeband**

	Plant Size (employment)		
	10-19	20-99	100+
<b>Republic of Ireland</b>			
<b>A. Product Innovation</b>			
Product Innovation during 2000 to 2002 (% of plants)	40.8	58.5	79.9
Number of new/improved products 2000-02	17.9	35.8	37.4
Sales from newly introduced products (mean %)	20.7	20.9	16.6
Sales from new products previously made elsewhere (mean %)	2.4	3.6	8.8
Sales from technically improved products (mean %)	13.8	14.8	19.5 **
Sales from aesthetically improved products (mean %)	4.7 *	11.7 *	6.1
<b>B. Process Innovation</b>			
Process Innovation during 2000 to 2002 (% of plants)	37.4	56.2	75.9
Introduced new process not in use elsewhere (% plants)	23.5	27.2	45.0 **
Introduced new process not in use in country (% plants)	10.4	39.1 **	56.2 **
Introduced new process not in use in industry (% plans)	9.1	25.2	34.2 **
<b>Northern Ireland</b>			
<b>A. Product Innovation</b>			
Product Innovation during 2000 to 2002 (% of plants)	49.5	52.4	68.2
Number of new/improved products 2000-02	11.5	63.8	66.0
Sales from newly introduced products (mean %)	19.5	19.5	24.7
Sales from new products previously made elsewhere (mean %)	5.0	4.6	8.6
Sales from technically improved products (mean %)	12.1	14.9	9.3
Sales from aesthetically improved products (mean %)	12.3	6.8	6.3
<b>B. Process Innovation</b>			
Process Innovation during 2000 to 2002 (% of plants)	45.1	47.3	73.8
Introduced new process not in use elsewhere (% plants)	20.5	21.5	31.6
Introduced new process not in use in country (% plants)	13.9	22.2	22.5
Introduced new process not in use in industry (% plans)	18.5	18.2	19.6

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent.

- No significant differences are evident in the number of product changes being made by plants in each sizeband, North and South.
- Significant differences do exist, however, between the sales composition and quality of process innovation being undertaken by larger plants in the two areas (Table 2.2). In both cases, Southern firms tend to be marketing products whose characteristics have been upgraded more significantly and also to be more commonly introducing more radical process technologies.

Reflecting industry maturity and differences in R&D intensity, marked differences also exist between the profile of innovative activity in each industrial sector. Table 2.3 summarises the key innovation indicators in tabular form, the key points for each sector are:

- ***Food, drink and tobacco*** – in this sector a significant differential was evident between the proportion of product innovators North (55.4 per cent) and South (65.6 per cent). The proportion of sales accounted for by innovative products in both areas, however, was below the manufacturing average (compare Table 2.1). The proportion of plants making process innovations was marginally – and insignificantly – higher in Northern Ireland and broadly similar to the manufacturing average. Reflecting the differences noted in the ‘quality’ of process innovations being made by all manufacturing plants (i.e. Table 2.1), there was a notable difference in proportion of food etc. plants undertaking radical process innovation in Republic of Ireland (40.3 per cent) and in Northern Ireland (20.5 per cent).
- ***Textiles and clothing*** – is a sector in which product innovation is particularly difficult to assess because of the difficulty of separating fashion changes from more fundamental product changes. Process changes are perhaps more meaningful here with an (insignificantly) higher proportion of Northern firms making process innovations. This sector is notable in that the ‘quality’ indicators of process change here favour Northern Ireland, although the difference is only significant in case of technology transfers from other sectors (Table 2.3).
- ***Wood and Wood Products*** – is a mature sector but has relatively high proportions of product and process innovators in the South and process innovators in the North. A significant difference exists between the proportion of process innovators in the South and the lower proportion of product innovators in the North. Levels of sales of innovative products are also low throughout the island. This sector also accords to the general pattern with the ‘quality’ of process innovations in the South higher than that in the North. The difference is only significant in the case of the percentage of plants introducing processes new to the country.
- ***Paper, Pulp and Printing*** – generally exhibits a lower level of innovative activity and innovative sales than the manufacturing average, with few significant North- South differences. A higher proportion of Northern plants (49.8 per cent) were introducing new products than in the Republic of Ireland (28.3 per cent).

- ***Chemicals (including pharmaceuticals)*** – both product and process innovation were more common in this sector than in manufacturing as a whole with few significant North-South differences. Somewhat surprisingly given the production trends in this sector noted in Chapter 1, sales of innovative products were also relatively similar in both sectors. Process innovations tended to be of higher quality in the South but this was only significant in one of the three indicators.
- ***Metals and Fabrication*** – this sector is characterised by below average levels of innovative activity in both products and processes and by no significant North South differences. Process innovation ‘quality’ is broadly similar, North and South.
- ***Mechanical Engineering*** – despite broadly similar proportions of product innovators and process innovators, North and South, significant differences were evident here in the quality of process innovation. On each of the three indicators the quality of process changes being made by Southern firms was higher. This was the only sector where this was the case.
- ***Electrical and Optical Engineering*** is characterised by above average proportions of product innovating plants and below average proportions of process innovators. Process innovation was more common in the Republic of Ireland, with evidence of higher process innovation quality.
- ***Transport Equipment*** plants were more likely to be product innovators than most manufacturing firms, and in the South were also more likely to be process innovators. Differentials were again evident in the quality of process innovations being made but these were again statistically insignificant.
- ***Other manufacturing*** – this sector includes the manufacture of furniture and levels of innovation in the sector are broadly similar to the manufacturing average. No consistent differences emerge between Northern Ireland and the Republic of Ireland, although the proportion of sales derived from aesthetically improved products is significantly higher in the Republic of Ireland (8.9 per cent) than in Northern Ireland (6.4 per cent).

**Table 2.3: Key Innovation Indicators for Manufacturing Plants: By Industry**

	Food, Drink Tobacco	Textiles and Clothing	Wood and Products	Paper and Printing	Chemic- als	Metals, Fabricati on	Mech. Eng	Electl, Optical Equip.	Transport Equipme nt	Other Manuf.
<b>Republic of Ireland</b>										
<b>A. Product Innovation</b>										
Product Innovation during 2000 to 2002 (% of plants)	65.6	57.9	68.4	28.3	69.9	43.0	64.4	64.1	73.5	62.6
Number of new/improved products 2000-02	15.2	34.5	22.1	176.0	25.2	10.7	7.2	28.6	17.9	33.2
Sales from newly introduced products (mean %)	15.8	34.6	6.6	22.1	12.0	19.3	21.3	21.1	20.8	23.3
Sales from new products previously made elsewhere (mean %)	3.7	3.7	1.2	3.7	4.4	4.4	5.5	9.0	16.7	2.9
Sales from technically improved products (mean %)	21.4	11.1	13.0	23.1	13.4	16.1	21.9	14.5	14.2	8.9
Sales from aesthetically improved products (mean %)										
<b>B. Process Innovation</b>										
Process Innovation during 2000 to 2002 (% of plants)	51.5	48.8	57.9	51.5	61.3	49.2	53.5	64.5	73.5	53.7
Introduced new process not in use elsewhere (% plants)	40.3	13.8	13.7	11.8	42.8	25.2	38.5	47.9	39.9	27.2
Introduced new process not in use in country (% plants)	30.1	27.7	54.6	33.3	42.8	22.0	40.7	57.0	36.0	36.3
Introduced new process not in use in industry (% plants)	34.1	4.8	13.7	17.6	37.3	11.6	32.9	31.8	24.0	25.6
<b>Northern Ireland</b>										
<b>A. Product Innovation</b>										
Product Innovation during 2000 to 2002 (% of plants)	55.4	69.4	38.9	49.8	80.5	36.7	60.2	62.5	55.0	56.0
Number of new/improved products 2000-02	18.7	139.8	59.2	6.7	25.4	13.0	172.2	8.9	4.2	40.7
Sales from newly introduced products (mean %)	15.6	24.5	5.9	18.7	23.5	22.0	26.4	29.2	10.3	18.1
Sales from new products previously made elsewhere (mean %)	6.9	2.7	14.2	3.3	7.8	8.4	4.6	5.1	0.0	3.5
Sales from technically improved products (mean %)	14.7	9.5	9.3	10.4	9.6	10.2	17.8	17.4	15.0	15.7
Sales from aesthetically improved products (mean %)	7.9	5.4	1.1	22.1	4.5	7.9	3.8	8.2	18.4	6.4
<b>B. Process Innovation</b>										
Process Innovation during 2000 to 2002 (% of plants)	53.2	57.4	60.3	50.0	52.7	42.4	50.1	46.9	60.4	47.9
Introduced new process not in use elsewhere (% plants)	20.5	37.4	12.6	16.7	12.7	21.9	0.0	37.2	12.4	26.8
Introduced new process not in use in country (% plants)	19.7	26.2	10.2	16.9	28.5	15.0	2.0	37.2	6.2	25.1
Introduced new process not in use in industry (% plants)	12.2	31.3	0.0	13.8	20.2	23.5	7.5	21.9	6.2	24.7

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent.

Finally, looking at innovation by ownership suggests as expected, that externally-owned plants are more innovative than their locally-owned counterparts both North and South (Table 2.4), but suggests few significant differences between Northern and Southern locally-owned and externally-owned plants. Where there are significant differences – notably in process innovation quality among externally owned plants – these favour the South.

**Table 2.4: Key Innovation Indicators for Manufacturing Plants: By Type of Ownership**

	Northern Ireland		Republic of Ireland	
	Locally Owned	Externally Owned	Locally Owned	Externally Owned
<b>A. Product Innovation</b>				
Product Innovation during 2000 to 2002 ( of plants)	52.0	67.3	53.5	67.6
Number of new/improved products 2000-02	56.3	19.6	32.3	31.1
Sales from newly introduced products (mean )	20.2	20.4	20.3	18.2
Sales from new products previously made elsewhere(mean)	4.7	9.3	2.7	10.4
Sales from technically improved products (mean )	13.9	8.4	16.5	15.2
Sales from aesthetically improved products (mean )	7.8	10.0	10.8	3.8
<b>B. Process Innovation</b>				
Process Innovation during 2000 to 2002 ( of plants)	48.4	61.4	51.4	60.1
Introduced new process not in use elsewhere ( plants)	22.8	25.0	25.4	47.2
Introduced new process not in use in country ( plants)	17.1	29.1	33.6	51.9
Introduced new process not in use in industry ( plants)	18.5	18.7	21.9	29.9

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). Shading denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level or below.

To summarise, we find significantly higher proportions of product and process innovating plants in the Republic of Ireland than in Northern Ireland from 2000 to 2002. Few significant differences are evident, however, for individual sectors, sizeband or ownership groups although in most groups of plants the indicators suggest a marginally higher level of innovative activity in the Republic of Ireland. The stronger overall effect, and weaker sectoral effects etc., suggests ‘structural’ factors are important in shaping the overall innovation rates, with the Republic of Ireland having a larger proportion of its manufacturing plants in more product and process intensive sectors.

No consistent and significant differences were found in the proportion of sales derived from innovative products, North and South. More interesting was evidence from a series of new indicators that the quality of process innovations was superior in the South. This difference was sufficiently strong to be evident in the aggregate figures but was, however, confined to certain sectors and was particularly evident in larger, externally-owned firms.

**Table 2.5: Change in Key Innovation Indicators From 1997-99 to 2000-02: By Plant Sizeband**

	1997-99				2000-02				% Change			
	10-19 emps.	20-99 emps.	100 plus	All Plants	10-19 emps.	20-99 emps.	100 plus	All Plants	10-19 emps.	20-99 emps.	100 plus	All Plants
<b>Northern Ireland</b>												
New products since 1996	37.4	60.6	75.3	58.3	49.5	52.4	68.2	53.8	12.1	-8.2	-7.1	-4.5
New Processes since 1996	47.1	58.7	66.6	57.7	45.1	47.3	73.8	50.6	-2.0	-11.4	7.2	-7.1
New Products sold for first time (% sales)	11.6	15.6	16.5	15.4	19.5	19.5	24.7	20.5	7.8	3.8	8.2	5.1
New Products made before (% sales)	11.6	4.6	6.4	6.0	5.0	4.6	8.6	5.6	-6.6	0.0	2.2	-0.4
Technically Improved Products (% sales)	13.4	16.9	22.3	18.0	12.1	14.9	9.3	13.0	-1.2	-2.0	-13.0	-4.9
Aesthetically Improved Products (% sales)	4.3	8.2	10.5	8.3	12.3	6.8	6.3	8.2	8.0	-1.4	-4.1	-0.1
<b>Republic of Ireland</b>												
New products since 1996	63.2	61.7	76.7	65.3	40.8	58.5	79.9	57.0	-22.4	-3.2	3.2	-8.3
New Processes since 1996	58.2	64.1	77.1	65.7	37.4	56.2	75.9	54.1	-20.8	-7.9	-1.2	-11.6
New Products sold for first time (% sales)	25.1	16.9	16.7	18.5	20.7	20.9	16.6	19.8	-4.3	4.0	0.0	1.3
New Products made before (% sales)	8.8	8.3	10.9	9.1	2.4	3.6	8.8	4.6	-6.4	-4.7	-2.1	-4.5
Technically Improved Products (% sales)	17.1	10.7	12.9	12.6	13.8	14.8	19.5	15.8	-3.4	4.1	6.7	3.1
Aesthetically Improved Products (% sales)	6.7	7.0	6.4	6.8	4.7	11.7	6.1	8.9	-2.0	4.7	-0.3	2.1

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details).



## **2.4 Changes in Innovative Activity**

As indicated in Chapter 1, the IIP4 survey follows three previous surveys on a broadly similar theme. Table 2.5 compares the results of the IIP4 with those of the third wave of the innovation panel which related to the 1997-99 period. In aggregate what is evident is that the proportion of product and process innovators has fallen in both Northern Ireland and the Republic of Ireland. In addition in both areas there has been a fall in the proportion of sales derived from new products transferred from other production sites. Both falls probably reflect the broader economic situation over the 2000 to 2002 period in contrast to the more buoyant climate of 1997-99.

Looking at the results for individual plant sizebands suggests some interesting contrasts. The proportion of product innovators has declined for each group with the exception of very small firms in Northern Ireland (with <20 employees) and large firms in the Republic of Ireland. A particularly large fall is evident in the innovating proportion of small firms in the South with a rise in the North. In the South the fall in innovating proportion may simply reflect the impact of weak economic conditions, with a similar fall also being evident in the proportion of plants introducing new processes. In the North, the rise in innovation rates is somewhat not easy to explain in terms of the wider economic situation, but may reflect policy initiatives such as the success of the Compete scheme in attracting first-time users.

## **2.5 Adoption of Best Practice Techniques**

Along with the generic indicators of process innovation discussed earlier the IIP4 also collected information on plants' adoption of a range of best practice production technologies and organisational techniques. The key indicator here is the proportion of plants using any given technique at the time of the survey. (Data on date of adoption was also collected in the survey but is not discussed here). Table 2.6 therefore gives the proportion of plants using each technique at end-2002, with shaded cells indicating a significant North-South difference.

In terms of the figures for all manufacturing plants we find a striking similarity between the profile of use of best practice production technologies, with no significant North-South differences (Table 2.6). For example, 30.9 per cent of Republic of Ireland plants were using AMH compared to 31.9 per cent in the North. Similarly, 43.1 per cent of Republic of Ireland plants were using CNC production machinery compared to 36.4 per cent in Northern Ireland. Smaller plants are – as we would expect – generally less likely to be using each best practice production technique, although CNC production equipment is almost equally common among smaller and larger plants.

**Table 2.6: Percentage of Manufacturing Plants Using Best Practice Techniques:  
By Plant Sizeband**

	Plant Size			Total
	10-19	20-99	100+	
<b>Republic of Ireland</b>				
CNC production equipment	40.9	43.4	44.3	43.1
Robotics	8.8	12.7	41.6	19.3
Automated Materials Handling	7.3	29.5	50.9	30.9
Computer Aided Design	53.2	54.4	68.6	57.8
Computer Aided Manufacturing	35.6	39.7	59.9	44.1
Computer Integrated Manufacturing	21.6	26.0	43.3	29.6
Quality Certification	47.0	57.0	85.7	62.4
Total Quality Management	11.5	28.1	45.3	29.4
Quality Circles	0.0	10.7	25.3	12.4
Just in Time Inventory Control	28.3	28.6	51.7	34.4
<b>Northern Ireland</b>				
CNC production equipment	33.5	35.7	41.1	36.4
Robotics	6.2	14.4	36.4	17.4
Automated Materials Handling	16.7	29.8	52.8	31.9
Computer Aided Design	60.0	45.1	68.3	54.0
Computer Aided Manufacturing	26.3	40.8	52.4	40.0
Computer Integrated Manufacturing	19.5	25.9	33.8	26.2
Quality Certification	29.3	50.2	71.7	50.1
Total Quality Management	12.4	19.1	33.4	20.7
Quality Circles	9.1	8.5	11.4	9.3
Just in Time Inventory Control	19.2	19.4	17.3	18.9

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). Shading denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level or below.

We observe a different pattern in terms of plants' use of best practice organisational techniques with significant aggregate differences evident for each of the four indicators. In each case the proportion of plants using each technique is higher in the Republic of Ireland than in Northern Ireland (Table 2.6). As with the product and process innovation indicators discussed earlier, however, these significant aggregate differences are not consistently reflected across plant sizebands:

- For JIT levels of usage are (significantly) higher in the Republic of Ireland in all plants with more than 20 employees and higher by an insignificant margin in smaller plants.
- Quality circles are more common among very small plants in Northern Ireland – although levels of usage remain low (9.1 per cent) – but significantly higher in larger Republic of Ireland plants.

**Table 2.7: Percentage of Manufacturing Plants Using Best Practice Techniques: By Industrial Sector**

	Food, Drink Tobacco	Textiles and Clothing	Wood and Products	Paper and Printing	Chemic- als	Metals, Fabrication	Mech. Eng	Electl, Optical Equip.	Transport Equipment	Other Manuf.
<b>Republic of Ireland</b>										
CNC production equipment	21.3	54.2	27.3	24.5	29.2	59.5	68.2	43.3	33.3	58.4
Robotics	13.0	4.8	13.7	6.7	29.2	7.7	24.6	32.1	33.3	26.7
Automated Materials Handling	37.6	18.6	68.3	17.8	35.4	18.9	17.8	25.2	16.7	40.3
Computer Aided Design	34.4	63.3	41.0	53.4	47.7	65.5	95.4	72.4	66.7	59.2
Computer Aided Manufacturing	48.1	50.0	31.7	55.6	41.0	43.5	40.7	49.2	16.7	35.9
Computer Integrated Manufacturing	30.6	18.1	31.7	37.8	17.4	29.7	31.8	39.5	33.3	18.6
Quality Certification	81.8	27.7	59.0	42.2	64.6	48.4	79.5	87.4	50.0	51.1
Total Quality Management	33.6	0.0	13.7	24.5	46.2	17.6	22.5	42.3	50.0	32.5
Quality Circles	16.1	0.0	13.7	6.7	5.6	11.3	8.7	25.2	33.3	8.1
Just in Time Inventory Control	31.8	27.1	4.4	42.2	41.5	34.9	47.8	41.6	50.0	26.0
<b>Northern Ireland</b>										
CNC production equipment	5.2	23.9	70.9	33.2	39.0	69.1	69.8	59.1	6.6	35.7
Robotics	8.2	15.1	12.6	6.9	44.5	16.2	26.6	52.4	0.0	19.2
Automated Materials Handling	62.2	20.5	19.0	39.9	45.5	16.2	33.7	30.5	0.0	18.3
Computer Aided Design	17.6	58.5	58.2	60.0	44.5	70.6	77.4	86.7	69.9	60.9
Computer Aided Manufacturing	42.9	56.6	29.1	20.1	61.0	54.4	13.4	50.5	50.0	29.6
Computer Integrated Manufacturing	28.3	47.8	19.0	39.9	23.6	23.5	9.5	29.5	23.5	11.4
Quality Certification	52.4	52.2	41.8	40.6	52.7	63.2	38.0	93.3	13.3	44.8
Total Quality Management	36.9	23.9	6.3	6.7	44.5	2.9	28.5	46.4	0.0	10.0
Quality Circles	10.3	17.6	6.3	6.7	0.0	1.4	19.0	15.2	0.0	4.4
Just in Time Inventory Control	15.5	22.9	29.1	6.7	30.8	16.2	24.6	23.7	30.1	13.5

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). Shading denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level or below.

- No significant difference is evident in TQM and quality certification in any individual plant size band despite the significant aggregate difference.

The apparently consistent aggregate differences between the use of production oriented and organisational best practice techniques are also only weakly reflected in industry (Table 2.7) and ownership (Table 2.8) comparisons.

On an industry level the key points are:

- The most significant differences in best practice adoption are evident between Northern and Southern *food and drink* companies. Northern firms lag somewhat in their adoption a range of best practice production and organisational techniques, although they are more likely to be using AMH than their Southern counterparts.
- *Textiles and clothing* firms in the North use a more extensive range of best practice organisational techniques than their Southern counterparts (Table 2.7).
- In the *Wood and Wood Products* sector, the main differences occur in the type of production techniques plants are using. In the North CNC production equipment is more common; in the South AMH is more commonly used.
- In *Paper and Printing*, Southern firms are much more likely to be using JIT inventory management systems than their Northern counterparts.
- In the *Mechanical Engineering* sector, quality certification was more common among Republic of Ireland plants, with TQM more common among Southern plants in *transport equipment* and *other manufacturing*.

No significant differences were evident between the use of best practice techniques by plants in the *Chemicals, Metals and Electrical* and *Optical Equipment* sectors.

Again, no significant differences were evident between production related best practice techniques used by locally or externally-owned firms (Table 2.8). Locally owned plants in the Republic of Ireland were, however, more likely to be using quality certification and JIT than their Northern counterparts. Among externally-owned plants the only significant difference was in the more common use of JIT among Southern plants.

Overall, therefore there is little significant difference in the use of production related best practice techniques, North and South. In terms of organisational best practice more significant differentials exist in favour of Southern plants. Again, however, these differentials are not consistent between sectors, plant sizebands etc. and therefore the aggregate comparisons reflect some specific differences and also the effects of industry-mix.

**Table 2.8: Percentage of Manufacturing Plants Using Best Practice Techniques:  
By Category of Ownership**

	Republic of Ireland		Northern Ireland	
	Locally Owned	Externally Owned	Locally Owned	Externally Owned
CNC production equipment	45.2	40.4	35.7	37.3
Robotics	12.7	39.8	12.3	37.8
Automated Materials Handling	27.7	42.8	27.1	49.1
Computer Aided Design	58.1	58.6	56.2	48.8
Computer Aided Manufacturing	39.0	58.7	36.0	50.6
Computer Integrated Manufacturing	25.3	42.4	22.3	38.4
Quality Certification	56.0	81.6	42.8	72.3
Total Quality Management	22.8	50.3	16.5	34.8
Quality Circles	10.5	18.2	8.4	9.1
Just in Time Inventory Control	29.3	49.9	20.8	13.9

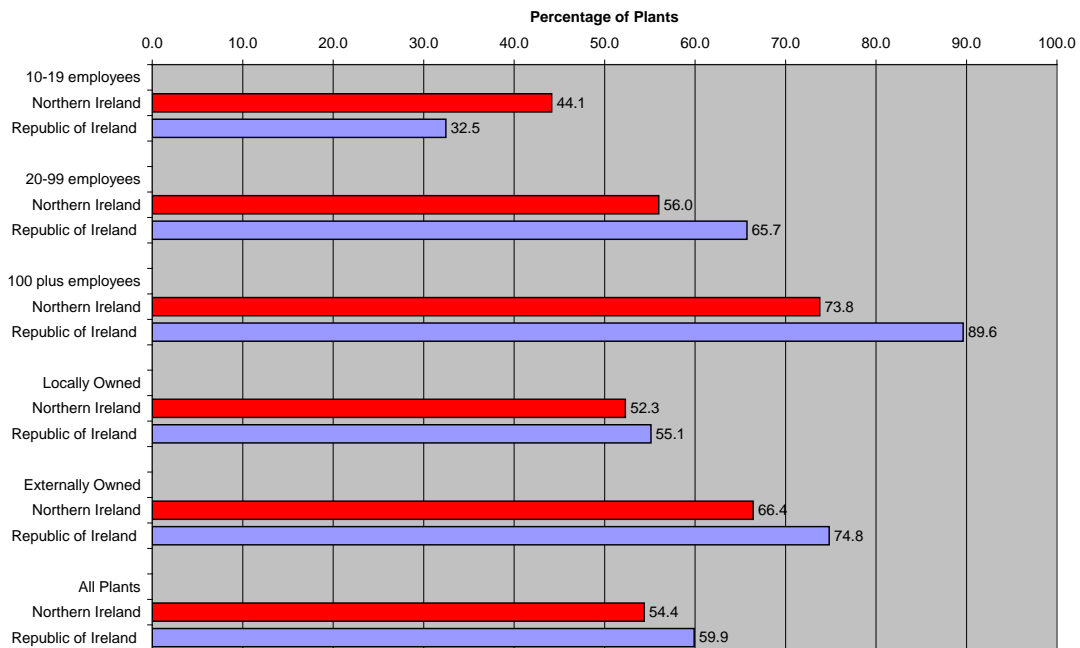
**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). Shading denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level or below.

## **2.6 Innovation and Strategic Planning**

In previous sections we have focussed on plants' innovation activities during the 2000 to 2002 period. Here we are more forward looking and examine the nature of plants' strategic planning process and the role and priority being given to various aspects of innovation in plants' business plans.

Overall, just over half of all manufacturing plants in Northern Ireland (54.4 per cent) and in the Republic of Ireland (59.9 per cent) had a formal plan for the development of the business over the next three years or more. Such plans were more common among larger plants and externally-owned plants and were generally more common in the Republic of Ireland (Figure 2.1). Interestingly, however, the one group where this was not the case was small firms with 10-19 employees. Here, the proportion of plants with a formal business plan was actually higher in the North (44.1 per cent compared to 32.5 per cent).

**Figure 2.1: Percentage of Plants with Formal Plan for Development of Business Over Next Three Years Or More**



**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details).

In terms of the targets specified in plants' development plans, there was little difference in the overall proportion of plants in each area specifying targets for the introduction of new products (79.7-81.6 per cent), the development of improved products (79.6-81.4 per cent) or R&D investment (49.2-54.3 per cent). More interesting are differences in the proportion of plants specifying targets for process development, with these being significantly more common in the South and among locally-owned plants (Table 2.9). The greater weight being given to targets for process improvement in the South over the next three years is consistent with the pattern noted earlier that process innovation has generally been of higher quality in the South over the 2000 to 2002 period.

**Table 2.9: Targets Specified in Development Plans: By Plant Sizeband and Ownership**

	Plant Size			Ownership		Total
	10-19	20-99	100+	Indigenous	External	
<b>Republic of Ireland</b>						
Introduction of New Products	82.9	76.6	85.0	81.3	77.1	79.7
Development of Improved Products	78.4	79.5	80.3	82.4	71.8	79.6
Research and Development Investment	37.9	55.6	60.4	60.3	41.2	54.3
Introduction of new Production Processes	70.7	72.6	71.4	70.9	72.7	72.0
Development of Improved Processes	63.9	80.3	77.5	75.8	77.3	77.1
R&D Joint Ventures or Partnerships	5.7	23.0	23.7	21.4	17.4	20.5
<b>Northern Ireland</b>						
Introduction of New Products	79.2	81.9	83.9	79.2	93.1	81.6
Development of Improved Products	88.9	79.5	76.6	81.2	77.5	81.4
Research and Development Investment	44.6	49.3	54.9	49.7	53.8	49.2
Introduction of new Production Processes	64.5	60.5	68.9	61.4	70.5	63.1
Development of Improved Processes	61.7	70.1	72.0	66.0	74.4	68.3
R&D Joint Ventures or Partnerships	13.6	18.0	32.0	17.6	29.1	19.6

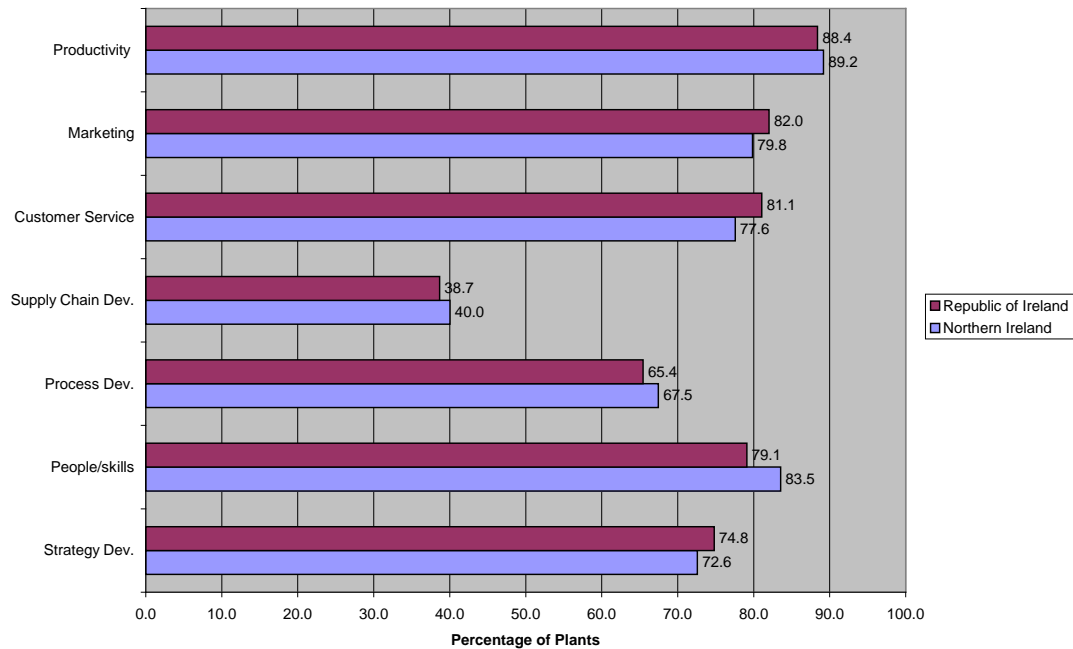
**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). Shading denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level or below.

In addition to asking plants about the specific targets included in their development plans, the IIP4 also asked plants about the areas of their operations that would have to be developed to meet these targets. Figure 2.2 contrasts the development priorities identified by small locally-owned plants and larger externally-owned plants. In each case, figures relate to the percentage of plants describing each development area as either ‘important’ or ‘very important’.

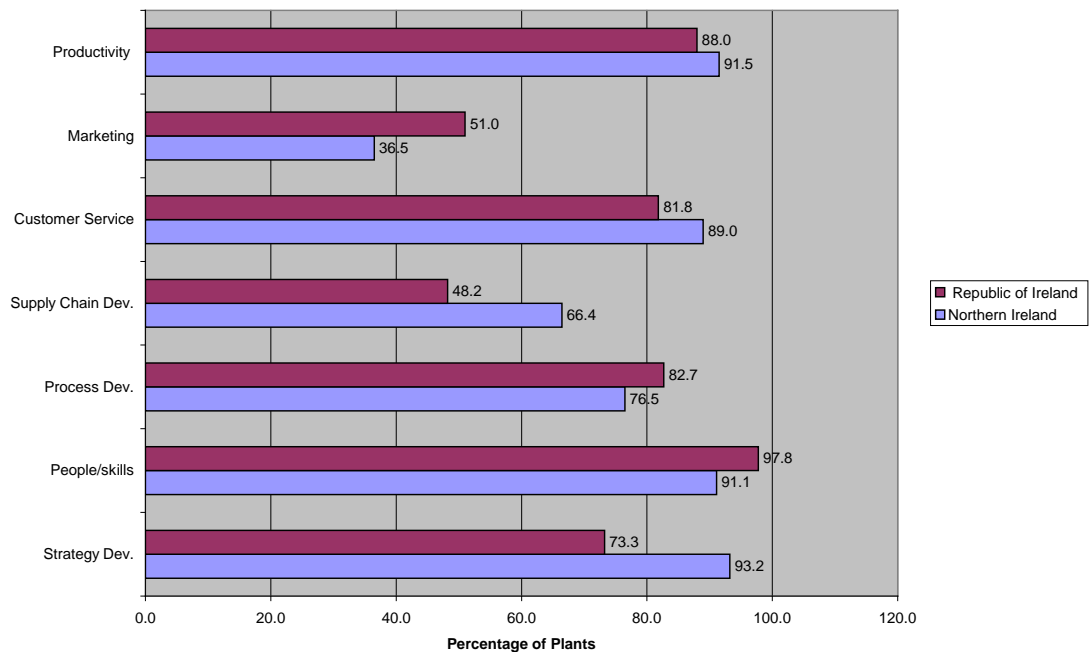
What emerges is a marked similarity between the development priorities of each type of plant, North and South, and more important differences between larger and smaller plants. For small plants, both North and South, development priorities are productivity, marketing, customer service and people/skills with much less attention focussed on supply chain development (Figure 2.2a). For larger plants, customer service, productivity and people/skills also remain important development areas but marketing was mentioned much less often. Supply chain development was seen as more important by larger externally-owned plants, particularly in Northern Ireland (Figure 2.2b).

**Figure 2.2: Development Priorities for Achievement of Business Plan Targets  
(Percentage of Plants)**

**(a) Small, Locally-owned Plants (<100 employees)**



**(b) Larger Externally-owned Plants (>100 employees)**



**Notes:** Figures relate to manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details).



## **2.7 Summary**

For all manufacturing we find significantly higher proportions of product and process innovating plants in the Republic of Ireland than in Northern Ireland from 2000 to 2002. Few significant differences are evident, however, for individual sectors, sizebands or ownership groups, although in most groups of plants the indicators suggest a marginally higher level of innovative activity in the Republic of Ireland. The stronger overall effect, and weaker sectoral effects etc., suggests 'structural' factors are important in shaping the overall innovation rates, with the Republic of Ireland having a larger proportion of its manufacturing plants in more product and process intensive sectors.

No consistent and significant differences were found in the proportion of sales derived from innovative products, North and South. More interesting was evidence from a series of new indicators that the quality of process innovations was superior in the South. This difference was sufficiently strong to be evident in the aggregate figures but was, however, confined to certain sectors and was particularly evident in larger, externally-owned firms.

Comparisons of the 2000-02 results with the earlier survey covering 1997-99 suggest that the proportion of product and process innovators has fallen in both Northern Ireland and the Republic of Ireland. In addition in both areas there has been a fall in the proportion of sales derived from new products transferred from other production sites. Both falls probably reflect the broader economic situation over the 2000 to 2002 period in contrast to the more buoyant climate of 1997-99.

Comparison of the profile of use of best practice production technologies suggests no significant North-South differences. We observe a different pattern in terms of plants' use of best practice organisational techniques with significant aggregate differences evident for each of the four indicators. In each case the proportion of plants using each technique is higher in the Republic of Ireland than in Northern Ireland. Again, however, these differentials are not consistent between sectors, plant sizebands etc. and therefore the aggregate comparisons reflect some specific differences and also the effects of industry-mix.

Overall, just over half of all manufacturing plants in Northern Ireland (54.4 per cent) and in the Republic of Ireland (59.9 per cent) had a formal plan for the development of the business over the next three years or more. Such plans were more common among larger plants and externally-owned plants and were generally more common in the Republic of Ireland. In terms of the targets specified in plants' development plans, there was little difference in the overall proportion of plants in each area specifying targets for the introduction of new products (79.7-81.6 per cent), the development of improved products (79.6-81.4 per cent) or R&D investment (49.2-54.3 per cent). More interesting are differences in the proportion of plants specifying targets for process development, with these being significantly more common in the South and among locally-owned plants (Table 2.9). The greater weight being given to targets for process improvement in the South over the next three years is consistent with the pattern noted earlier that process innovation has generally been of higher quality in the South over the 2000 to 2002 period.

## **Chapter 3 - Service Sector Innovation**

### **3.1 Introduction**

Here we compare the level of innovative activity in a group of tradable services sectors in Northern Ireland and the Republic of Ireland. As in Chapter 2 we focus first on a comparison of the level of innovative activity in each area over the 2000 to 2002 period. We then focus on firms' strategic plans and priorities for the 2003 to 2005 period and beyond.

Service sector innovation may be regarded as important for at least two reasons. First, the tradable services sector has been the most important source of new employment and wealth creation over the last decade, and innovation is crucial if this growth is to be sustained. Secondly, the availability of high quality and innovative business services has often been seen as a crucial support to enhanced manufacturing competitiveness, particularly in an era when outsourcing has become more common.

### **3.2 Innovation Measures**

We again use a range of measures to capture the extent and quality of service sector innovation activity in Northern Ireland and the Republic of Ireland. First, to measure the extent of innovation in the population of service sector companies we consider the proportion of businesses which introduced either a new or improved service over the 2000 to 2002 period. Second, to measure the quality of service sector innovation we consider a range of measures analogous to the measures of process innovation quality discussed in Chapter 3. More specifically we consider three indicators:

- The proportion of sales derived from entirely new services, i.e. sales introduced to the market for the first time by the subject business.
- The proportion of sales derived from services which were newly introduced by the business but which had previously been offered by other firms.
- The proportion of sales derived from services which were being offered in 1999 but had since been upgraded.

The final residual category was sales derived from services which have been provided unchanged since 1999.

### **3.3 Service Innovation in Northern Ireland and the Republic of Ireland**

From 2000 to 2002, 49.4 per cent of service sector businesses in Northern Ireland introduced a new or improved service compared to 52.7 per cent in the Republic of Ireland (Table 3.1). Levels of sales derived from entirely new, newly introduced and

upgraded services were also very similar, North and South, with no significant differences.

**Table 3.1: Key Service Innovation Indicators**

	Northern Ireland	Republic of Ireland	Total
Service innovation during 2000 to 2002 (% businesses)	49.4	52.7	51.7
Sales from entirely new services (%)	17.9	18.2	18.1
Sales from services copied from elsewhere (%)	7.6	7.0	7.2
Sales from improved services (%)	18.3	18.6	18.5

**Notes:** Figures relate to tradable services businesses with ten employees or more. Survey responses are weighted to give representative results (see Appendix 1 for details). No statistically significant differences exist between the Northern Ireland and Republic of Ireland figures.

As with product and process innovation among manufacturing plants, innovation tends to be more common among larger service sector businesses (Table 3.2). For example, in Northern Ireland 55.1 per cent of service sector businesses with 100 plus employees introduced new or improved services compared to 43.2 per cent of businesses with 10-19 employees. Few other consistent differences emerge in either the extent or quality of service sector innovation between sectors or between business sizebands.

**Table 3.2: Key Service Innovation Indicators by Sector and Sizeband**

	Sectors		Sizebands (employment)		
	Financial and Communications Services	Computer & Business Services	10-19	20-99	100+
<b>Northern Ireland</b>					
Service innovation during 2000 to 2002	51.8	47.9	43.2	53.0	55.1
Sales from entirely new services (%)	17.9	18.5	12.9	22.0	20.1
Sales from services copied from elsewhere (%)	5.4	8.0	8.8	6.5	7.3
Sales from improved services (%)	23.4	17.3	17.3	19.7	22.4
<b>Republic of Ireland</b>					
Service innovation during 2000 to 2002	58.4	50.1	45.7	55.4	77.9
Sales from entirely new services (%)	16.1	19.2	19.3	19.3	12.7
Sales from services copied from elsewhere (%)	5.5	7.7	8.2	5.5	6.4
Sales from improved services (%)	12.6	21.6	18.5	17.8	20.4

**Notes:** Figures relate to tradable services businesses with ten employees or more. Survey responses are weighted to give representative results (see Appendix 1 for details). Statistically significant differences (shaded) exist between the Northern Ireland and Republic of Ireland figures only for larger plants ( $\rho = 0.043$ ).

The combination of no significant aggregate difference between service sector innovation in Northern Ireland and the Republic of Ireland and the lack of sectoral/sizeband differences suggests a rather different picture to that for manufacturing. First, and foremost it suggests broad parity between levels of service sector innovation in Northern Ireland and the Republic of Ireland. Second, it suggests that the structure (i.e. sectoral and business size-mix) of the service sector in the Republic of Ireland is no more favourable for innovation than that in Northern Ireland.

### 3.4 Innovation and Strategic Planning

Looking forward, 58.5 per cent of Northern Ireland service sector businesses have formal development plans covering the next three years or more of the business. This is a significantly lower percentage (64.2 per cent) than among their counterparts in the Republic of Ireland ( $\rho = 0.038$ ). Comparison by sector highlights no significant differences (Table 3.3), with more important differences occurring between larger plants. More specifically, the proportion of service sector businesses with 10-19 employees with formal development plans was relatively similar, North and South (57-62 per cent). Among larger businesses more significant differentials emerged, however, with Southern plants notably more likely to have a formal development plan.

**Table 3.3: Percentage of Service Sector Businesses With Development Plan: By Size and Sector**

	Sectors		Sizebands (employment)		
	Financial and Communications Services	Computer & Business Services	10-19	20-99	100+
Northern Ireland	62.9	56.8	61.8	50.4	63.2
Republic of Ireland	67.8	62.7	57.0	66.0	91.5

**Notes:** Figures relate to tradable services businesses with ten employees or more. Survey responses are weighted to give representative results (see Appendix 1 for details). Statistically significant differences (shaded) exist between the Northern Ireland and Republic of Ireland figures only for businesses with more than 20 employees ( $\rho < 0.010$  in both cases).

The specific targets included in firms' development plans, however, were very similar, North and South. Most common were the development of improved services (c. 94 % of cases), the development of new services or products (78-79 per cent). R&D and joint ventures were specified as targets in only around a third of cases (Table 3.4).

**Table 3.4: Percentage of Service Sector Businesses with Specific Development Targets**

	Northern Ireland	Republic of Ireland	Total
New services or products	77.5	79.4	78.8
Development of improved services or products	94.0	94.5	94.3
Research and Development Investment	38.8	31.5	33.5
R&D joint ventures or partnerships	23.6	25.9	25.3

**Notes:** Figures relate to tradable services businesses with ten employees or more. Survey responses are weighted to give representative results (see Appendix 1 for details). No statistically significant differences exist between the Northern Ireland and Republic of Ireland figures.

Analysis by business size and sector does, however, highlight some specific differences:

- Research and Development expenditure was specified as a target by two thirds of Northern Ireland financial and communications companies compared to only a third of similar firms in the Republic of Ireland (Table 3.5).
- Computer and business services companies specified very similar objectives, North and South, as did businesses with 100 or more employees.

**Table 3.5: Percentage of Service Sector Businesses with Specific Development Targets by Sector and Sizeband**

	Sectors		Sizebands (employment)		
	Financial and Communications Services	Computer & Business Services	10-19	20-99	100+
<b>Northern Ireland</b>					
New services or products	86.1	74.7	75.0	85.5	72.6
Development of improved services or products	95.2	93.3	89.0	100.0	94.8
Research and Development Investment	67.8	30.8	28.1	53.7	27.2
R&D joint ventures or partnerships	17.2	26.9	21.1	29.0	21.9
<b>Republic of Ireland</b>					
New services or products	87.3	75.6	73.8	89.0	79.0
Development of improved services or products	98.7	92.5	95.3	91.1	97.7
Research and Development Investment	29.8	32.3	35.9	20.0	37.7
R&D joint ventures or partnerships	10.1	33.2	33.8	17.5	18.0

**Notes:** Figures relate to tradable services businesses with ten employees or more. Survey responses are weighted to give representative results (see Appendix 1 for details). Shaded cells indicate significant difference between Northern Ireland and the Republic of Ireland at 10 per cent or less.

- Amongst firms with 10-19 employees, joint ventures were a more common target in the Republic of Ireland.
- Finally, among businesses with 20-99 employees the development of improved services and R&D investment were more common targets among Republic of Ireland firms.

In the IIP4 firms were not only asked about the specific targets included in their development plan but also about the strategic priorities they had in order to achieve their targets. Again there was a marked similarity in the strategic priorities identified by Northern Ireland and Republic of Ireland firms with no statistically significant differences (Table 3.6). Highest priority in both areas was given to people and skills development, strategy development and implementation and improving productivity and efficiency. Perhaps not surprisingly, lower priority was given to supply chain development.

**Table 3.6: Strategic Priorities of Service Sector Businesses for Achieving Development Plan Targets**

	Northern Ireland	Republic of Ireland	Total
Strategy Dev and Implementation	85.6	83.9	84.3
People/Skills Development	91.5	86.5	87.9
Operational Process Improvement	53.2	65.9	62.1
Supply Chain Development	21.1	25.3	23.9
Improving Customer Service	78.8	75.6	76.5
Improving Marketing	68.5	72.7	71.5
Improving Productivity/Efficiency	78.7	79.6	79.3

**Notes:** Figures relate to tradable services businesses with ten employees or more. Survey responses are weighted to give representative results (see Appendix 1 for details). No statistically significant differences exist between the Northern Ireland and Republic of Ireland figures.

**Table 3.7: Strategic Priorities of Service Sector Businesses for Achieving Development Plan Targets: By Sector and Sizeband**

	Sectors		Sizebands (employment)		
	Financial and Communications Services	Computer & Business Services	10-19	20-99	100+
<b>Northern Ireland</b>					
Strategy Dev and Implementation	81.8	87.8	85.4	93.6	83.2
People/Skills Development Operational Process Improvement	100.0	90.0	94.0	85.3	94.8
Supply Chain Development	69.3	48.8	50.8	56.5	55.4
Improving Customer Service	33.6	17.8	12.0	35.4	18.7
Improving Marketing	72.8	79.4	80.3	82.7	84.3
Improving Productivity/Efficiency	47.1	74.9	76.4	72.9	51.0
	73.6	80.6	78.0	84.5	72.6
<b>Republic of Ireland</b>					
Strategy Dev and Implementation	86.1	82.8	80.5	84.6	92.5
People/Skills Development Operational Process Improvement	88.1	85.7	82.2	92.8	89.3
Supply Chain Development	78.2	60.0	67.3	58.3	71.9
Improving Customer Service	31.5	22.1	23.2	32.1	22.5
Improving Marketing	72.2	77.2	69.0	82.7	82.3
Improving Productivity/Efficiency	71.0	73.5	75.3	70.9	68.5
	77.0	80.7	83.5	77.6	72.3

**Notes:** Figures relate to tradable services businesses with ten employees or more. Survey responses are weighted to give representative results (see Appendix 1 for details). Shaded cells indicate significant difference between Northern Ireland and the Republic of Ireland at 10 per cent or less.

In summary, we find a higher overall proportion of service sector firms in the Republic of Ireland have formal strategic plans, a difference being driven largely by the greater frequency of strategic planning among larger Southern businesses. Among those firms which do have strategic plans there is a marked similarity in the objectives specified, North and South. Service development emerges as a priority with fewer firms specifying formal targets for R&D investment or joint ventures. To achieve their targets firms also perceive similar challenges North and South centring on people and skills, strategy development and improving efficiency.

### **3.5 Summary**

Perhaps the most striking feature of our comparison of service sector innovation is the similarity between the situations in Northern Ireland and the Republic of Ireland. In particular there is broad parity between levels of service sector innovation in Northern Ireland and the Republic of Ireland. In addition – and unlike manufacturing – the Republic of Ireland appears to enjoy little structural advantage (i.e. sectoral and business size-mix) in terms of the overall level of service sector innovation.

Reflecting the situation in manufacturing more closely, we do find that a higher overall proportion of service sector firms in the Republic of Ireland have formal strategic plans, a difference being driven largely by the greater frequency of strategic planning among larger Southern businesses. Among those firms which do have strategic plans there is again a marked similarity in the objectives specified, North and South. Service development emerges as a priority with fewer firms specifying formal targets for R&D investment or joint ventures. To achieve their targets firms also perceive similar challenges North and South centring on people and skills, strategy development and improving efficiency.



(a)

# Chapter 4 - Innovation Networking in Manufacturing

## 4.1 Introduction

Technological innovation is more often than not, the result of interaction and cooperation between firms and other organisations rather than the independent outcome of isolated actions (Lundvall, 1988, OECD, 2002). Interaction between firms and organisations also enables technological innovation to spill over from one part of the economy (where it is created) to another.

In recent years new perspectives on regional science have stressed “the importance of geographical *proximity* or agglomeration characteristics, for facilitating innovative tacit-knowledge exchange and other externalities; and [...] an institutional and organizational *learning* propensity to regional economic performance” (Cooke *et. al.* 1998, p. 1563). This together with the fact that innovation is a source of economic growth, has had a major influence on the strategic priorities of economic policy.

Policy making in Northern Ireland has been strongly influenced by these perspectives. This is manifest in the recent Regional Innovation Strategy, “Think, Create, Innovate” with the recognition that to strengthen the regional innovation system “ever stronger links must be encouraged between higher and further education and the business sector” (2002, p.4).

A necessary pre-requisite for the successful implementation of policies to strengthen the regional innovation system through networks and links, however, is an understanding of the current level of interaction both within the private sector and between the private and public sectors. For the first time in the IIP4, we therefore focus on the geographical nature of firms’ innovation linkages. Are these with other local companies? Cross-border? Or, are they with companies or other organisations outside Ireland?

This section profiles the external links of manufacturing plants with other firms and organisations as part of their product and process development activities. More specifically, we focus on three questions:

- What is the extent of manufacturing plants’ external innovation links with other firms and organisations, and are there any differences between firms of varying size, sector, ownership and location (Section 5.2)?
- Who are plants’ external partners, and how do sizeband, sector and ownership factors affect the type of links formed (Section 5.3)?
- Are plants’ external innovation links predominantly ‘local’, and to what extent are firms engaged in cross-border and international partnerships (Section 5.4)?

In each case the key indicator used is the proportion of plants in each group having links of the appropriate type.

## 4.2 Innovation Links in the Manufacturing Sector

Overall, a similar proportion of manufacturing plants in Northern Ireland (36.9 per cent) and the Republic of Ireland (37.7 per cent) involved other firms or organisations in their innovation activity (Table 4.1). The belief that innovation linkages enhance innovative capability is supported by the data, with product innovators and process innovators both being more likely to have had innovation linkages than non-innovators. The likelihood of plants having innovation linkages is further enhanced if they are involved in R&D activity. In both the Republic of Ireland and Northern Ireland, approximately 54 per cent of plants undertaking in-house R&D were also engaged in innovation linkages. More marked differences were evident in the proportion of plants that had innovation linkages that also had R&D departments in their plants or who acquired R&D externally. For example, of those plants that had in-house R&D departments, 65.4 per cent also had external innovation linkages, while 63.7 per cent of those plants that outsourced R&D had innovation linkages. This latter proportion is significantly higher among Northern Ireland plants, with Republic of Ireland plants which purchased externally conducted R&D, being slightly less likely to have had innovation linkages.

**Table 4.1: Percentage of plants undertaking R&D or innovation involved with innovation linkages to other firms and/or organisations**

	Northern Ireland	Republic of Ireland
All Plants	36.9	37.7
Firms with R&D in Plant (% of plants)	54.1	54.4
Firms with R&D Department (% of plants)	70.2	63.9
Firms with R&D undertaken externally (% of plants) ***	78.0	59.3
Product Innovators (% of plants)	51.5	51.8
Process Innovators (% of plants)	51.5	51.4
Non Innovators (% of plants)	20.4	21.2

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

Although overall 37.5 per cent of manufacturing plants had external links as part of their product and process development activity this varied considerably between plants according to size, sector and ownership.

In terms of plant size, small plants were less likely to be engaged in product or process development than larger plants (Chapter 2). In addition, small plants' ability to innovate was constrained by lower R&D capability, a less skilled workforce and often limited financial resources. It might be expected therefore that small plants would benefit to a greater extent than larger plants from innovation linkages in enabling them to access information, share the risk of development, access specialist technology and speed-up the development process. Small plants were however significantly less likely to have external innovation linkages than larger plants (Table 4.2).

**Table 4.2: Percentage of plants in Northern Ireland and Republic of Ireland with Innovation Linkages by Plant Size, Sector and Ownership**

	ALL Plants		Product Innovators Only		Process Innovators Only			
	NI	ROI	NI	ROI	NI	ROI		
<b>A. By Plant Size (% of plants)</b>								
10 – 19	27.3	23.4		36.3	45.2	**	33.3	38.9
20 – 99	34.3	39.5	**	50.5	48.8		52.0	50.8
100 +	67.1	59.4	**	74.7	65.2	**	75.3	64.1
<b>B. By Industrial Sector (% of plants)</b>								
Food, Drink and Tobacco	40.5	45.7		56.9	58.8		64.9	64.5
Textiles and Clothing	41.1	26.8	***	48.4	31.1	***	53.8	41.0
Wood and Wood Products	17.1	18.4		29.6	26.9		28.6	31.5
Paper and Printing	25.0	29.4		37.7	43.1		41.4	29.3
Chemicals	48.0	52.9		60.0	58.9		30.8	57.1
Metals and Metal Fabrication	20.5	31.0	***	46.4	52.8		28.4	48.8
Mechanical Engineering	61.2	37.3	***	80.4	44.8	***	76.2	42.5
Electrical and Optical Eqpt.	54.5	50.1		72.9	63.4		91.4	65.3
Transport Equipment	47.1	43.6		32.1	48.3		30.0	59.6
Other Manufacturing	38.6	39.5		50.8	55.8		45.0	54.4
<b>C. By Ownership (% of plants)</b>								
Indigenously Owned	34.0	34.9		48.3	47.8		47.1	48.0
Externally Owned	54.4	49.3		65.0	61.4	**	69.2	61.1

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

In Northern Ireland, plants with between 20 and 99 employees were also significantly less likely to have innovation links than their Republic of Ireland counterparts. At the same time, larger plants in Northern Ireland, that is those with over 100 employees,

were significantly *more* likely to be engaged in innovation linkages, irrespective of whether they were product or process innovators.

Variation was also evident by industrial sector in the use of linkages as part of product and process innovation. Plants manufacturing wood and wood products were the least likely to have had innovation linkages, with mechanical engineering plants in Northern Ireland and chemical plants in the Republic of Ireland being the most likely to have had innovation links (Table 4.2). Focusing specifically on product innovators, 80 per cent of mechanical engineering plants in Northern Ireland, however, had external links with other firms and organizations, with this being significantly higher than for Republic of Ireland mechanical engineering plants (44.8 per cent). Northern Ireland product and process innovators in the textile and clothing sector were also significantly more likely to have innovation links than their Republic of Ireland counterparts.

Significant differences were also evident in the proportion of indigenously-owned (30.6 per cent) plants and externally-owned plants (56.6 per cent) with external links. Overall however, indigenously-owned plants in Northern Ireland were no more or less likely to have external links than indigenously-owned plants in the Republic of Ireland. In contrast, externally-owned plants in Northern Ireland that undertook product or process innovation between 2000 and 2002 were significantly more likely to have external links than similar plants in the Republic of Ireland. While it might be suggested that Republic of Ireland plants are less dependent on external innovation links due to high internal R&D capability, this is not supported by the data with a similar proportion of externally-owned plants in Northern Ireland and the Republic of Ireland having in-house R&D departments and acquiring R&D externally.

Given the often large differences in the likelihood of having innovation linkages between firms of different size and sector, the proportion of firms in each size/sector category with links was calculated (Table 4.3). Without exception, the proportion of manufacturing plants that had innovation links in each of the industrial sectors varies significantly with plant size. In almost all cases, smaller plants are less likely to have external links than larger plants. A notable exception to this is plants in the chemicals sector where 41.2 per cent of plants with 10 to 19 employees had innovation links, 58.2 per cent of plants with 20 to 99 employees had external innovation links, and only 40 per cent of plants with over 100 employees had innovation links.

The largest differences in the proportion of plants of different sizes having external innovation links were found in the food, drink and tobacco, transport equipment and wood and wood products sectors. In the food, drink and tobacco sector no plants with between 10 and 19 employees had external innovation links as part of their product and process development. In contrast, 66.3 per cent of plants with over 100 employees in this sector had innovation links. Similarly, in the transport equipment sector, plants with over 100 employees were 15.5 times more likely to have had external innovation links than plants with 10 to 19 employees.

**Table 4.3: Percentage of Firms with Linkages as part of their Product and Process Development Activity, by Size and Sector**

Industrial Sector	Employment Sizeband				All Plants
	10 to 19	20 to 99	100+		
Food, Drink and Tobacco	0.00	37.70	66.29	***	44.16
Textiles and Clothing	36.00	29.69	44.05	**	33.59
Wood and Wood Products	5.00	21.21	56.25	***	17.98
Paper and Printing	7.10	40.68	27.42	***	28.19
Chemicals	41.18	58.16	40.00	**	52.13
Metals and Metal Fabrication	14.67	29.67	60.00	***	27.15
Mechanical Engineering	12.40	59.52	75.00	***	43.32
Electrical and Optical Eqpt.	37.86	38.54	75.50	***	50.90
Transport Equipment	6.45	50.00	100.00	***	45.31
Other Manufacturing	31.51	38.39	72.16	***	39.22
<b>All Plants</b>	34.78	37.94	61.54		37.50

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

Profiling plant's use of innovation links in terms of adoption or non-adoption of links by region, size, sector and ownership therefore highlights significant differences in the extent to which plants draw on the knowledge and resources of others in their innovation efforts. A further dimension to this is the intensity of external links. For example, while two plants may both use external firms and organisations to assist them with their innovation activity, one plant may be linked to only one external partner, while the other plant may engage with a range of different actors in undertaking product or process developments. One measure of the intensity of plants' innovation links is the number of different firms or organisations that the plant was engaged with as part of its innovation activity.

On average, Northern Ireland and Republic of Ireland plants had a very similar number of innovation links at 2.89 and 2.91 respectively. Not only are small plants (10 to 19 employees) less likely to have engaged in innovation links as part of their innovation activity (Table 4.2) but, where they did, this is also with significantly fewer partners than larger plants. This pattern is consistent in both Northern Ireland and the Republic of Ireland, with the exception of those plants with 20 to 99 employees in Northern Ireland which, on average, had approximately the same average number of links as plants with over 100 employees. Although larger plants in Northern Ireland (100+ employees) were significantly more likely to engage in innovation links than similar sized plants in the Republic of Ireland, those that did have external links had significantly fewer than the Republic of Ireland plants. In other words, while larger Northern Ireland plants were more likely to engage in

external relationships as part of their product and process development activity, it tended to involve fewer partners than in the Republic of Ireland.

In terms of industrial sector, again significant differences existed in the average number of partners that firms engaged with for innovation. Chemical plants and transport equipment plants had the widest network of innovation links, with plants in the metals and metal fabrication sector having the most limited number of innovation partners. In three of the industrial sectors, namely textile and clothing plants, wood and wood products plants and metals and metal fabrication, for those plants engaged in innovation links, Northern Ireland plants had a significantly greater number of partners than Republic of Ireland plants. In contrast, Republic of Ireland mechanical engineering plants had significantly more partners than their Northern Ireland counterparts.

Not only are indigenously-owned plants less likely to have had innovation links than externally-owned plants, but indigenously-owned plants are also likely to have had fewer partners than externally-owned plants. There were however, no statistically significant differences between indigenously-owned plants in Northern Ireland and Republic of Ireland or externally-owned plants in both areas in terms of their number of innovation links.



**Table 4.4: Average number of links for those plants involved in external innovation links by region, plant size, sector and ownership**

	All Plants		Northern Ireland	Republic of Ireland	
All Plants			2.89	2.91	
<b>A. Plant Size (Average No. Links)</b>					
10-19	2.27	***	2.41	2.20	
20-99	2.93		3.07	2.87	
100+	3.38		3.00	3.54	***
<b>B. Industrial Sector (Average No. Links)</b>					
Food, Drink and Tobacco	2.97	***	2.82	3.03	
Textiles and Clothing	2.68		3.28	1.83	***
Wood and Wood Products	2.22		2.78	1.98	**
Paper and Printing	2.79		2.67	2.83	
Chemicals	3.34		3.02	3.38	
Metals and Metal Fabrication	2.02		2.35	1.92	*
Mechanical Engineering	2.97		2.13	3.40	***
Electrical and Optical Equipment	3.24		3.39	3.20	
Transport Equipment	3.73		3.33	4.00	
Other Manufacturing	2.83		2.77	2.86	
<b>C. Ownership (Average No. Links)</b>					
Indigenous	2.68	***	2.63	2.70	
External	3.55		3.77	3.48	

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

### **4.3 Nature of Product and Process Development Links**

Where plants stated that they had external innovation links, they were asked to identify the type of firm or organisation with whom they had linkages. This included:

- other plants within their corporate group;
- ‘producer-user’ interaction with suppliers, customers or clients;

- other industrial partners such as competitors or joint ventures;
- business advisors, such as consultants;
- public sector expertise, through government research labs and universities;
- private sector expertise through industry operated labs and private research institutes.

Producer-user relationships were found to be the most common type of innovation linkage (Table 4.5). Of those plants with external innovation links, 65.1 per cent were collaborating on development with their suppliers, and 57.2 per cent were collaborating with clients or customers. Industry operated labs and private research institutes were the least common type of external partners, collaborating with only 13.2 and 13.9 per cent of plants.

The profile of innovation partners of manufacturing plants was similar for plants, North and South (Table 4.5). The only exceptions were the extent of innovation links to clients or customers, competitors and higher education institutions. Northern Ireland manufacturing plants were significantly more likely to have innovation links with their clients or customers as well as higher education institutions, than plants in the Republic of Ireland. In contrast, Republic of Ireland plants were more likely to engage with their competitors in the development of new products or processes than Northern Ireland plants.

**Table 4.5 Percentage of plants with innovation links to different firms and organisations**

	All Plants	Northern Ireland	Republic of Ireland	
	% of Plants	% of Plants	% of Plants	
<b>Links to:</b>				
other group companies	43.5	44.87	42.83	
clients or customers	57.2	61.34	55.34	**
Suppliers	65.1	63.12	65.90	
Competitors	19.7	13.74	22.27	***
joint ventures	15.1	16.28	14.54	
Consultants	40.0	39.72	40.13	
Government	14.2	14.22	14.18	
Higher Education Institutions	31.5	35.58	29.66	**
industry labs	15.2	15.83	14.96	
private research institutes	13.9	15.15	13.35	

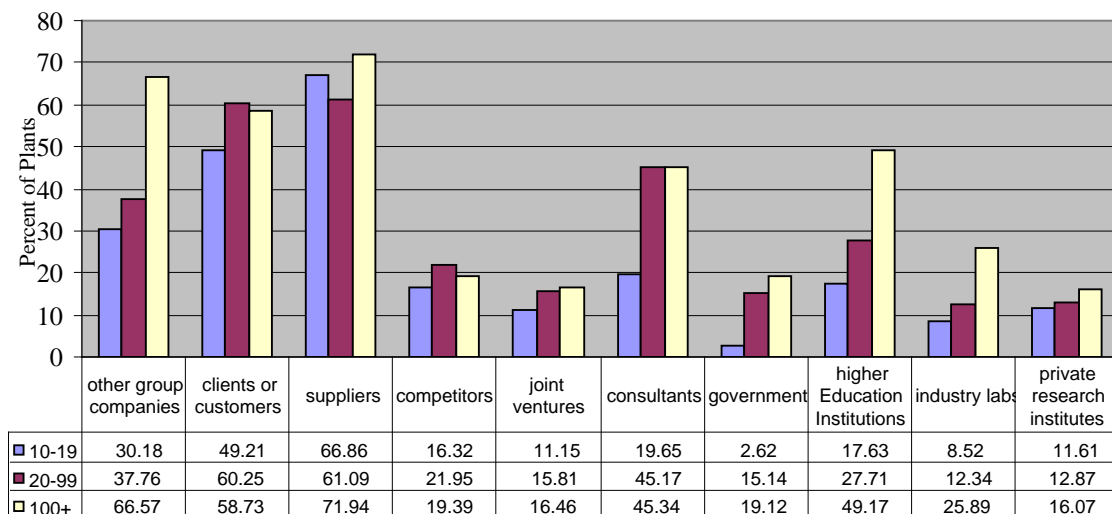
**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

Differences were also evident in the innovation partners of small and larger plants (Figure 5.1). Focusing just on those plants that had innovation links, as found previously, producer-user innovation links were the most common type of collaboration for innovation irrespective of plant size. For the largest plants (100+ employees), collaboration with other group plants was significantly more important, although this also reflects the higher proportion of larger plants that are externally-owned.

Small plants (10 to 19 employees) are 5.8 times *less* likely to have had collaboration with government labs than plants with 20 to 99 employees, and 7.3 times less likely to have had this form of collaboration than the largest plants (100+ employees). On the basis of available data it is difficult to explain this lack of collaboration, however, it is possible that smaller plants are less aware of the facilities, expertise, services that are available from government labs as well as the means of accessing them (see Case Study – T S Foods).

Smaller plants were also significantly less likely than larger plants (100+ employees) to engage in innovation linkages with industry operated research labs (3 times less likely), consultants (2.3 times less likely) and higher education institutions (2.8 times less likely).

**Percentage of plants with specific links by plant sizeband**



In each industrial sector, innovation links were again dominated by producer-user relationships. Mechanical engineering plants and electrical and optical equipment plants were the most likely to collaborate with clients or customers in undertaking product or process development. Backward innovation links along the supply chain to supplier firms were most common among textile and clothing firms, with over 85 per cent of all textile and clothing plants which had innovation links, having these types of partnerships.

Textile and clothing plants along with transport equipment manufacturing plants were also most likely to have had developmental links with their competitors. The use of consultants as part of plants' innovation activity varied considerably across the industrial sectors, being more common among transport equipment manufacturers,

mechanical engineering, wood and wood products and paper and printing plants. In contrast, plants in the more high-tech sectors of chemicals and electrical and optical equipment depend to a much lesser extent on innovation links with consultants.

Chemical and electrical and optical equipment manufacturing plants tended to use external public and private sector research labs and facilities in their innovation activities to a much greater extent than plants in other sectors (with the exception of the food, drink and tobacco sector).

A number of significant differences were also evident in the type of innovation partners used by indigenously-owned and externally-owned plants. Unsurprisingly, externally-owned plants access the resources and expertise of other group plants almost 3 times more than indigenously-owned plants. This reflects the greater tendency for externally-owned plants to have more than one plant with 70.1 per cent of externally-owned plants in the sample belonging to a corporate group with more than one plant as compared to 13.8 per cent of indigenously-owned plants.

Externally-owned plants were also significantly more likely than indigenously-owned plants to have innovation links with their suppliers, universities and private sector industry labs. In contrast, indigenously-owned plants were more likely to engage in joint ventures to develop new products or processes than externally owned plants. It is possible that indigenous plants may have had fewer financial, technical, human and knowledge-based resources than larger plants and therefore in a relationship to develop new products and processes the partnership may be more evenly balanced with each partner sharing the risk as well as the rewards of development. For externally-owned plants there may be adequate internal resources to pursue product and process developments, yet the need to collaborate externally on specific issues where specialist knowledge and expertise are required may lead to innovation links which are either informal (i.e. suppliers and customers) or paid for (i.e. industry, private labs etc.).

**Table 4.6 Percentage of plants with specific external innovation links by industrial sector**

	<b>Food, Drink and Tobacco</b>	<b>Textiles and Clothing</b>	<b>Wood and Wood Products</b>	<b>Paper and Printing</b>	<b>Chemicals</b>	<b>Metals and Metal Fabrication</b>	<b>Mechanical Engineering</b>	<b>Electrical and Optical Equipment</b>	<b>Transport Equipment</b>	<b>Other Manufacturing</b>
<b>Percentage of Plants with</b>										
<b>Links to:</b>										
Other group companies	45.38	44.18	16.15	27.05	55.11	34.58	37.00	55.34	76.24	40.62
clients or customers	53.66	67.69	56.80	64.52	52.81	45.57	69.72	69.00	38.50	48.78
Suppliers	56.51	85.54	26.54	71.08	57.72	44.28	60.18	68.38	62.26	78.64
Competitors	22.44	25.41	0.00	23.63	12.04	20.16	17.24	19.18	50.38	19.01
joint ventures	20.02	22.27	0.00	13.88	6.07	15.10	20.47	8.72	23.38	9.98
Consultants	35.43	42.93	53.58	49.29	44.89	11.31	54.06	45.52	60.45	35.41
Government	21.00	14.46	16.15	9.90	27.55	3.68	18.68	9.60	11.88	7.18
higher Education Institutions	34.48	25.41	43.20	15.79	51.12	14.99	20.32	51.12	37.74	26.99
industry labs	25.60	14.36	9.69	0.00	27.82	5.72	16.48	14.92	11.88	13.37
private research institutes	24.24	6.80	0.00	3.90	22.84	6.92	14.27	15.93	0.00	11.51

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

**Table 4.7 Percentage of Indigenous and Externally Owned plants with innovation links to Each Type of Partner**

	Indigenous	Externally Owned	
	% of Plants	% of Plants	
<b>Links to:</b>			
other group companies	27.70	82.77	***
clients or customers	56.36	58.65	
Suppliers	64.04	69.97	**
Competitors	19.79	18.89	
joint ventures	16.60	12.22	**
Consultants	39.62	42.12	
Government	14.45	12.68	
Higher Education Institutions	27.93	38.35	***
industry labs	11.15	25.15	***
private research institutes	13.58	15.06	

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

#### **4.4 Location of Innovation Partners**

Sections 4.2 and 4.3 have profiled the use of innovation links and the type of partners manufacturing plants have as part of their innovation activities. In this section our concern focuses on where these partners are located. It is important to know where plants are acquiring knowledge from, as this indicates the strength of the regional innovation system. If for example plants are pursuing innovation links with university labs outside Northern Ireland then this may suggest that Northern Ireland firms are not benefiting from knowledge generated inside Northern Ireland or that the expertise in the universities is not aligned to the needs of business. The benefit from innovation links is not one-way but rather accrues to both the manufacturing plant and the partner firm or organisation. If the partner is local then the net gain from the collaboration will be greater than that from a non-local collaboration.

Table 4.8 gives the proportion of plants whose links were in the local region (i.e. Northern Ireland-based partners for Northern Ireland plants and Republic of Ireland - based partners for Republic of Ireland plants), cross border links (i.e. Republic of Ireland-based partners for Northern Ireland plants and Northern Ireland-based partners for Republic of Ireland plants), in GB, Other EU and non-EU regions.

Northern Ireland manufacturing plants had significantly stronger *local* links to other group companies, government labs and universities than Republic of Ireland manufacturing plants. Overall Northern Ireland plants were more likely to have

innovation links with other group plants located in Northern Ireland, Republic of Ireland or GB than Republic of Ireland plants. Yet, Republic of Ireland based plants were more likely to engage with other group plants internationally, both in other-EU and non-EU countries. It is likely that these figures reflect the ownership pattern of plants in both Northern Ireland and the Republic of Ireland. For example, the Republic of Ireland sample had a significantly higher proportion of externally owned plants (22.4 per cent in Republic of Ireland compared to 15.9 per cent in Northern Ireland) as well as having a significantly higher proportion of externally owned plants with head quarters outside the UK and Ireland (78.8 per cent compared to 34.7 per cent of the Northern Ireland sample).

Focusing on cross-border innovation links by plants in Northern Ireland and Republic of Ireland, it is evident that Northern Ireland manufacturing plants were significantly more likely to have cross-border innovation links – inter-corporate, producer-user, inter-industry, as well as private sector research institutes – than Republic of Ireland plants. In contrast, Republic of Ireland plants were more likely to be partners with consultants based in Northern Ireland as well as Northern Ireland government labs and Northern Ireland universities.

Innovation links to GB were dominated by Northern Ireland plants which, with the exception of innovation links to competitors and universities, were significantly higher for Northern Ireland plants. The strength of innovation links by Northern Ireland plants into GB may reflect the geo-political legacy, economic and financial criteria such as a common currency with GB, as well as historical social and economic inter-dependence. Indeed, for a number of innovation partners – other group plants, clients, suppliers, competitors, joint ventures, industry labs and private research institutes – Northern Ireland plants were more likely to have links in GB than in Northern Ireland.

Although Northern Ireland manufacturing plants were more likely to have innovation links with GB partners than Republic of Ireland manufacturing plants, Republic of Ireland plants were still quite dependent on GB links. In some instances, namely the use of innovation links with suppliers and other joint ventures, Republic of Ireland manufacturing plants were equally as likely to have GB as local links. Furthermore both Northern Ireland and Republic of Ireland manufacturing plants were more likely to collaborate with GB based competitors than local competitors.

The most striking difference in the spatial pattern of innovation partners for Northern Ireland and Republic of Ireland plants relates to the use of other-EU and non-EU links. Without exception Republic of Ireland plants were more likely to have innovation partners in other-EU countries than Northern Ireland plants. Although the disparity between Northern Ireland and Republic of Ireland plants in use of non-EU partners was less marked it was still evident for all types of partners with the exception of joint ventures and consultants.

**Table 4.8 Location of Innovation Links – Percentage of Plants with Innovation Links to each of type of partner by Location of these links**

Links to:	Local		Cross Border		Great Britain		Other EU		Non EU	
	NI	ROI	NI	ROI	NI	ROI	NI	ROI	NI	ROI
other group companies	38.6	25.1	34.4	15	40.8	28.6	23.7	42.8	21	35.9
clients or customers	61	58.1	47.1	27.2	52.9	43.7	23.6	41.3	21.1	25.1
Suppliers	48	52.4	29.7	22.6	64.6	52.5	47.9	48.3	20.1	20.2
Competitors	36.3	38.7	33.8	12.1	48.7	44.8	23.9	39.5	23.1	24.5
joint ventures	19.9	19.3	33.1	6.3	36.2	19.5	0	47.4	32	24.2
Consultants	76.8	72.8	6.3	23	37.8	22.1	7.6	13.4	10.3	8.7
Government	82	70.5	9	20.3	35.8	10.4	7.9	11.8	0	15.4
Higher Education Institutions	86.4	78.8	8.1	23	16.6	13.4	4.8	15.9	5.6	6.3
industry labs	41.2	64.5	15.1	14.7	54.4	24.3	15.1	18.8	1.9	14
private research institutes	42	45.3	21.7	10.3	53.8	29.6	10.7	19.9	0	21.3

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.



## **4.5 Summary**

Inter-firm and inter-organisational linkages are an important element of a vibrant regional innovation system with levels of innovation activity and firms' capability to innovate being maximised where knowledge is shared between the different actors in a region.

Nurturing effective networks between firms and organisations in Northern Ireland has become a priority in Northern Ireland as highlighted in the recent Research, Development and Innovation strategy document for Northern Ireland.

This study is timely in providing an insight into the extent of innovation linkages that Northern Ireland firms are currently engaged in, the type of partners with whom they are collaborating and the location of these partners, in terms of whether they are local, cross-border, or further a field.

Overall, we find that a similar proportion of manufacturing plants in Northern Ireland and Republic of Ireland had innovation links at 36.9 per cent and 37.7 per cent respectively. Manufacturing plants in Northern Ireland and the Republic of Ireland also had very similar average numbers of partner 'types' at 2.89 and 2.91 respectively. We also find that:

- Smaller manufacturing plants were less likely to be engaged in innovation links than larger plants.
- Considerable variation was found in the use of external innovation links by industrial sector. Wood and wood products plants are the least likely to have been engaged in innovation linkages with mechanical engineering plants in Northern Ireland and chemical plants in the Republic of Ireland being the most likely to have had external innovation links.
- Externally-owned manufacturing plants in both Northern Ireland and the Republic of Ireland were significantly more likely to have external innovation links.

In terms of the type of partner with which manufacturing plants are collaborating we find that:

- Producer-user collaboration was the most common form of external links as part of innovation activity.
- Collaboration with industry and private sector laboratories were the least common forms of collaboration.
- Northern Ireland manufacturing plants were significantly more likely to have innovation links with their clients or customers than Republic of Ireland manufacturing plants.

- Northern Ireland manufacturing plants were also significantly more likely to be collaborating with university labs than Republic of Ireland manufacturing plants.
- Small manufacturing plants are 5.8 times less likely to have had innovation links with government labs than plants with 20 to 99 employees, and 7.3 times less likely to have had this form of collaboration than the largest plants (100+ employees).
- Small manufacturing plants were significantly less likely than larger plants to engage in innovation linkages with industry operated research labs, consultants and universities.

Another important dimension of the pattern of innovation linkages is whether or not these are local, i.e. within Northern Ireland or the Republic of Ireland. Strong local linkages are a key component of a strong regional innovation system and assist with technology diffusion. Our key findings are:

- The extent to which the innovation partners of Northern Ireland and Republic of Ireland manufacturing plants were local (i.e. located in Northern Ireland and Republic of Ireland respectively), is similar for most of the innovation partners. Yet, for Northern Ireland manufacturing plants, local collaboration on innovation with other group plants, government labs and universities in Northern Ireland was stronger than that found for Republic of Ireland manufacturing plants.
- Northern Ireland manufacturing plants engaged in cross-border innovation links to a much greater extent than Republic of Ireland plants (with the exception of use of consultants, government labs and universities).
- Northern Ireland manufacturing were more strongly linked into partners in GB than their Republic of Ireland counterparts.
- Without exception, Republic of Ireland manufacturing plants were more likely to have innovation partners in other EU countries than Northern Ireland plants. In addition, Republic of Ireland manufacturing plants were also more likely to engage in innovation links outside the EU than Northern Ireland plants.

## **Chapter 5 - Innovation Networks in the Service Sector**

### ***5.1 Introduction***

In this section – for the first time in the Irish Innovation Panel surveys – we report a comparison of the level of innovation networks in the tradable services sector in Northern Ireland and the Republic of Ireland. The main questions addressed are similar to those for manufacturing: How common are tradable services businesses (TSBs) innovation linkages or networks? Who are their partners? And, where are they located?

The indicators we use are also similar. The extent of networks is measured by the proportion of firms having each type of innovation linkage. The intensity of firms' networking activity is measured by the average number of partner types with which firms have links. (This will of necessity be equal or smaller than the average number of innovation partners which each firm has).

### ***5.2 Innovation Networks***

Links with other firms or organisations as part of service development activity are relatively more common in tradable service businesses (TSBs) than in manufacturing plants. Whereas 37.5 per cent of manufacturing plants had external links, the proportion of TSBs with external links was 49.8 per cent. Northern Ireland TSBs were however, significantly less likely to have external innovation links (42.3 per cent) than Republic of Ireland firms (53 per cent) (Table 5.1). This tendency for a lower proportion of Northern Ireland TSBs to have innovation links persists for firms undertaking R&D, where formal R&D departments exist in the firms, for firms introducing product innovation or for non-innovating firms (Table 5.1). In each case, TSBs in the Republic of Ireland were more likely to have external linkages with other firms or organisations as part of their innovation activities.

**Table 5.1: Percentage of service firms undertaking R&D or innovation involved with innovation linkages to other firms and/or organisations**

	NI	ROI	
<b>All Firms</b>	42.3	53.0	***
<b>Firms with R&amp;D in Plant (% of firms)</b>	56.7	69.6	***
<b>Firms with R&amp;D Department (% of firms)</b>	71.8	100.0	***
<b>Firms with R&amp;D undertaken externally (% of firms)</b>	73.7	71.6	
<b>Service Innovators (% of firms)</b>	59.3	65.1	**
<b>Non Innovators (% of firms)</b>	27.5	36.1	***

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

In terms of the probability of TSBs of different sizes having external innovation links the results are similar to that obtained for manufacturing plants, with smaller firms being significantly less likely to have external innovation links than larger firms (Table 5.2). Yet, irrespective of firm size, those firms that introduced new services to their customers between 2000 and 2002 were almost twice as likely to have innovation links as non-innovators.

Although smaller TSBs were significantly less likely to have external innovation links than larger firms, there is, however, no significant difference in the use of external links by innovating firms of different sizes. The tendency for a smaller proportion of Northern Ireland TSBs to have external innovation linkages compared to the Republic of Ireland was also found in terms of firm size. In particular, a significantly lower proportion of TSBs in Northern Ireland with between 10 and 19 employees and those with over 100 employees had stronger external innovation links compared to Republic of Ireland (Table 5.2).

The bias towards Republic of Ireland TSBs having links is however less robust for those firms which introduced new products between 2000 and 2002, with no significant difference in the proportion of Northern Ireland and Republic of Ireland firms with over 20 employees, having external links. Yet, for smaller TSBs, those with between 10 and 19 employees, innovating TSBs in the Republic of Ireland were significantly more likely to have external links than similarly sized service firms in Northern Ireland.

Little difference was evident in the use of external innovation links in Northern Ireland and Republic of Ireland TSBs in financial and communication services. In

contrast, a significant difference was found for computer and business services firms, with a significantly higher proportion of Republic of Ireland firms in this sector having external innovation links than in Northern Ireland.

Externally-owned TSBs in both Northern Ireland and Republic of Ireland were more likely to have external innovation links with other firms and organisations than indigenously-owned firms. No significant difference was evident between the proportion of externally-owned service firms with innovation links in Northern Ireland and the Republic of Ireland. In contrast, indigenously-owned service firms in the Republic of Ireland were significantly more likely to have external innovation links than indigenously-owned service firms in Northern Ireland.

**Table 5.2: Proportion of Service firms with External Innovation Links**

	ALL Firms			Service Innovators Only		
	NI	ROI		NI	Republic of Ireland	
<b>A. By Plant Size (% of firms)</b>						
10 – 19	32.7	51.8	***	50.6	66.0	***
20 – 99	53.8	50.3		67.3	62.7	
100 +	46.9	65.4	***	69.2	66.7	
<b>B. By Industrial Sector (% of firms)</b>						
Financial & Communications	46.8	51.9		67.1	57.7	
Computer & Business Services	40.6	53.5	***	56.2	69.1	***
<b>C. By Ownership (% of firms)</b>						
Indigenously Owned	39.9	51.0	***	54.6	63.8	***
Externally Owned	45.9	52.9		63.5	60.8	

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

Another dimension of TSBs use of external linkages as part of their innovation activities relates to the intensity of innovation links. Table 5.3 focuses on those TSBs that stated that they were engaged in innovation links and reports the average number of innovation linkages these firms had by area, firm size, sectoral classification and ownership.

Although a significantly lower proportion of Northern Ireland TSBs had external innovation links, among those firms that do have links, the extent of these is similar to that for Republic of Ireland TSBs. On average, those TSBs that were involved with other firms or organisations as part of their innovation activity in Northern Ireland and Republic of Ireland engaged with 2.3 different partners.

As in the manufacturing sector, not only are smaller firms less likely to have external links, but of those that do tend to have fewer partners. This trend is evident in both Northern Ireland and Republic of Ireland although the data also suggests that not only were larger firms (over 100 employees) in the Republic of Ireland more likely to engage in external innovation links than similar firms in Northern Ireland (Table 5.2), but that of firms with innovation links Northern Ireland firms had significantly fewer partnerships (1.91) than in the Republic of Ireland (2.71).

TSBs in Northern Ireland in the financial and communications sector had significantly more external partnerships (2.68) than Republic of Ireland firms in this sector (1.95). In contrast, computer & business services firms in the Republic of Ireland with innovation links had significantly more partnerships (2.48) than Northern Ireland firms in this sector (2.26).

Whereas differences were evident in the proportion of indigenously-owned and externally-owned service firms engaged in innovation links (Table 5.3), no statistically significant difference was evident in the breadth of innovation links for indigenously-owned firms in either Northern Ireland or the Republic of Ireland.

**Table 5.3: Average number of external innovation links by region, plant size, sector and ownership**

	All Firms	Northern Ireland	Republic of Ireland	
Northern Ireland	2.33			
Republic of Ireland	2.31			
<b>A. Plant Size (Average No. Links)</b>				
10-19	2.13	2.07	2.15	
20-99	2.48	2.52	2.45	
100+	2.53	1.91	2.71	***
<b>B. Industrial Sector (Average No. Links)</b>				
Financial & Communications	2.09	2.68	1.95	***
Computer & Business Services	2.42	2.26	2.48	*
<b>C. Ownership (Average No. Links)</b>				
Indigenous	2.33	2.35	2.32	
External	2.23	2.28	2.20	

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

### **5.3 Nature of Innovation Links with Service Firms**

The type of links that service firms were engaged in as part of their innovation activity mirrored those for manufacturing plants and included:

- other plants in their corporate group;
- ‘producer-user’ innovation links with suppliers, customers or clients;
- other industrial partners such as competitors or joint ventures;
- business advisors, such as consultants;
- public sector expertise, through government research labs and universities;
- private sector expertise through industry operated labs and private research institutes.

Producer-user relationships again dominate external innovation links; 36.3 per cent of service firms with innovation links were collaborating with suppliers on service innovations; and, 39.8 per cent of firms were collaborating with clients or customers. Also, as found for manufacturing plants, external consultants were used widely by service firms in acquiring assistance with innovation. Service firms were much more likely to engage in formal joint ventures with other firms as part of their innovation than manufacturing plants yet, only 17 per cent of service firms with external innovation links were collaborating with universities, compared to 31.5 per cent of manufacturing plants.

Some significant differences were evident between service firms in Northern Ireland and Republic of Ireland in their involvement with different partners (Table 5.5). For example, of those firms with innovation links, a significantly higher proportion of Northern Ireland service firms collaborate with their clients or customers and their suppliers on innovation issues than Republic of Ireland service firms. Republic of Ireland service firms with innovation links were, however, significantly more likely to collaborate with competitors, industry labs or private research institutes than Northern Ireland service firms.

**Table 5.5: Percentage of firms with innovation links to different firms and organisations**

	All Firms	Northern Ireland	Republic of Ireland	
	%	% of Firms	% of Firms	
<b>Links to:</b>				
other group companies	40.4	37.7	41.3	
clients or customers	39.8	45.2	38.0	**
Suppliers	36.3	40.3	34.9	*
Competitors	19.9	15.3	21.5	**
joint ventures	31.0	33.6	30.1	
Consultants	34.9	34.3	35.1	
Government	5.7	5.2	5.9	
Higher Education Institutions	17.0	18.0	16.7	
industry labs	4.4	2.7	5.0	*
private research institutes	9.1	1.3	11.8	***

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

Differences were also evident in the type of innovation partner used by service firms depending on the size of the firm, the sector in which it is operating and its ownership structure (Table 5.6). For example, although producer-user innovation links dominate the type of partnerships that service firms form, these were used to a greater extent by the larger service firms (100+ employees) and those involved in financial and communications services.

Larger TSBs (100+ employees), as well as indigenously-owned service firms, were also significantly more likely to engage with competitors, or to establish formal joint ventures in innovation activities than smaller firms or externally-owned firms.

A significantly higher proportion of firms involved in the computer and business services sector engaged in formal joint ventures as part of their innovation process than firms in the financial and communications services. Computer and business services TSBs were also more likely to engage the expertise of external consultants to assist them with innovation activities. Similarly, small TSBs (10 to 19 employees) were also much more likely to use external consultants than larger firms, and this may reflect limitations in terms of internal specialist expertise in smaller firms.

No statistical difference was found between service firms of different sizes and ownership in their use of government labs, which tends to be rather limited. Although computer and related activities, R&D and other business services firms like the other



service firms had limited use of government labs in their innovation activities, the level of use was significantly higher compared to service firms in the financial and communications sector. Furthermore, computer and business services firms that had innovation links are significantly more likely to have drawn on the expertise in universities than financial and communications firms.

Finally, larger TSBs (100+ employees), computer and business services firms and indigenously-owned service firms that had innovation links, were significantly more likely to have had links with private research institutes than smaller firms, financial and communications firms and externally-owned firms respectively.

**Table 5.6: Proportion of Service Firms engaged in External Innovation Links by Type of Collaborating Partner**

	other group companies (%)	clients or customers (%)	Suppliers (%)	Competitors (%)	joint ventures (%)	Consultants (%)	Government (%)	Univ. (%)	Industry labs (%)	Private res insts (%)
<b>Firm Size</b>										
10-19	34.02	35.56	30.88	19.46	29.83	36.47	5.64	14.96	3.18	7.05
20-99	46.57	42.65	40.97	18.38	29.32	35.12	5.77	18.63	5.67	9.04
100+	45.76	45.52	43.67	25.96	37.83	28.20	5.91	19.09	5.91	14.39
	***	***	***	*	**	*			*	***
<b>Sector</b>										
Financial & Communications	47.17	44.26	54.38	21.69	14.25	19.01	1.29	7.00	4.48	2.52
Computer & Business Services	38.28	38.12	28.59	19.55	37.65	41.23	7.54	21.33	4.43	11.88
	***	**	***		***	***	***	***		***
<b>Ownership</b>										
Indigenously Owned	34.84	36.95	36.01	21.61	38.23	35.41	4.15	17.95	4.14	8.09
Externally Owned	66.24	39.53	38.55	15.38	9.08	30.23	2.28	11.91	6.05	3.76
	***			**	***			**		**

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). \* denotes a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level; \*\* denotes a significant difference at 5 per cent and \*\*\* denotes significance at the 1 per cent level.

## **5.4 Location of Service Firms' Innovation Partners**

Sections 5.2 and 5.3 have highlighted differences in the innovation links of service firms as well as their choice of partners. In this section the importance of local networks is examined.

For each type of external innovation link, the proportion of service firms with links in each of the regions is given in Table 5.7. Here, each type of partnership is dealt with separately, with firms having links to this type of partner being included in the location analysis, and firms with no links to a specific partner being excluded from the analysis. Where a firm stated that it had a link to a particular type of partner, e.g. other group companies, it was subsequently asked where this (these) partner (partners) was (were) located. In many instances firms had partners of a given type in different regions, e.g. supplier innovation partnerships in Northern Ireland, the Republic of Ireland and Other EU etc.

Republic of Ireland TSBs are slightly more strongly embedded in the Republic of Ireland economy than their Northern Ireland counterparts, a significantly higher proportion of Republic of Ireland TSBs having local innovation links with other group companies, competitors, government labs and private research institutes than in Northern Ireland. No statistically significant difference was found, however, between Northern Ireland and Republic of Ireland TSBs use of local innovation links to clients or customers, suppliers, joint ventures, consultants, universities or industry labs.

Northern Ireland TSBs were more likely to have cross-border links with group companies, clients, suppliers, consultants, government labs and joint ventures based in the Republic of Ireland than Republic of Ireland service firms. Cross-border partnerships are broadly equal in terms of collaboration with competitors, universities, industry labs and private research institutes.

As for manufacturing plants, Northern Ireland TSBs were more strongly linked into the GB market than Republic of Ireland firms for all types of partnerships, with the exception of government and industry labs. Northern Ireland TSBs, however, have fewer international links to European suppliers, competitors, joint ventures, consultants and private research institutes as well as international links to non-EU consultants and joint ventures.

**Table 5.7: Location of Innovation Links – Percentage of Service Firms with Innovation Links to each type of Partner by Location of Partners**

Location of Partner Location of Service Firm	Local		Cross Border		Great Britain		Other EU		Non EU	
	NI	ROI	NI	ROI	NI	ROI	NI	ROI	NI	ROI
<b>Links to:</b>										
other group companies	48.0	68.2	45.1	18.5	64.3	31.2	30.2	24.9	24.1	31.3
clients or customers	84.1	87.6	48.9	24.3	54.8	29.5	21.1	24.5	12.5	7.3
Suppliers	69.1	74.3	38.9	15.9	57.1	39.6	18.1	32.0	10.5	12.9
Competitors	43.1	89.0	21.7	16.2	50.3	30.7	8.1	22.7	35.8	16.2
joint ventures	52.3	46.8	44.7	7.8	53.2	38.1	12.1	35.7	6.4	20.3
Consultants	73.6	80.4	42.4	14.2	62.9	40.4	12.8	20.4	6.3	17.8
Government	75.9	100.0	24.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Higher Education	100.0	96.7	13.8	8.8	18.9	5.1	6.9	6.1	0.0	0.0
industry labs	53.4	75.6	0.0	0.0	53.4	40.6	0.0	0.0	46.6	0.0
private research institutes	0.0	84.9	0.0	13.7	100	18.8	0.0	13.3	0.0	0.0

**Notes:** Figures relate to all manufacturing plants with 10 or more employees. Survey responses are weighted to give representative results (see Appendix 1 for details). Shaded cells represent a significant difference between Northern Ireland and the Republic of Ireland at the 10 per cent level or below.

## **5.5 Summary**

As for manufacturing firms, innovation links can play an important role in helping service sector companies to innovate. Indeed, we find that overall a larger proportion of service sector firms (49.8 per cent) had external linkages than in manufacturing (37.5 per cent). Notably, however, Northern Ireland service firms were less likely to have external innovation links (42.3 per cent of firms) than Republic of Ireland service firms (53 per cent). Manufacturing plants also tend to have a slightly broader network of collaborators than service firms with on average 2.9 different partners compared to 2.3 for service firms. Although a significantly lower proportion of Northern Ireland service firms had innovation links of those that do, the breadth of these links are similar to that for Republic of Ireland service firms at 2.3 partners.

Differences in the pattern of external links between sizes, sectors etc. among TSBs reflect closely those for manufacturing. Smaller service firms, for example, are less likely to be engaged in innovation links than larger plants or service firms. Similarly, externally-owned service firms in both Northern Ireland and the Republic of Ireland are significantly more likely to have external innovation links.

In terms of the type of partners with which firms have external links, producer-user collaboration is the most common form of external links for service firms. Northern Ireland service firms, in particular, were significantly more likely to have innovation links with their clients or customers than Republic of Ireland firms. In the service sectors, collaboration with industry and private sector laboratories were the least common forms of collaboration.

In terms of the location of innovation partners, Republic of Ireland service firms appear to be more embedded in the Republic of Ireland economy in terms of significant higher proportion of firms with local innovation links to other group companies, competitors, government labs and private research institutes than that in Northern Ireland. Northern Ireland service sector firms, however, have stronger cross-border linkages and are more strongly linked into GB partners than their Republic of Ireland counterparts. Evidence of stronger international links of Republic of Ireland manufacturing plants is weaker for the service sectors.

## Chapter 6 - Key Points and Policy Implications

### 6.1 Key Empirical Results

In this report we have focussed on firms' innovation activities over the 2000 to 2002 period, made some comparisons with earlier periods and looked at the nature of firms' strategic plans for the next three years. In addition, we provide some information on the nature of firms' innovation links and their geographical orientation. Perhaps the key aspect of the linkages data is the extent to which linkages are 'local', or can be said to contribute to a local innovation system.

A number of key empirical points are worth emphasising. First, in terms of product innovation, we find few systematic – and statistically robust – differences between innovation indicators in Northern Ireland and the Republic of Ireland. In particular, at an aggregate level we do find a statistically higher level of innovation activity in the Republic of Ireland. This is not, however, reflected in significant differences at the level of individual plant sizebands or sectors. The implication is that structural factors – industry-mix and plant size structure – are having a more felicitous impact on overall innovation rates in the Republic of Ireland than in Northern Ireland.

Second, in terms of process development we find significant aggregate differences between Northern Ireland and Republic of Ireland firms (Northern Ireland lagging) in both the frequency of process innovation and the quality of process innovations being introduced. In particular, we see a difference in the quality of process innovation among larger and externally-owned firms. This may reflect the vintage of inward investment into Northern Ireland and the Republic of Ireland but is an issue which may be worthy of further investigation.

Third, we find little difference in the level of innovative activity in tradable services, North and South. This is true both in aggregate and at sectoral level. This is important because an innovative service sector has both the capability to generate jobs directly and provide innovative services to support competitive improvements in other parts of the economy.

Fourth levels of innovative activity in manufacturing in both Northern Ireland and the Republic of Ireland were generally lower in the 2000 to 2002 period than in the 1997-1999 period. The consistency of this result across areas, plant sizebands and types of ownership suggests it is due to some general environmental influence, and we attribute it primarily to the weaker economic situation during the later period. This has important implications: (a) it means that future increases in innovation indicators are likely to reflect both policy impacts and, hopefully, a more positive general economic climate; (b) it emphasises the impact of general economic conditions on innovation rates and the importance of contextual indicators in any policy assessment.

Fifth, we find a significantly higher proportion of Republic of Ireland firms have formal strategic plans than in Northern Ireland. However, among those firms which do have such plans very similar targets are being specified by firms in each area.

Manufacturing firms in the Republic of Ireland, however, were placing more emphasis on process improvement while service sector firms in both areas emphasised people and skills, strategy development and improving efficiency as key areas for development.

Sixth, a very similar proportion of manufacturing plants in Northern Ireland and Republic of Ireland have innovation links as well as very similar numbers of innovation partners. Producer-user collaboration dominates most firms' innovation partnerships, with Northern Ireland firms more likely to engage in local collaboration with other group plants, government labs and universities. Northern Ireland manufacturing plants are also more likely to be engaged in cross-border innovation cooperation. Republic of Ireland plants on the other hand are more likely to be engaged in international collaboration.

Seventh, a larger proportion of service sector firms (49.8 per cent) have external linkages than in manufacturing (37.5 per cent). Notably, however, Northern Ireland service firms were less likely to have external innovation links (42.3 per cent of firms) than Republic of Ireland service firms (53 per cent). Again producer-user collaboration dominates with Republic of Ireland service firms more strongly embedded in the local economy. Northern Ireland service sector firms, however, have stronger cross-border linkages and are more strongly linked into GB partners than their Republic of Ireland counterparts. Evidence of stronger international links of Republic of Ireland manufacturing plants is weaker for the service sectors.

## **6.2 Policy Implications**

Overall, it is difficult to draw any clear implications about the efficacy of policy North and South from our survey results. Instead, the negative influence of general economic conditions during 2000 to 2002 seems to have dominated any positive policy effect. The results do, however, highlight a number of continuing policy challenges many of which are already addressed by existing measures:

- Innovation indicators generally remain lower for smaller and indigenously-owned manufacturing firms and both groups must remain priority areas.
- The introduction of a set of new measures has highlighted issues in terms of the quality of process innovation in Northern Ireland for the first time. This is a key issue particularly as firms continue to face intense cost pressures from low-cost producers.
- Levels of tradable services innovation in Northern Ireland are in line with those in the Republic of Ireland but here again issues arise with smaller firms.
- Levels of innovation networking in Northern Ireland compare relatively well with the Republic of Ireland, a positive result. It remains the case, however, that only around 38 per cent of manufacturing plants had innovation links. Increasing the overall proportion of firms having such contacts will remain important.

More specifically, our results also emphasise the areas which firms themselves see as developmental priorities over the next three years. For small plants, both North and South, development priorities are productivity, marketing, customer service and people/skills with less attention focussed on supply chain development. For larger plants, customer service, productivity and people/skills remain important development areas but marketing was mentioned much less often. Supply chain development was seen as important by larger externally-owned plants.

Finally, given the overall similarities between the levels of innovation activity in Northern Ireland and the Republic of Ireland, it may be worth considering whether it may be more appropriate to use more challenging benchmarks in future studies. Core UK regions (or parts thereof) provide possible candidates although international comparisons may also be of value.



# Appendix 1: Survey Data and Methods

## ***A1.1 Introduction***

This appendix provides details of the survey procedures adopted during the fourth wave of the Irish Innovation Panel (IIP4) conducted between January 2003 and May 2003.

The IIP4 was a postal survey, the primary aim of which was to provide representative indicators of innovation and the adoption of best practice techniques by manufacturing and tradable services firms in the Republic of Ireland and Northern Ireland. A secondary aim of the survey was to contribute to the creation of a longitudinal database of innovation in Irish companies. The IIP4 is a plant level (rather than company) survey with the sample being structured to minimise the burden on firms while maintaining statistical robustness. In particular, sample structure and response rates were monitored both by plant size-band and broad sectoral group to enable a representative analysis.

Section A1.2 summarises the main characteristics of the sampling obtained for the IIP4 and the characteristics of the final sample. Section A1.3 focuses on survey response and Section A1.4 describes pattern of non-response and discusses the possibility of non-response bias. Section A1.5 describes the construction of weights designed to give representative results.

## ***A1.2 Sampling Frames***

Separate sampling frames were obtained from official and commercial sources in Northern Ireland and the Republic of Ireland. In Northern Ireland the sampling frame used for both manufacturing and tradable services was provided by the Department of Enterprise, Trade and Investment (DETI) and was drawn from the Inter-Departmental Business Register (IDBR). Sampling for manufacturing plants was in two stages. First, a random sample was drawn from the IDBR using guidelines provided by NIERC. Sampling fractions were: 50 per cent for plants with 10-19 employees, 75 per cent for plants with 20-99 employees and 100 per cent for plants with 100 plus employees. Secondly, to maximise the longitudinal coverage of the survey, the IDBR sample was augmented by those respondents to the third wave of the Irish Innovation Panel that were excluded from the random sample. Details of the number of plants in the population and final augmented manufacturing random sample are given in Table A1.1.

Sampling fractions for the tradable services sample from the IDBR were the same but there was no need for augmentation as this was the first time that tradable services companies had been included in the IIP surveys. Details of the number of plants in the population and the tradable services random sample for Northern Ireland are given in Table A1.2.

**Table A1.1: Northern Ireland Manufacturing Sample Structure – Number of Plants**

	Plant Size-band			Not Assigned	Total
	10-19	20-99	100+		
Food, Drink and Tobacco	44	122	50	14	230
Textiles, Clothing	21	69	52	8	150
Wood Products	26	48	3	2	79
Paper and Printing	40	52	15	3	110
Chemicals	12	22	10	2	46
Metals and Fabrication	39	78	14	2	133
Mechanical Eng.	29	50	15	4	98
Electrical and Optical Equipment	12	40	29	3	84
Transport Equipment	12	15	12	2	41
Other Manufacturing	80	127	39	9	255
Not Assigned	6	22	8	8	44
<b>Total</b>	<b>321</b>	<b>645</b>	<b>247</b>	<b>57</b>	<b>1270</b>
<i>Memo Items:</i>					
<i>Population</i>	<i>550</i>	<i>625</i>	<i>195</i>		<i>1370</i>

**Source:** IIP4

**Table A1.2: Northern Ireland Services Sample Structure – Number of Plants**

	Plant Size-band			Not Assigned	Total
	10-19	20-99	100+		
Financial Intermediation & Post & Telecommunications	32	51	27	12	122
Computer & Related Activities, R&D and Other Business Services	121	167	65	9	362
Creative Entertainment	20	33	3	0	56
Not Assigned	0	16	2	12	30
<b>Total</b>	<b>173</b>	<b>267</b>	<b>97</b>	<b>33</b>	<b>570</b>
<i>Memo Items:</i>					
<i>Population</i>	<i>530</i>	<i>435</i>	<i>120</i>		<i>1085</i>

**Source:** IIP4

A similar sampling approach was adopted in the Republic of Ireland. A population listing of manufacturing firms was provided by Forfas and a random sample was constructed from this population. As in Northern Ireland, sampling fractions were: 50 per cent for plants with 10-19 employees, 75 per cent for plants with 20-99 employees and 100 per cent for plants with 100 plus employees. This random sample was then augmented by those respondents to the third wave of the IIP that were excluded from the random sample. Details of the number of manufacturing plants in the population and the final augmented random sample are given in Table A1.3.

Details of tradable services firms were obtained from Kompass. As in Northern Ireland sampling fractions were the same for both manufacturing and tradable services firms. This was also the first time that tradable services firms from the Republic of Ireland were included in the IIP surveys so there was no need for augmentation of the sample. Details of the number of plants in the population and the tradable services random sample for the Republic of Ireland are given in Table A1.4.

### ***A1.3 Survey Methodology and Response***

The IIP4 questionnaire included a number of new questions that had not been used in previous IIP questionnaires. First time questions related to R&D in other group companies, staff involved in product development, the type of production processes that had been introduced, the location of linkages and an entirely new section on future business strategy. The IIP4 tradable services questionnaire was shorter than that for manufacturing as the section on process development was omitted. Otherwise, it was broadly similar to the manufacturing questionnaire. The manufacturing questionnaire is included as Appendix 2 and the services questionnaire is included as Appendix 3.

As the manufacturing questionnaire was different from previous IIP surveys and the tradable services sector had never been targeted before in the IIP a pilot survey was carried out in Scotland in October 2002. 100 manufacturing companies and 100 tradable services companies were targeted in the pilot. This pilot was carried out to ensure that there were no difficulties in completing the survey and that all questions were understood correctly. As a result of this pilot a few minor changes were made to both questionnaires.

The main IIP4 postal survey was conducted between January 2003 and March 2003 with each plant being sent an initial form and two postal reminders. All non-respondents in the sample were then also contacted by fax in April 2003. In addition, plants which had responded to at least two of the three previous IIP surveys were also contacted by telephone. From the original sample of 3,803 manufacturing companies a total of 920 usable responses were obtained with 378 additional responses or contacts with plants which had closed, were not involved in manufacturing or were out of scope. Adjusting the manufacturing sample by these proportions suggests an overall survey response rate of 34.1 per cent (920 responses). A significant difference was evident, however, between the response rate of 44.3 per cent (443 responses) in Northern Ireland and 29.0 per cent (477 responses) in the Republic of Ireland. Expressing the respondent plants as a proportion of the population suggests that the

**Table A1.3: Republic of Ireland Manufacturing Sample Structure – Number of Plants**

	Plant Size-band			Not Assigned	Total
	10-19	20-99	100+		
Food, Drink and Tobacco	97	252	139	4	492
Textiles, Clothing	47	91	24	1	163
Wood Products	26	54	17	1	98
Paper and Printing	50	122	37	1	210
Chemicals	21	85	62		168
Metals and Fabrication	93	182	33		308
Mechanical Eng.	55	85	28	1	169
Electrical and Optical Equipment	61	157	151	3	372
Transport Equipment	14	43	18		75
Other Manufacturing	140	270	59	4	473
Not Assigned	1	2	1	1	5
<b>Total</b>	<b>605</b>	<b>1343</b>	<b>569</b>	<b>16</b>	<b>2533</b>
<i>Memo Items:</i>					
<i>Population</i>	<i>1083</i>	<i>1576</i>	<i>575</i>		<i>3234</i>
<i>Sampling Proportion</i>	<i>50</i>	<i>75</i>	<i>100</i>		<i>70</i>

**Source:** IIP4

**Table A1.4: Republic of Ireland Services Sample Structure – Number of Plants**

	Plant Size-band			Total
	10-19	20-99	100+	
Financial Intermediation & Post & Telecommunications	161	152	121	434
Computer & Related Activities, R&D and Other Business Services	433	290	145	868
Creative Entertainment	33	45	8	86
Not Assigned	0	0	1	1
<b>Total</b>	<b>627</b>	<b>487</b>	<b>275</b>	<b>1389</b>
<i>Memo Items:</i>				
<i>Population</i>	<i>1254</i>	<i>649</i>	<i>274</i>	<i>2177</i>
<i>Sampling Proportion (%)</i>				

**Source:** IIP4

sample covers 41 per cent of all manufacturing plants in Northern Ireland and 22.8 per cent of all manufacturing plants in the Republic of Ireland. From the original sample of 1959 tradable services companies a total of 430 usable responses were obtained with 111 additional responses or contacts with businesses which had closed, were not involved in tradable services or were out of scope. Adjusting the tradable services sample by these proportions suggests an overall survey response rate of 27.6 per cent (430 responses). There was also a significant difference evident here between a response rate of 34.7 per cent (181 responses) in Northern Ireland and 24.7 per cent (249 responses) in the Republic of Ireland. Expressing the respondent firms as a proportion of the population suggests that the sample covers 18.2 per cent of all tradable services companies in NI and 15.6 per cent of all tradable services companies in the Republic of Ireland.

### ***A1.4 Non Response***

One potentially significant issue in innovation surveys is the possibility that survey respondents are more likely to be innovators than non-respondents. To check the representativeness of the group of respondents, a random sample of non-respondents in Northern Ireland and the Republic of Ireland was contacted by telephone. Plants were asked about the nature of any R&D they undertook and whether they had made any product and process changes since 1999. Table A1.7 and A1.8 summarise the response from IIP4 survey in weighted and unweighted form and the results of the non-response survey. Overall, little difference is evident between the innovative behaviour of respondents and non-respondents suggesting that IIP4 may be regarded as representative.

### ***A1.5 Sample Weights***

The IIP4 survey was based on a structured sample with different sampling proportions for different plant size-bands. Obtaining representative results therefore requires that sample observations be weighted. Weights were specified separately for plant size-bands (i.e. 10-19, 20-99 and 100 plus employees) and for manufacturing plants they were split by ten industrial categories. The categories were combinations of 2-digit groupings from SIC92: Food, Drink and Tobacco, 15,16; Textiles and Clothing, 17, 18, 19; Wood and Wood Products, 20; Paper and Printing, 21, 22; Chemicals, 24; Metals and Metal Fabrication, 27, 28; Mechanical Engineering, 29; Electrical & Optical Equipment, 30, 31, 32, 33; Transport Equipment, 34, 35; Other Manufacturing, 25, 26, 36, 37. Plants were excluded from the survey if they were in Nuclear, Coal, Coke etc, 23. Weights for tradable services companies were also specified separately for plant size-bands but only for two industrial categories. The industrial categories were also combinations of 2-digit groupings from SIC92: Financial Intermediation and Post and Telecommunications, 64, 65, 66, 67 and Computer and related Activities, Research and Development and Other Business Services, 72, 73, 74.

**Table A1.5: Survey Response Rates: Manufacturing**

	Northern Ireland	Republic of Ireland	Total
Sample (no. of plants)	1270	2533	3803
Response	562	736	1298
Of which:			
Out of Scope/Closed (no. of plants)	119	259	378
Usable Responses (no. of plants)	443	477	920
Response Rate (%)	44.3	29.0	34.1
Population Proportion (%)	41.0	22.8	28.2

**Source:** IIP4**Table A1.6: Survey Response Rates: Services**

	Northern Ireland	Republic of Ireland	Total
Sample (no. of plants)	570	1389	1959
Response	198	343	541
Of which:			
Out of Scope/Closed (no. of plants)	17	94	111
Usable Responses (no. of plants)	181	249	430
Response Rate (%)	34.7	24.7	27.6
Population Proportion (%)	18.2	15.6	16.6

**Source:** IIP4

**Table A1.7: Non-Response Analysis of Main Technological Indicators: Manufacturing**

	Northern Ireland			Republic of Ireland		
	PPDS4	PPDS4	Non-Response Check	PPDS4	PPDS4	Non-Response Check
	Weighted	Unweighted		Weighted	Unweighted	
N	435	435	68	469	469	71
Undertaking R&D in plant (%)	36.1	38.2	44.3	44.6	48.6	47.9
R&D Dept in plant (%)	12.3	14.0	21.0	17.9	21.9	30.0
Product changes since 1999 (%)	53.8	55.3	62.9	56.7	61.0	71.8
Average proportion of sales from product changes (%)	46.9	47.5	26	49.2	50.1	22
Process changes since 1999 (%)	50.1	51.8	48.4	53.9	57.7	58.6
Links to other firms (%)	37.1	40.0	29.0	38.3	43.0	49.3

**Source:** IIP4 Non-Response Survey

**Table A1.8: Non-Response Analysis of Main Technological Indicators: Services**

	Northern Ireland			Republic of Ireland		
	PPDS4	PPDS4	Non-Response Check	PPDS4	PPDS4	Non-Response Check
	Weighted	Unweighted		Weighted	Unweighted	
N	171	171	27	239	239	30
Undertaking R&D in plant (%)	30.1	29.2	33.3	34.8	35.1	40.0
R&D Dept in plant (%)	10.0	10.2	22.2	5.6	6.9	23.3
Service & Product changes since 1999 (%)	49.4	48.3	37.0	52.4	55.4	56.7
Average proportion of sales from product changes (%)	44.6	45.4	39.0	43.8	43.0	20.0
Links to other firms (%)	42.3	42.5	29.6	52.8	52.1	26.7

**Source:** IIP4 Non-Response Survey

## **Appendix 2: Manufacturing Questionnaire**



# PRODUCT AND PROCESS DEVELOPMENT INITIATIVE - PHASE FOUR

Northern Ireland Manufacturing - ©2003 NIERC

These are the contact details that we have for your plant. Please amend if necessary.

% of sales

Label Here

Indicate the main type of production undertaken in your plant: (tick relevant box)

One-offs	
Small batches	
Large Batches	
Continuous Production	

Please indicate the percentage growth of this plant since 1999:

	Percentage Growth Since 1999
Employment Growth	%
Sales Growth	%

Please indicate *approximately* what proportion of the people who work in your plant have as their highest qualification:

	% of Workforce
A degree or equivalent qualification	%
A technician level qualification	%
A relevant apprenticeship level qualification:	%
Some relevant vocational qualification	%
No post-school vocational qualification	%

(Note: percentages should sum to 100%)

## 1. Background

Please indicate whether this plant is: (Please tick relevant box)

A single-plant company	
A parent or group HQ	
A subsidiary plant in a group	
Other	

If this plant is a subsidiary, in which country is your group's headquarters located?

Location of Group HQ:

In what year did your plant start production?

Year

Please indicate your average employment during 2001

Employment 2001:

Please indicate approximately what proportion of your sales (by value) were outside the UK and Ireland in 2001

For the 2001 business year please estimate:

The value of your sales turnover	£
The value of materials and fuels purchased	£
Total gross expenditure on wages and salary payments	£
Investment spending on plant, machinery and fixed assets	£

Investment spending on buildings	£
----------------------------------	---

## 2. Research and Development

(Please tick as appropriate)

	Yes	No
Was any R&D undertaken in your plant in 2001?		
Is there a formal R&D department in your plant?		

Please *estimate* how many man-years were spent on R&D in your plant during 2001

Man-years:
------------

*Approximately* what was total R&D expenditure by your plant in 2001 (£000s)?

£000s:
--------

What percentage, if any, of this R&D expenditure was used to buy-in R&D services from other companies or organisations?

%:
----

Does your company own other plants apart from yours?

	Yes	No
Company owns other plants		

**IF NO SKIP TO SECTION 3**

Is R&D relevant to your plant done in other group companies in (tick as appropriate?)

	Yes	No
Northern Ireland		
Republic of Ireland		
Other UK		
Other EU countries		
North America		
Elsewhere		

## 3. Product Developments

Have you introduced ANY new or improved products at this plant since 1999?

	Yes	No
Product Changes since 1999		

**IF NO SKIP TO SECTION 4**

How many products are there in your current product range?

Number of products in range:
------------------------------

How many new or improved products have you introduced since 1999?

Number of new/improved products:
----------------------------------

Please *estimate* the proportion of your current sales (by value) that consist of:

(Note: percentages should add to 100%)

	% of Sales
New products introduced to the market <i>for the first time</i> since 1999 by this plant	%
New products introduced by this plant since 1999 but <i>previously made elsewhere</i>	%
<i>Technically improved</i> products which were being made by this plant in 1999	%
<i>Aesthetically improved</i> products which were being made by this plant in 1999	%
Products which have remained <i>unchanged</i> since 1999	%

Please indicate which groups of staff in your plant would be involved in each of the following elements of the product development process:

	Scient-ists	Engineers	Skilled Production Staff	Design Staff	Marketing or Sales Staff
Identifying new products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Prototype development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Final product design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Product testing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Production engineering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Market research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Developing					

marketing strategy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

#### 4. Process Developments

Have you introduced ANY new or improved production processes at this plant since 1999?

	Yes	No
Process Changes since 1999		

#### IF NO SKIP TO SECTION 5

Please indicate whether the production process changes you introduced were (tick as appropriate):

	Yes	No
New processes introduced by your plant which <i>have not previously been used elsewhere</i>		
New processes which <i>have not previously been used in the UK</i>		
New processes which <i>have not previously been used in your industry</i>		
New processes which <i>have not previously been used in your plant</i>		
Improvements to processes which your plant was already using in 1999		

Please indicate if you now use any of the following production techniques. Also, please indicate the date when they were first introduced:

	Use Now	First Introduced:		
		Before 1996	During 1996-99	Since 1999
Numerically Controlled (NC) or CNC Machinery				
Robotic Equipment				
Automated Materials Handling				
Computer Aided Design (CAD)				
Computer Aided Production Management				
Computer Integrated Manufacturing				
Quality Certification (e.g. ISO 9000)				
Total Quality Management				
Quality Circles				

Just in time	
Investors in People	


#### 5. Links to Other Firms and Organisations

Since 1999 did you have links with any other companies or organisations as part of your product or process development?

	Yes	No
Links with other companies or organisations		

#### IF NO SKIP TO SECTION 6

Which of the following types of company or organisation were these links with and where they were located (tick as many options as necessary)?

	Links With	Location				
		N.I.	ROI	Other UK	Other Europe	Other
Other Group Companies						
Clients/Customers						
Suppliers						
Competitors						
Joint Ventures						
Consultants						
Government Labs						
Universities						
Industry Operated Labs						
Private Research Institutes						

#### 6. Government and EU Assistance

Please indicate whether you have received government support for any of the following since 1999. Tick as applicable but omit support of less than £5,000

	Yes	No
Product development		
Process development		
R&D not related to any specific product or process development		
Purchase of licences to manufacture		
New Plant/Machinery		
Exporting		
Management training in relation to product/process development		
Training for product development techniques		

Training for process development techniques		
Best Practice or Benchmarking		

## 7. Constraints on Product/Process Development

Please indicate if any of the following factors have reduced or hindered product or process development in your plant over the last 3 years: (Please tick relevant boxes)

	Not Important		Very Important		
	1	2	3	4	5
Riskiness of product/process development					
Low rate of return					
Attitudinal barriers in this plant					
Lack of necessary finance					
Few market opportunities					
Lack of information about technologies					
Legislative or regulatory requirements					
Lack of partners					
Lack of technical expertise in this plant					
Lack of managerial expertise in this plant					

## 8. Future Business Strategy

Do you have a formal plan for the development of your business over the next 3 years or more?

	Yes	No
Formal Development Plan		

**IF NO SKIP TO SECTION 9**

Does your development plan include targets for:

	Yes	No
The introduction of new products		
The development of improved products		
Research and development investment		
The introduction of new production processes		

The development of improved processes		
R&D Joint Ventures or partnerships		

How important will the following be in enabling you to achieve your business targets (please tick as appropriate)?

	Not Important		Very Important		
	1	2	3	4	5
Strategy Development & Implementation					
People/Skills Development					
Operational Process Improvement					
Supply Chain Development					
Improving Customer Service					
Improving Marketing					
Improving Productivity/Efficiency					

## 9. E-Business

Do you use the internet for (please tick as appropriate):

	Yes	No
Gathering information		
Purchasing		
Sharing information in-house		
Raising your company profile		
Advertising/marketing		
Selling products on-line		

Do you have a web-site which allows your customers to (please tick as appropriate):

	Yes	No
Obtain an overview of your business		
Obtain details of <i>a selection</i> of your firm's products		
Obtain details of <i>all</i> of your firm's products		
Make contact with your company to obtain further information		
Obtain immediate pricing information for your products on-line		
Compile and place orders on-line		
Provide secure system for on-line payments		
Allows order tracking		

## **Appendix 3: Services Questionnaire**

# NEW SERVICE AND PRODUCT DEVELOPMENT INITIATIVE - PHASE FOUR

*Northern Ireland Tradable Services - ©2003 NIERC*

*These are the contact details that we have for your business. Please amend if necessary.*

Label Here

## 1. Background

Please indicate whether this business is: *(Please tick relevant box)*

A stand-alone company	
A parent or group HQ	
A subsidiary in a group	
Other	

If this business is a subsidiary, in which country is your group's headquarters located?

Location of Group HQ:
-----------------------

In what year did your business start operating? 

Year
------

Please indicate your average employment during 2001

Employment 2001:
------------------

Please indicate approximately what proportion of your sales (by value) were outside the UK and Ireland in 2001

	% of sales
--	------------

Indicate the main type of services/products supplied by your business: *(tick relevant box)*

Services/products customised to individual customers	
Services/products tailored to specific customer groups	
Services/products suitable for large customer groups	
Standardised services/products	

Please indicate the percentage growth of this business since 1999:

	Percentage Growth Since 1999
Employment Growth	%
Sales Growth	%

Please indicate *approximately* what proportion of the people who work in your business have as their highest qualification:

	% of Workforce
A degree or equivalent qualification	%
A technician level qualification	%
A relevant apprenticeship level qualification:	%
Some relevant vocational qualification	%
No post-school vocational qualification	%

*(Note: percentages should sum to 100%)*

For the 2001 business year please estimate:

The value of your sales turnover	£
The value of materials and fuels purchased	£
Total gross expenditure on wages and salary payments	£
Investment spending on business, machinery and fixed assets	£
Investment spending on buildings	£

## 2. Research and Development

(Please tick as appropriate)

Was any R&D undertaken in your business in 2001?

Yes	No

Is there a formal R&D department in your business?

Please *estimate* how many man-years were spent on R&D in your business during 2001

Man-years:

Approximately what was total R&D expenditure by your business in 2001 (£000s)?

£000s:

What percentage, if any, of this R&D expenditure was used to buy-in R&D services from other companies or organisations?

%:

Does your company own other businesses apart from yours?

Company owns other businesses	Yes	No

**IF NO SKIP TO SECTION 3**

Is R&D relevant to your business done in other group companies in (tick as appropriate?)

	Yes	No
Northern Ireland		
Republic of Ireland		
Other UK		
Other EU countries		
North America		
Elsewhere		

## 3. Service and Product Development

Have you introduced ANY new or improved services or products at this business since 1999?

Service/Product Changes since 1999	Yes	No

**IF NO SKIP TO SECTION 4**

Please *estimate* the proportion of your current sales (by value) that consist of:

(Note: percentages should add to 100%)

	% of Sales
New services/products introduced to the market <i>for the first time</i> since 1999 by your business	%
New services/products introduced by this business since 1999 but <i>previously provided by other firms</i>	%
<i>Improved</i> services/products which were being provided by this business in 1999	%
Services/products which have remained <i>unchanged</i> since 1999	%

## 4. Links to Other Firms and Organisations

Since 1999 did you have links with any other companies or organisations as part of your service or product development?

	Yes	No
Links with other companies or organisations		

**IF NO SKIP TO SECTION 5**

Which of the following types of company or organisation were these links with and where they were located (tick as many options as necessary)?

	Links With	Location				
		N.I.	ROI	Other UK	Other Europe	Other
Other Group Companies						
Clients/Customers						
Suppliers						
Competitors						
Joint Ventures						
Consultants						
Government Labs						
Universities						
Industry Operated Labs						
Private Research Institutes						

## 5. Government and EU Assistance

Please indicate whether you have received government support for any of the following since 1999. Tick as applicable but omit support of less than £5,000

	Yes	No
Service or product development		
R&D not related to any specific service or product development		
Exporting		
Management training in relation to service/product development		
Training for service/product development techniques		
Best Practice or Benchmarking		

## 6. Constraints on Service/Product Development

Please indicate if any of the following factors have reduced or hindered service or product development in your business: (Please tick relevant boxes)

	Not Important			Very Important	
	1	2	3	4	5
Riskiness of service/product development					
Low rate of return					
Attitudinal barriers in this business					
Lack of necessary finance					
Few market opportunities					
Lack of information about technologies					
Legislative or regulatory requirements					
Lack of partners					
Lack of technical expertise in this business					
Lack of managerial expertise in this business					

## 7. Future Business Strategy

Do you have a formal plan for the development of your business over the next 3 years or more?

	Yes	No
Formal Development Plan		

**IF NO SKIP TO SECTION 8**

Does your development plan include targets for:

	Yes	No
The introduction of new services/products		
The development of improved services/products		
Research and development investment		
R&D Joint Ventures or partnerships		

How important will the following be in enabling you to achieve your business targets (please tick as appropriate)?

	Not Important			Very Important	
	1	2	3	4	5
Strategy Development & Implementation					
People/Skills Development					
Operational Process Improvement					
Supply Chain Development					
Improving Customer Service					
Improving Marketing					
Improving Productivity/Efficiency					

## 8. E-Business

Do you use the internet for (please tick as appropriate):

	Yes	No
Gathering information		
Purchasing		
Sharing information in-house		
Raising your company profile		
Advertising/marketing		
Selling products on-line		

Do you have a web-site which allows your customers to (please tick as appropriate):

	Yes	No
Obtain an overview of your business		
Obtain details of <i>a selection</i> of your firm's services/products		
Obtain details of <i>all</i> of your firm's services/products		
Make contact with your company to obtain further information		
Obtain immediate pricing information for your services/products on-line		
Compile and place orders on-line		
Provide secure system for on-line payments		
Allows order tracking		



## **Appendix 4: Additional Tabular Material - Manufacturing**

**Table A4.1**  
**Percentage of Businesses Undertaking In-House R&D**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	26.7	31.2	29.8
20-99 employees	37.1	46.8	43.7
100 plus employees	50.3	61.4	58.4
All businesses	35.9	44.7	42.0
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	38.2	55.2	50.0
Textiles and Clothing	56.3	56.0	56.1
Wood and Wood Products	19.9	44.6	37.0
Paper and Printing	16.7	14.1	14.8
Chemicals	47.8	54.6	53.8
Metals and Metal Fabrication	29.6	40.1	36.6
Mechanical Engineering	51.5	51.2	51.2
Electrical and Optical Equipment	48.2	43.3	44.2
Transport Equipment	41.1	26.5	32.1
Other Manufacturing	33.8	53.0	47.0
All businesses	35.9	44.7	42.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	35.5	46.9	43.2
Externally-owned	42.4	37.3	38.6
All businesses	35.9	44.7	42.0

**Table A4.2**  
**Percentage of Businesses with Formal R&D Department**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	4.4	10.7	8.7
20-99 employees	11.4	13.8	13.0
100 plus employees	30.9	42.7	39.4
All businesses	12.2	18.0	16.1
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	16.1	23.4	21.0
Textiles and Clothing	19.4	16.4	18.0
Wood and Wood Products	0.0	10.4	7.3
Paper and Printing	4.3	0.0	1.3
Chemicals	21.3	34.9	33.3
Metals and Metal Fabrication	6.5	9.3	8.4
Mechanical Engineering	9.6	25.4	21.1
Electrical and Optical Equipment	38.8	28.3	30.3
Transport Equipment	18.7	8.8	12.7
Other Manufacturing	8.9	19.1	16.0
All businesses	12.2	18.0	16.1
<b>C. Ownership Analysis</b>			
Indigenously-owned	10.4	16.8	14.6
Externally-owned	22.6	22.6	22.6
All businesses	12.2	18.0	16.1

**Table A4.3**  
**Average number of Man-Years spent on R&D as a proportion of**  
**Employment**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	2.2	1.5	1.7
20-99 employees	1.4	3.0	2.5
100 plus employees	1.2	2.5	2.1
All businesses	1.6	2.5	2.2
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	1.0	1.7	1.5
Textiles and Clothing	1.6	2.1	1.9
Wood and Wood Products	0.9	1.3	1.2
Paper and Printing	0.2	0.5	0.4
Chemicals	3.1	2.4	2.5
Metals and Metal Fabrication	1.4	6.1	4.5
Mechanical Engineering	2.6	4.2	3.8
Electrical and Optical Equipment	8.0	3.6	4.4
Transport Equipment	1.5	1.9	1.7
Other Manufacturing	1.1	1.6	1.4
All businesses	1.6	2.5	2.2
<b>C. Ownership Analysis</b>			
Indigenously-owned	1.8	3.0	2.6
Externally-owned	2.2	1.4	1.6
All businesses	1.6	2.5	2.2

**Table A4.4**  
**Percentage of businesses with new products since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	49.5	40.8	43.6
20-99 employees	52.4	58.5	56.6
100 plus employees	68.2	79.9	76.7
All businesses	53.8	57.0	56.0
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	55.4	65.6	62.4
Textiles and Clothing	69.4	57.9	63.4
Wood and Wood Products	38.9	68.4	59.3
Paper and Printing	49.8	28.3	34.0
Chemicals	80.5	69.9	71.1
Metals and Metal Fabrication	36.7	43.0	40.9
Mechanical Engineering	60.2	64.4	63.3
Electrical and Optical Equipment	62.5	64.1	63.8
Transport Equipment	55.0	73.5	66.3
Other Manufacturing	56.0	62.6	60.5
All businesses	53.8	57.0	56.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	52.0	53.5	53.0
Externally-owned	67.3	67.6	67.5
All businesses	53.8	57.0	56.0

**Table A4.5**  
**Average number of New/Improved Products as a proportion of the**  
**Number of Products in the range**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	47.0	42.2	43.9
20-99 employees	71.1	39.6	48.6
100 plus employees	38.4	32.6	34.2
All businesses	57.6	38.4	44.1
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	30.9	33.5	32.8
Textiles and Clothing	35.9	49.9	43.1
Wood and Wood Products	18.5	18.2	18.3
Paper and Printing	63.6	47.5	54.6
Chemicals	32.0	23.2	24.5
Metals and Metal Fabrication	31.4	45.5	42.3
Mechanical Engineering	50.2	45.6	46.8
Electrical and Optical Equipment	72.0	30.0	38.9
Transport Equipment	50.5	94.4	82.4
Other Manufacturing	32.7	38.1	36.7
All businesses	57.6	38.4	44.1
<b>C. Ownership Analysis</b>			
Indigenously-owned	60.9	38.5	46.0
Externally-owned	41.0	38.2	38.9
All businesses	57.6	38.4	44.1

**Table A4.6**  
**Percentage of businesses with New Processes since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	45.1	37.4	39.9
20-99 employees	47.3	56.2	53.4
100 plus employees	73.8	75.9	75.3
All businesses	50.6	54.1	53.0
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	53.2	51.5	52.0
Textiles and Clothing	57.4	48.8	52.9
Wood and Wood Products	60.3	57.9	58.6
Paper and Printing	50.0	51.5	51.1
Chemicals	52.7	61.3	60.3
Metals and Metal Fabrication	42.4	49.2	46.9
Mechanical Engineering	50.1	53.5	52.6
Electrical and Optical Equipment	46.9	64.5	61.4
Transport Equipment	60.4	73.5	68.4
Other Manufacturing	47.9	53.7	51.9
All businesses	50.6	54.1	53.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	48.4	51.4	50.4
Externally-owned	61.4	60.1	60.5
All businesses	50.6	54.1	53.0

**Table A4.7**  
**Percentage of businesses that have had Links since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	27.4	23.5	24.8
20-99 employees	34.3	39.5	37.9
100 plus employees	67.2	59.4	61.5
All businesses	37.0	38.3	37.9
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	40.5	45.7	44.1
Textiles and Clothing	41.3	26.8	33.6
Wood and Wood Products	17.6	18.4	18.1
Paper and Printing	25.2	29.3	28.2
Chemicals	47.3	52.8	52.1
Metals and Metal Fabrication	20.3	30.9	27.2
Mechanical Engineering	61.0	37.3	43.2
Electrical and Optical Equipment	54.6	50.2	50.9
Transport Equipment	47.1	44.2	45.3
Other Manufacturing	38.4	39.6	39.2
All businesses	37.0	38.3	37.9
<b>C. Ownership Analysis</b>			
Indigenously-owned	34.0	34.8	34.6
Externally-owned	54.3	49.3	50.6
All businesses	37.0	38.3	37.9



**Table A4.8**  
**Percentage of businesses that have had Links with Other Group Companies**  
**since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	24.8	33.3	30.2
20-99 employees	42.9	35.8	37.8
100 plus employees	71.6	64.4	66.6
All businesses	46.4	43.0	44.0
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	48.0	44.3	45.4
Textiles and Clothing	57.8	25.3	44.2
Wood and Wood Products	21.7	13.8	16.2
Paper and Printing	25.2	27.6	27.0
Chemicals	75.7	52.6	55.1
Metals and Metal Fabrication	15.4	40.6	34.6
Mechanical Engineering	40.3	35.2	37.0
Electrical and Optical Equipment	57.6	54.8	55.3
Transport Equipment	100.0	60.0	76.2
Other Manufacturing	29.3	45.6	40.6
All businesses	46.4	43.0	44.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	31.6	25.8	27.7
Externally-owned	87.4	81.1	82.8
All businesses	46.4	43.0	44.0

**Table A4.9**  
**Percentage of businesses that have had Links with Clients since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	60.5	42.7	49.2
20-99 employees	63.0	59.2	60.2
100 plus employees	62.5	57.1	58.7
All businesses	62.3	55.7	57.7
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	61.2	50.6	53.7
Textiles and Clothing	68.2	67.0	67.7
Wood and Wood Products	56.6	56.9	56.8
Paper and Printing	50.3	69.0	64.5
Chemicals	54.2	52.6	52.8
Metals and Metal Fabrication	49.3	44.4	45.6
Mechanical Engineering	79.8	64.2	69.7
Electrical and Optical Equipment	82.2	66.0	69.0
Transport Equipment	36.3	40.0	38.5
Other Manufacturing	52.9	47.0	48.8
All businesses	62.3	55.7	57.7
<b>C. Ownership Analysis</b>			
Indigenously-owned	56.8	56.2	56.4
Externally-owned	74.6	53.0	58.6
All businesses	62.3	55.7	57.7

**Table A4.10**  
**Percentage of businesses that have had Links with Suppliers since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	60.1	70.8	66.9
20-99 employees	67.0	58.8	61.1
100 plus employees	59.4	77.4	71.9
All businesses	63.3	65.9	65.1
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	53.6	57.7	56.5
Textiles and Clothing	87.0	83.5	85.5
Wood and Wood Products	56.6	13.8	26.5
Paper and Printing	66.9	72.4	71.1
Chemicals	47.6	58.9	57.7
Metals and Metal Fabrication	35.3	47.1	44.3
Mechanical Engineering	58.6	61.0	60.2
Electrical and Optical Equipment	75.4	66.8	68.4
Transport Equipment	36.3	80.0	62.3
Other Manufacturing	76.0	79.8	78.6
All businesses	63.3	65.9	65.1
<b>C. Ownership Analysis</b>			
Indigenously-owned	63.0	64.6	64.0
Externally-owned	63.7	72.2	70.0
All businesses	63.3	65.9	65.1

**Table A4.11**  
**Percentage of businesses that have had Links with Competitors**  
**since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	7.9	21.1	16.3
20-99 employees	17.3	23.7	21.9
100 plus employees	14.7	21.4	19.4
All businesses	14.4	22.7	20.2
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	19.4	23.7	22.4
Textiles and Clothing	31.8	16.5	25.4
Wood and Wood Products	0.0	0.0	0.0
Paper and Printing	0.0	31.0	23.6
Chemicals	15.9	11.6	12.0
Metals and Metal Fabrication	15.4	21.6	20.2
Mechanical Engineering	1.6	25.9	17.2
Electrical and Optical Equipment	12.7	20.7	19.2
Transport Equipment	36.3	60.0	50.4
Other Manufacturing	7.3	24.2	19.0
All businesses	14.4	22.7	20.2
<b>C. Ownership Analysis</b>			
Indigenously-owned	13.6	22.8	19.8
Externally-owned	15.0	20.3	18.9
All businesses	14.4	22.7	20.2

**Table A4.12**  
**Percentage of businesses that have had Links with Joint Ventures**  
**since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	8.6	12.6	11.2
20-99 employees	17.6	15.1	15.8
100 plus employees	18.7	15.5	16.5
All businesses	15.8	14.8	15.1
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	21.9	19.2	20.0
Textiles and Clothing	20.1	25.3	22.3
Wood and Wood Products	0.0	0.0	0.0
Paper and Printing	25.2	10.3	13.9
Chemicals	8.4	5.8	6.1
Metals and Metal Fabrication	3.0	18.9	15.1
Mechanical Engineering	10.7	25.9	20.5
Electrical and Optical Equipment	0.0	10.7	8.7
Transport Equipment	28.3	20.0	23.4
Other Manufacturing	8.2	10.8	10.0
All businesses	15.8	14.8	15.1
<b>C. Ownership Analysis</b>			
Indigenously-owned	15.1	17.3	16.6
Externally-owned	21.0	9.1	12.2
All businesses	15.8	14.8	15.1

**Table A4.13**  
**Percentage of businesses that have had Links with Consultants**  
**since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	32.7	12.1	19.7
20-99 employees	43.4	45.8	45.2
100 plus employees	41.3	47.1	45.3
All businesses	40.3	40.2	40.3
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	29.1	38.0	35.4
Textiles and Clothing	49.4	34.0	42.9
Wood and Wood Products	78.3	43.1	53.6
Paper and Printing	41.6	51.7	49.3
Chemicals	24.3	47.4	44.9
Metals and Metal Fabrication	33.9	4.3	11.3
Mechanical Engineering	41.4	61.0	54.1
Electrical and Optical Equipment	51.7	44.1	45.5
Transport Equipment	31.8	80.0	60.4
Other Manufacturing	36.0	35.2	35.4
All businesses	40.3	40.2	40.3
<b>C. Ownership Analysis</b>			
Indigenously-owned	36.6	41.1	39.6
Externally-owned	51.8	38.7	42.1
All businesses	40.3	40.2	40.3

**Table A4.14**  
**Percentage of businesses that have had Links with Government Labs**  
**since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	7.1	0.0	2.6
20-99 employees	13.6	15.8	15.1
100 plus employees	19.3	19.0	19.1
All businesses	13.6	13.9	13.8
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	23.0	20.2	21.0
Textiles and Clothing	13.0	16.5	14.5
Wood and Wood Products	21.7	13.8	16.2
Paper and Printing	8.5	10.3	9.9
Chemicals	15.9	29.0	27.5
Metals and Metal Fabrication	15.4	0.0	3.7
Mechanical Engineering	15.3	20.7	18.7
Electrical and Optical Equipment	13.6	8.7	9.6
Transport Equipment	0.0	20.0	11.9
Other Manufacturing	4.4	8.4	7.2
All businesses	13.6	13.9	13.8
<b>C. Ownership Analysis</b>			
Indigenously-owned	14.0	14.7	14.5
Externally-owned	15.5	11.7	12.7
All businesses	13.6	13.9	13.8

**Table A4.15**  
**Percentage of businesses that have had Links with Universities since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	27.3	12.0	17.6
20-99 employees	33.7	25.4	27.7
100 plus employees	47.6	49.9	49.2
All businesses	36.0	29.6	31.5
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	35.2	34.2	34.5
Textiles and Clothing	31.8	16.5	25.4
Wood and Wood Products	43.4	43.1	43.2
Paper and Printing	33.2	10.3	15.8
Chemicals	29.9	53.7	51.1
Metals and Metal Fabrication	49.3	4.3	15.0
Mechanical Engineering	32.2	13.3	20.3
Electrical and Optical Equipment	32.2	55.4	51.1
Transport Equipment	63.7	20.0	37.7
Other Manufacturing	35.1	23.4	27.0
All businesses	36.0	29.6	31.5
<b>C. Ownership Analysis</b>			
Indigenously-owned	31.8	26.0	27.9
Externally-owned	46.8	35.3	38.4
All businesses	36.0	29.6	31.5



**Table A4.16**  
**Percentage of businesses that have had Links with Industry Operated Labs**  
**since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	10.2	7.6	8.5
20-99 employees	16.4	10.8	12.3
100 plus employees	17.8	29.4	25.9
All businesses	15.3	15.2	15.2
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	19.4	28.1	25.6
Textiles and Clothing	24.7	0.0	14.4
Wood and Wood Products	0.0	13.8	9.7
Paper and Printing	0.0	0.0	
Chemicals	14.1	29.5	27.8
Metals and Metal Fabrication	3.0	6.6	5.7
Mechanical Engineering	9.4	20.7	16.5
Electrical and Optical Equipment	6.8	16.8	14.9
Transport Equipment	0.0	20.0	11.9
Other Manufacturing	24.6	8.4	13.4
All businesses	15.3	15.2	15.2
<b>C. Ownership Analysis</b>			
Indigenously-owned	13.3	10.1	11.1
Externally-owned	24.8	25.3	25.2
All businesses	15.3	15.2	15.2

**Table A4.17**  
**Percentage of businesses that have had Links with Private Research Institutes**  
**since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	18.6	7.6	11.6
20-99 employees	14.8	12.1	12.9
100 plus employees	10.7	18.4	16.1
All businesses	14.6	13.0	13.5
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	29.1	22.3	24.2
Textiles and Clothing	11.7	0.0	6.8
Wood and Wood Products			
Paper and Printing	16.4	0.0	3.9
Chemicals	15.9	23.7	22.8
Metals and Metal Fabrication	15.4	4.3	6.9
Mechanical Engineering	15.3	13.7	14.3
Electrical and Optical Equipment	6.8	18.0	15.9
Transport Equipment			
Other Manufacturing	9.1	12.6	11.5
All businesses	14.6	13.0	13.5
<b>C. Ownership Analysis</b>			
Indigenously-owned	13.8	13.5	13.6
Externally-owned	20.3	13.2	15.1
All businesses	14.6	13.0	13.5

**Table A4.18**  
**Percentage of businesses that have a Formal Development Plan**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	44.1	32.5	36.3
20-99 employees	56.0	65.7	62.7
100 plus employees	73.8	89.6	85.3
All businesses	54.9	60.3	58.6
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	45.3	65.2	59.1
Textiles and Clothing	61.0	45.4	53.0
Wood and Wood Products	40.4	60.4	54.3
Paper and Printing	56.4	56.3	56.3
Chemicals	61.5	72.0	70.8
Metals and Metal Fabrication	59.8	54.7	56.4
Mechanical Engineering	55.8	54.7	55.0
Electrical and Optical Equipment	71.0	60.9	62.7
Transport Equipment	56.7	77.8	68.3
Other Manufacturing	54.8	63.6	60.8
All businesses	54.9	60.3	58.6
<b>C. Ownership Analysis</b>			
Indigenously-owned	52.3	55.1	54.2
Externally-owned	66.4	74.8	72.7
All businesses	54.9	60.3	58.6

**Table A4.19**  
**Government Assistance with Product Development**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	12.2	7.2	8.8
20-99 employees	24.3	20.4	21.6
100 plus employees	25.2	24.6	24.7
All businesses	20.8	17.3	18.3
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	18.0	18.5	18.3
Textiles and Clothing	19.4	15.6	17.3
Wood and Wood Products	18.7	26.3	24.0
Paper and Printing	4.5	6.9	6.2
Chemicals	31.5	24.9	25.7
Metals and Metal Fabrication	16.4	7.0	9.9
Mechanical Engineering	34.5	21.8	24.7
Electrical and Optical Equipment	38.4	23.7	26.5
Transport Equipment	52.9	11.1	29.8
Other Manufacturing	22.4	18.8	19.9
All businesses	20.8	17.3	18.3
<b>C. Ownership Analysis</b>			
Indigenously-owned	20.9	18.5	19.3
Externally-owned	21.8	13.5	15.6
All businesses	20.8	17.3	18.3

**Table A4.20**  
**Government Assistance with Process Development**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	4.5	4.8	4.7
20-99 employees	12.6	12.3	12.3
100 plus employees	24.8	15.5	18.1
All businesses	12.0	10.6	11.0
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	12.5	5.4	7.6
Textiles and Clothing	17.3	2.3	9.0
Wood and Wood Products	18.7	18.4	18.5
Paper and Printing	4.4	10.3	8.7
Chemicals	14.2	18.0	17.6
Metals and Metal Fabrication	11.0	8.8	9.5
Mechanical Engineering	15.3	7.2	9.0
Electrical and Optical Equipment	6.2	17.4	15.3
Transport Equipment	18.7	11.1	14.5
Other Manufacturing	12.1	12.3	12.2
All businesses	12.0	10.6	11.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	11.3	11.2	11.2
Externally-owned	15.9	6.8	9.1
All businesses	12.0	10.6	11.0

**Table A4.21**  
**Government Assistance with R&D**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	7.0	3.6	4.7
20-99 employees	6.3	7.1	6.9
100 plus employees	11.6	11.7	11.6
All businesses	7.3	6.9	7.0
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	10.2	2.9	5.1
Textiles and Clothing	11.9	2.3	6.6
Wood and Wood Products	13.0	31.6	26.2
Paper and Printing	2.2		0.6
Chemicals	20.8	16.1	16.6
Metals and Metal Fabrication	3.4	5.7	5.0
Mechanical Engineering	5.3	5.9	5.8
Electrical and Optical Equipment	3.1	8.4	7.4
Transport Equipment	0.0	11.1	6.1
Other Manufacturing	8.7	5.5	6.5
All businesses	7.3	6.9	7.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	7.9	6.3	6.8
Externally-owned	2.6	8.4	7.0
All businesses	7.3	6.9	7.0

**Table A4.22**  
**Government Assistance with Purchase of Licence to Manufacture**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	0.0	1.1	0.8
20-99 employees	0.7	0.6	0.7
100 plus employees	0.0	1.4	1.0
All businesses	0.4	0.9	0.8
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	0.0	0.0	0.0
Textiles and Clothing	0.0	0.0	0.0
Wood and Wood Products	0.0	0.0	0.0
Paper and Printing	0.0	0.0	0.0
Chemicals	0.0	0.0	0.0
Metals and Metal Fabrication	0.0	1.3	0.9
Mechanical Engineering	0.0	2.5	1.9
Electrical and Optical Equipment	3.1	2.2	2.4
Transport Equipment	0.0	0.0	0.0
Other Manufacturing	0.0	1.7	1.2
All businesses	0.4	0.9	0.8
<b>C. Ownership Analysis</b>			
Indigenously-owned	0.5	0.7	0.6
Externally-owned	0.0	2.0	1.5
All businesses	0.4	0.9	0.8

**Table A4.23**  
**Government Assistance with New Plant/Machinery**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	3.3	6.5	5.5
20-99 employees	17.1	12.3	13.7
100 plus employees	48.8	20.5	28.5
All businesses	17.8	12.0	13.8
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	20.3	14.8	16.5
Textiles and Clothing	29.3	2.4	14.6
Wood and Wood Products	8.1	18.4	15.3
Paper and Printing	13.3	6.9	8.7
Chemicals	27.5	24.9	25.2
Metals and Metal Fabrication	18.4	10.7	13.1
Mechanical Engineering	10.0	4.8	6.0
Electrical and Optical Equipment	33.9	16.9	20.2
Transport Equipment	18.7	0.0	8.4
Other Manufacturing	9.7	13.1	12.0
All businesses	17.8	12.0	13.8
<b>C. Ownership Analysis</b>			
Indigenously-owned	15.9	9.2	11.4
Externally-owned	27.0	21.2	22.7
All businesses	17.8	12.0	13.8



**Table A4.24**  
**Government Assistance with Exporting**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	8.7	2.9	4.7
20-99 employees	19.1	9.4	12.3
100 plus employees	13.5	4.8	7.2
All businesses	15.0	6.7	9.2
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	7.1	7.1	7.1
Textiles and Clothing	19.4	13.6	16.2
Wood and Wood Products	18.7	15.8	16.7
Paper and Printing	4.4	5.8	5.4
Chemicals	14.7	6.1	7.1
Metals and Metal Fabrication	13.0	2.5	5.7
Mechanical Engineering	29.4	4.9	10.3
Electrical and Optical Equipment	31.7	6.6	11.4
Transport Equipment	18.7	0.0	8.4
Other Manufacturing	16.2	7.6	10.3
All businesses	15.0	6.7	9.2
<b>C. Ownership Analysis</b>			
Indigenously-owned	15.5	7.9	10.4
Externally-owned	14.1	2.6	5.5
All businesses	15.0	6.7	9.2

**Table A4.25: Government Assistance with Management Training**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	4.7	6.0	5.6
20-99 employees	14.1	17.4	16.4
100 plus employees	26.1	16.2	18.9
All businesses	13.1	13.9	13.6
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	13.8	14.4	14.2
Textiles and Clothing	18.4	22.3	20.6
Wood and Wood Products	33.3	18.4	22.8
Paper and Printing	6.6	9.2	8.5
Chemicals	6.7	15.5	14.5
Metals and Metal Fabrication	11.0	13.7	12.9
Mechanical Engineering	10.9	10.9	10.9
Electrical and Optical Equipment	17.1	15.4	15.7
Transport Equipment	0.0	11.1	6.1
Other Manufacturing	9.7	13.2	12.1
All businesses	13.1	13.9	13.6
<b>C. Ownership Analysis</b>			
Indigenously-owned	12.0	15.3	14.2
Externally-owned	17.9	9.9	11.9
All businesses	13.1	13.9	13.6

**Table A4.26: Government Assistance with Training for Product Development Techniques**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	1.1	1.1	1.1
20-99 employees	3.3	7.7	6.3
100 plus employees	15.8	9.4	11.2
All businesses	4.6	6.0	5.6
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	3.8	6.8	5.9
Textiles and Clothing	8.7	17.9	13.8
Wood and Wood Products	4.1	10.4	8.6
Paper and Printing	0.0	9.2	6.6
Chemicals	0.0	3.0	2.7
Metals and Metal Fabrication	5.1	1.3	2.4
Mechanical Engineering	2.2	4.8	4.2
Electrical and Optical Equipment	6.9	3.7	4.3
Transport Equipment			
Other Manufacturing	2.5	4.3	3.7
All businesses	4.6	6.0	5.6
<b>C. Ownership Analysis</b>			
Indigenously-owned	3.2	7.1	5.8
Externally-owned	12.3	1.7	4.3
All businesses	4.6	6.0	5.6

**Table A4.27: Government Assistance with Training for Process Development Techniques**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	1.1	1.4	1.3
20-99 employees	1.7	6.7	5.2
100 plus employees	9.3	7.9	8.3
All businesses	2.6	5.3	4.5
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	2.3	5.4	4.4
Textiles and Clothing	2.7	18.1	11.1
Wood and Wood Products	4.1	18.4	14.2
Paper and Printing			
Chemicals	0.0	3.3	2.9
Metals and Metal Fabrication	0.6	2.5	1.9
Mechanical Engineering	1.1	7.3	5.9
Electrical and Optical Equipment	6.9	4.5	5.0
Transport Equipment			
Other Manufacturing	4.0	2.8	3.2
All businesses	2.6	5.3	4.5
<b>C. Ownership Analysis</b>			
Indigenously-owned	2.0	5.8	4.6
Externally-owned	5.5	3.1	3.7
All businesses	2.6	5.3	4.5

**Table A4.28: Government Assistance with Best Practice or Benchmarking**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	3.0	2.9	2.9
20-99 employees	8.3	11.6	10.6
100 plus employees	25.7	6.0	11.5
All businesses	9.3	8.1	8.5
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	4.5	8.8	7.4
Textiles and Clothing	15.2	15.6	15.4
Wood and Wood Products	8.1	10.4	9.8
Paper and Printing	8.9	10.3	9.9
Chemicals	21.7	3.0	5.2
Metals and Metal Fabrication	3.3	10.8	8.5
Mechanical Engineering	10.9	3.6	5.3
Electrical and Optical Equipment	12.9	5.5	7.0
Transport Equipment	0.0	0.0	0.0
Other Manufacturing	10.2	8.3	8.9
All businesses	9.3	8.1	8.5
<b>C. Ownership Analysis</b>			
Indigenously-owned	8.2	9.2	8.9
Externally-owned	13.0	4.3	6.5
All businesses	9.3	8.1	8.5

**Table A4.29**  
**Using the Internet for Gathering Information**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	73.8	77.3	76.1
20-99 employees	78.7	89.7	86.3
100 plus employees	94.3	95.3	95.1
All businesses	79.4	87.1	84.7
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	74.8	80.6	78.8
Textiles and Clothing	79.0	90.5	85.0
Wood and Wood Products	67.9	92.1	84.7
Paper and Printing	68.9	91.9	85.8
Chemicals	92.5	90.6	90.8
Metals and Metal Fabrication	86.0	83.0	84.0
Mechanical Engineering	96.2	93.8	94.4
Electrical and Optical Equipment	100.0	88.6	90.6
Transport Equipment	75.4	79.5	77.9
Other Manufacturing	80.1	85.4	83.7
All businesses	79.4	87.1	84.7
<b>C. Ownership Analysis</b>			
Indigenously-owned	79.5	85.9	83.8
Externally-owned	79.1	88.8	86.4
All businesses	79.4	87.1	84.7

**Table A4.30**  
**Using the Internet for Purchasing**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	37.2	34.8	35.5
20-99 employees	50.6	48.3	49.0
100 plus employees	65.0	63.6	64.0
All businesses	48.5	47.0	47.5
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	42.1	27.8	32.2
Textiles and Clothing	49.9	38.2	43.8
Wood and Wood Products	34.3	20.9	25.0
Paper and Printing	39.7	54.5	50.6
Chemicals	77.8	52.1	55.3
Metals and Metal Fabrication	47.0	66.5	59.9
Mechanical Engineering	55.3	51.0	52.1
Electrical and Optical Equipment	80.4	63.6	66.6
Transport Equipment	58.3	82.3	73.0
Other Manufacturing	49.3	43.9	45.6
All businesses	48.5	47.0	47.5
<b>C. Ownership Analysis</b>			
Indigenously-owned	47.6	41.5	43.5
Externally-owned	54.9	63.4	61.3
All businesses	48.5	47.0	47.5

**Table A4.31**  
**Using the Internet for Sharing Information In-House**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	23.5	29.2	27.4
20-99 employees	37.9	47.5	44.6
100 plus employees	77.2	86.4	83.9
All businesses	39.3	48.9	46.0
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	33.1	48.8	43.9
Textiles and Clothing	47.3	29.0	37.7
Wood and Wood Products	26.7	26.3	26.4
Paper and Printing	31.6	63.7	55.1
Chemicals	80.5	57.0	59.8
Metals and Metal Fabrication	40.7	54.0	49.6
Mechanical Engineering	35.6	49.4	46.0
Electrical and Optical Equipment	58.5	61.0	60.6
Transport Equipment	56.6	55.8	56.1
Other Manufacturing	33.3	37.3	36.0
All businesses	39.3	48.9	46.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	30.3	39.3	36.3
Externally-owned	80.4	78.5	78.9
All businesses	39.3	48.9	46.0



**Table A4.32**  
**Using the Internet for Raising Company Profile**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	48.1	45.6	46.4
20-99 employees	59.5	64.7	63.1
100 plus employees	74.7	70.2	71.4
All businesses	58.2	60.1	59.5
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	41.7	54.5	50.6
Textiles and Clothing	60.1	57.4	58.7
Wood and Wood Products	59.5	52.5	54.7
Paper and Printing	55.4	62.6	60.7
Chemicals	77.0	66.2	67.5
Metals and Metal Fabrication	51.6	69.9	64.0
Mechanical Engineering	69.2	71.6	71.0
Electrical and Optical Equipment	76.8	55.5	59.3
Transport Equipment	79.2	82.3	81.1
Other Manufacturing	63.7	58.7	60.3
All businesses	58.2	60.1	59.5
<b>C. Ownership Analysis</b>			
Indigenously-owned	57.7	58.0	57.9
Externally-owned	61.0	65.4	64.3
All businesses	58.2	60.1	59.5

**Table A4.33**  
**Using the Internet for Advertising/ Marketing**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	45.9	44.3	44.8
20-99 employees	42.2	47.6	45.9
100 plus employees	50.3	57.6	55.6
All businesses	44.5	48.4	47.2
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	27.5	36.9	34.0
Textiles and Clothing	35.4	50.1	43.1
Wood and Wood Products	46.5	36.7	39.7
Paper and Printing	44.7	54.5	52.0
Chemicals	58.8	40.7	42.9
Metals and Metal Fabrication	43.6	62.1	56.0
Mechanical Engineering	48.3	68.0	63.0
Electrical and Optical Equipment	70.1	46.0	50.4
Transport Equipment	50.8	64.7	59.3
Other Manufacturing	56.5	44.5	48.3
All businesses	44.5	48.4	47.2
<b>C. Ownership Analysis</b>			
Indigenously-owned	44.8	46.0	45.6
Externally-owned	46.4	51.9	50.5
All businesses	44.5	48.4	47.2

**Table A4.34**  
**Using the Internet for Selling Products On-Line**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	15.3	12.4	13.3
20-99 employees	13.5	14.8	14.4
100 plus employees	22.3	19.4	20.2
All businesses	15.3	14.9	15.0
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	5.0	8.4	7.3
Textiles and Clothing	21.5	22.5	22.0
Wood and Wood Products	3.8	10.4	8.4
Paper and Printing	36.2	23.2	26.6
Chemicals	32.3	12.5	14.8
Metals and Metal Fabrication	8.9	16.3	13.8
Mechanical Engineering	5.0	15.7	13.1
Electrical and Optical Equipment	13.4	20.7	19.4
Transport Equipment	32.1	20.5	25.0
Other Manufacturing	16.1	9.4	11.5
All businesses	15.3	14.9	15.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	14.1	13.3	13.5
Externally-owned	20.8	18.8	19.3
All businesses	15.3	14.9	15.0

**Table A4.35**  
**Use website to obtain an overview of business**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	54.7	47.0	49.4
20-99 employees	60.5	68.3	65.9
100 plus employees	85.1	83.6	84.0
All businesses	62.4	64.7	64.0
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	48.4	57.1	54.4
Textiles and Clothing	63.2	60.2	61.7
Wood and Wood Products	67.9	68.4	68.2
Paper and Printing	56.4	69.8	66.1
Chemicals	88.5	75.1	76.7
Metals and Metal Fabrication	57.1	67.3	63.9
Mechanical Engineering	71.1	71.6	71.5
Electrical and Optical Equipment	87.1	75.2	77.4
Transport Equipment	92.5	80.6	85.5
Other Manufacturing	65.6	54.7	58.2
All businesses	62.4	64.7	64.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	59.5	59.8	59.7
Externally-owned	80.1	78.3	78.7
All businesses	62.4	64.7	64.0

**Table A4.36**  
**Use website to obtain details of a selection of firm's products**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	51.5	39.2	43.2
20-99 employees	47.9	62.4	57.9
100 plus employees	75.0	70.1	71.5
All businesses	53.1	56.9	55.7
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	42.3	44.2	43.6
Textiles and Clothing	49.3	52.6	51.0
Wood and Wood Products	48.8	57.0	54.4
Paper and Printing	56.3	67.7	64.6
Chemicals	77.8	65.4	66.8
Metals and Metal Fabrication	48.6	64.6	59.5
Mechanical Engineering	58.0	70.4	67.3
Electrical and Optical Equipment	66.4	64.7	65.0
Transport Equipment	65.8	61.2	63.1
Other Manufacturing	59.4	46.6	50.6
All businesses	53.1	56.9	55.7
<b>C. Ownership Analysis</b>			
Indigenously-owned	50.0	52.9	51.9
Externally-owned	70.4	66.9	67.8
All businesses	53.1	56.9	55.7

**Table A4.37**  
**Use website to obtain details of all firm's products**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	24.9	20.0	21.6
20-99 employees	35.3	40.9	39.2
100 plus employees	51.6	42.0	44.6
All businesses	34.5	34.9	34.8
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	20.4	35.7	31.1
Textiles and Clothing	36.5	20.2	28.2
Wood and Wood Products	32.8	28.5	29.9
Paper and Printing	31.9	39.6	37.5
Chemicals	55.5	40.4	42.1
Metals and Metal Fabrication	28.9	36.2	33.9
Mechanical Engineering	38.0	30.4	32.2
Electrical and Optical Equipment	59.0	47.5	49.6
Transport Equipment	70.5	41.9	53.4
Other Manufacturing	36.0	29.1	31.2
All businesses	34.5	34.9	34.8
<b>C. Ownership Analysis</b>			
Indigenously-owned	30.3	30.7	30.6
Externally-owned	58.5	45.6	48.8
All businesses	34.5	34.9	34.8

**Table A4.38**  
**Use website to make contact with company**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	50.5	53.1	52.2
20-99 employees	61.5	69.1	66.8
100 plus employees	79.2	82.3	81.5
All businesses	60.6	66.6	64.8
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	50.3	58.1	55.7
Textiles and Clothing	62.6	69.4	66.0
Wood and Wood Products	69.4	68.4	68.7
Paper and Printing	58.5	70.8	67.5
Chemicals	79.6	72.0	72.9
Metals and Metal Fabrication	58.8	73.5	68.7
Mechanical Engineering	67.2	74.8	72.8
Electrical and Optical Equipment	79.9	70.1	71.9
Transport Equipment	92.5	80.6	85.5
Other Manufacturing	56.5	59.8	58.8
All businesses	60.6	66.6	64.8
<b>C. Ownership Analysis</b>			
Indigenously-owned	58.3	62.4	61.1
Externally-owned	74.1	77.9	76.9
All businesses	60.6	66.6	64.8

**Table A4.39**  
**Use website to obtain immediate pricing information**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	10.2	6.7	7.8
20-99 employees	6.1	11.7	10.0
100 plus employees	16.6	13.8	14.6
All businesses	8.9	10.6	10.1
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	2.6	8.8	6.9
Textiles and Clothing	13.9	21.2	17.5
Wood and Wood Products	3.8	17.2	12.8
Paper and Printing	18.7	18.7	18.7
Chemicals	0.0	9.4	8.4
Metals and Metal Fabrication	6.7	4.4	5.1
Mechanical Engineering	4.6	8.5	7.5
Electrical and Optical Equipment	16.5	18.5	18.1
Transport Equipment	32.1	22.5	26.5
Other Manufacturing	5.9	2.4	3.5
All businesses	8.9	10.6	10.1
<b>C. Ownership Analysis</b>			
Indigenously-owned	7.9	8.8	8.5
Externally-owned	14.2	14.1	14.1
All businesses	8.9	10.6	10.1



**Table A4.40**  
**Use website to compile and place orders online**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	14.0	9.8	11.1
20-99 employees	10.7	13.9	12.9
100 plus employees	24.0	16.6	18.6
All businesses	13.7	13.1	13.3
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	7.8	5.4	6.1
Textiles and Clothing	13.9	14.9	14.4
Wood and Wood Products	3.8	7.9	6.7
Paper and Printing	38.3	29.2	31.6
Chemicals	27.5	16.1	17.3
Metals and Metal Fabrication	12.8	6.9	8.8
Mechanical Engineering	4.6	9.6	8.4
Electrical and Optical Equipment	16.5	18.8	18.4
Transport Equipment	15.0	32.2	25.1
Other Manufacturing	12.9	8.9	10.2
All businesses	13.7	13.1	13.3
<b>C. Ownership Analysis</b>			
Indigenously-owned	13.0	10.6	11.4
Externally-owned	15.2	20.7	19.4
All businesses	13.7	13.1	13.3

**Table A4.41**  
**Use website to provide secure systems for online payments**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	4.7	6.2	5.7
20-99 employees	5.5	9.3	8.1
100 plus employees	13.7	16.0	15.3
All businesses	6.4	9.5	8.6
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	2.6	6.1	5.0
Textiles and Clothing	10.8	17.5	14.2
Wood and Wood Products	0.0	7.9	5.5
Paper and Printing	12.6	15.6	14.8
Chemicals	0.0	12.5	11.1
Metals and Metal Fabrication	6.7	2.0	3.5
Mechanical Engineering	1.0	12.3	9.4
Electrical and Optical Equipment	16.5	13.4	14.0
Transport Equipment	15.0	32.2	25.1
Other Manufacturing	5.5	4.0	4.5
All businesses	6.4	9.5	8.6
<b>C. Ownership Analysis</b>			
Indigenously-owned	6.6	7.2	7.0
Externally-owned	6.3	16.6	14.0
All businesses	6.4	9.5	8.6

**Table A4.42**  
**Use website to allow order tracking**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	5.6	7.9	7.2
20-99 employees	5.0	6.3	5.9
100 plus employees	19.1	18.3	18.5
All businesses	7.3	8.8	8.4
<b>B. Industrial Sector</b>			
Food, Drink and Tobacco	3.7	6.6	5.7
Textiles and Clothing	13.9	9.9	11.9
Wood and Wood Products	0.0	0.0	0.0
Paper and Printing	6.3	14.6	12.3
Chemicals	4.3	6.6	6.4
Metals and Metal Fabrication	3.0	8.5	6.7
Mechanical Engineering	1.0	7.3	5.6
Electrical and Optical Equipment	20.1	16.1	16.8
Transport Equipment	15.0	32.2	25.1
Other Manufacturing	9.6	4.3	6.0
All businesses	7.3	8.8	8.4
<b>C. Ownership Analysis</b>			
Indigenously-owned	7.2	4.9	5.7
Externally-owned	9.6	21.3	18.4
All businesses	7.3	8.8	8.4

## **Appendix 5: Additional Tables – Services**

**Table A5.1**  
**Percentage of Businesses Undertaking In-House R&D**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	24.6	34.0	31.8
20-99 employees	34.2	33.9	34.0
100 plus employees	28.2	42.0	38.3
All businesses	29.0	35.0	33.3
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	29.0	32.7	31.9
Computer & Related Activities, R&D & Other Business Services	31.9	35.8	34.6
All businesses	29.0	35.0	33.3
<b>C. Ownership Analysis</b>			
Indigenously-owned	31.9	32.3	32.2
Externally-owned	27.8	44.6	38.3
All businesses	29.0	35.0	33.3

**Table A5.2**  
**Percentage of Businesses with Formal R&D Department**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	4.7	2.2	2.8
20-99 employees	17.7	6.2	10.4
100 plus employees	3.8	19.9	15.6
All businesses	9.9	5.6	6.9
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	15.5	7.3	9.1
Computer & Related Activities, R&D & Other Business Services	9.1	4.8	6.2
All businesses	9.9	5.6	6.9
<b>C. Ownership Analysis</b>			
Indigenously-owned	9.0	4.8	6.0
Externally-owned	8.9	11.6	10.5
All businesses	9.9	5.6	6.9

**Table A5.3**  
**Average number of Man-Years spent on R&D as a proportion of Employment**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	2.0	3.2	2.9
20-99 employees	9.5	1.7	4.5
100 plus employees	0.9	19.3	14.4
All businesses	5.0	4.8	4.9
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	2.4	2.7	2.7
Computer & Related Activities, R&D & Other Business Services	5.9	5.7	5.8
All businesses	5.0	4.8	4.9
<b>C. Ownership Analysis</b>			
Indigenously-owned	5.6	2.3	3.1
Externally-owned	2.1	2.0	2.0
All businesses	5.0	4.8	4.9

**Table A5.4**  
**Percentage of businesses with new services or products since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	43.2	45.7	45.1
20-99 employees	53.0	55.4	54.6
100 plus employees	55.1	77.9	71.5
All businesses	48.6	52.7	51.5
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	51.8	58.4	57.0
Computer & Related Activities, R&D & Other Business Services	47.9	49.7	49.2
All businesses	48.6	52.7	51.5
<b>C. Ownership Analysis</b>			
Indigenously-owned	43.5	50.1	48.2
Externally-owned	64.2	71.9	69.1
All businesses	48.6	52.7	51.5

**Table A5.5**  
**Percentage of businesses with Links since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	32.6	51.8	47.0
20-99 employees	53.7	50.2	51.5
100 plus employees	46.9	65.5	60.2
All businesses	42.8	53.0	50.1
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	46.6	51.9	50.8
Computer & Related Activities, R&D & Other Business Services	40.7	53.2	49.2
All businesses	42.8	53.0	50.1
<b>C. Ownership Analysis</b>			
Indigenously-owned	40.4	51.3	48.2
Externally-owned	44.3	51.5	48.8
All businesses	42.8	53.0	50.1

**Table A5.6**  
**Percentage of businesses with Links to Other Group Companies since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	32.6	34.3	34.0
20-99 employees	38.8	51.3	46.6
100 plus employees	35.2	48.8	45.8
All businesses	36.0	41.3	40.0
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	48.8	46.7	47.2
Computer & Related Activities, R&D & Other Business Services	36.4	39.0	38.3
All businesses	36.0	41.3	40.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	28.6	36.3	34.5
Externally-owned	65.2	66.8	66.2
All businesses	36.0	41.3	40.0

**Table A5.7**  
**Percentage of businesses with Links to Clients since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	39.2	34.8	35.6
20-99 employees	47.3	39.8	42.6
100 plus employees	42.3	46.4	45.5
All businesses	43.7	38.0	39.4
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	48.7	43.1	44.3
Computer & Related Activities, R&D & Other Business Services	44.5	35.8	38.1
All businesses	43.7	38.0	39.4
<b>C. Ownership Analysis</b>			
Indigenously-owned	40.0	36.8	37.6
Externally-owned	49.2	34.6	39.5
All businesses	43.7	38.0	39.4

**Table A5.8**  
**Percentage of businesses with Links to Suppliers since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	32.6	30.5	30.9
20-99 employees	42.6	40.0	41.0
100 plus employees	50.7	41.7	43.7
All businesses	40.0	34.9	36.2
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	63.2	52.0	54.4
Computer & Related Activities, R&D & Other Business Services	31.7	27.5	28.6
All businesses	40.0	34.9	36.2
<b>C. Ownership Analysis</b>			
Indigenously-owned	41.7	35.1	36.6
Externally-owned	43.2	36.2	38.5
All businesses	40.0	34.9	36.2



**Table A5.9**  
**Percentage of businesses with Links to Competitors since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	16.1	20.2	19.5
20-99 employees	15.9	19.8	18.4
100 plus employees	13.9	29.4	26.0
All businesses	15.7	21.5	20.1
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	16.2	23.1	21.7
Computer & Related Activities, R&D & Other Business Services	15.9	20.8	19.5
All businesses	15.7	21.5	20.1
<b>C. Ownership Analysis</b>			
Indigenously-owned	19.0	23.5	22.4
Externally-owned	11.2	17.5	15.4
All businesses	15.7	21.5	20.1

**Table A5.10**  
**Percentage of businesses with Links to Joint Ventures since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	31.0	29.6	29.8
20-99 employees	39.7	23.1	29.3
100 plus employees	14.1	44.6	37.8
All businesses	33.1	30.1	30.9
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	30.5	10.0	14.2
Computer & Related Activities, R&D & Other Business Services	34.4	38.8	37.6
All businesses	33.1	30.1	30.9
<b>C. Ownership Analysis</b>			
Indigenously-owned	43.3	37.4	38.8
Externally-owned	12.7	7.2	9.1
All businesses	33.1	30.1	30.9

**Table A5.11**  
**Percentage of businesses with Links to Consultants since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	44.6	34.7	36.5
20-99 employees	31.3	37.4	35.1
100 plus employees	14.1	32.2	28.2
All businesses	33.9	35.1	34.8
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	30.7	15.9	19.0
Computer & Related Activities, R&D & Other Business Services	35.3	43.4	41.2
All businesses	33.9	35.1	34.8
<b>C. Ownership Analysis</b>			
Indigenously-owned	37.1	34.4	35.1
Externally-owned	15.9	37.5	30.2
All businesses	33.9	35.1	34.8

**Table A5.12**  
**Percentage of businesses with Links to Government Labs since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	0.0	6.9	5.6
20-99 employees	10.5	2.9	5.8
100 plus employees	0.0	7.6	5.9
All businesses	5.3	5.9	5.7
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	6.2	0.0	1.3
Computer & Related Activities, R&D & Other Business Services	5.1	8.4	7.5
All businesses	5.3	5.9	5.7
<b>C. Ownership Analysis</b>			
Indigenously-owned	5.5	3.7	4.1
Externally-owned	6.8	0.0	2.3
All businesses	5.3	5.9	5.7

**Table A5.13**  
**Percentage of businesses with Links to Universities since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	10.8	15.9	15.0
20-99 employees	20.6	17.4	18.6
100 plus employees	21.1	18.5	19.1
All businesses	17.1	16.7	16.8
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	11.8	5.7	7.0
Computer & Related Activities, R&D & Other Business Services	21.0	21.5	21.3
All businesses	17.1	16.7	16.8
<b>C. Ownership Analysis</b>			
Indigenously-owned	17.8	17.8	17.8
Externally-owned	17.1	9.3	11.9
All businesses	17.1	16.7	16.8

**Table A5.14**  
**Percentage of businesses with Links to Industry Operated Labs since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	0.0	3.9	3.2
20-99 employees	5.4	5.8	5.7
100 plus employees	0.0	7.6	5.9
All businesses	2.7	5.0	4.4
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	6.2	4.0	4.5
Computer & Related Activities, R&D & Other Business Services	1.7	5.4	4.4
All businesses	2.7	5.0	4.4
<b>C. Ownership Analysis</b>			
Indigenously-owned	1.8	4.8	4.1
Externally-owned	6.8	5.7	6.0
All businesses	2.7	5.0	4.4

**Table A5.15**  
**Percentage of businesses with Links to Private Research Institutes since 1999**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	0.0	8.6	7.1
20-99 employees	0.0	14.5	9.0
100 plus employees	0.0	18.5	14.4
All businesses	0.0	11.8	8.8
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	0.0	1.7	2.5
Computer & Related Activities, R&D & Other Business Services	0.0	16.1	11.9
All businesses	0.0	11.8	8.8
<b>C. Ownership Analysis</b>			
Indigenously-owned	0.0	10.5	8.0
Externally-owned	0.0	5.7	3.8
All businesses	0.0	11.8	8.8

**Table A5.16**  
**Percentage of businesses with a Formal Business Plan**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	61.8	57.0	58.2
20-99 employees	50.4	66.0	60.5
100 plus employees	63.2	91.5	83.9
All businesses	57.4	64.2	62.3
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	62.9	67.8	66.7
Computer & Related Activities, R&D & Other Business Services	56.8	62.3	60.6
All businesses	57.4	64.2	62.3
<b>C. Ownership Analysis</b>			
Indigenously-owned	52.7	60.2	58.2
Externally-owned	79.7	88.0	84.9
All businesses	57.4	64.2	62.3

**Table A5.17**  
**Government Assistance with Service or Product Development**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	11.9	5.7	7.3
20-99 employees	20.2	2.9	8.9
100 plus employees	9.9	7.3	8.0
All businesses	14.9	5.1	7.9
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	8.2	2.1	3.5
Computer & Related Activities, R&D & Other Business Services	18.0	6.4	10.1
All businesses	14.9	5.1	7.9
<b>C. Ownership Analysis</b>			
Indigenously-owned	16.8	4.9	8.2
Externally-owned	7.9		3.0
All businesses	14.9	5.1	7.9

**Table A5.18**  
**Government Assistance with R&D**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	1.3	1.9	1.7
20-99 employees	5.8	1.5	3.0
100 plus employees	0.0	4.8	3.5
All businesses	2.9	2.1	2.4
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	2.9	0.0	0.7
Computer & Related Activities, R&D & Other Business Services	2.8	3.1	3.0
All businesses	2.9	2.1	2.4
<b>C. Ownership Analysis</b>			
Indigenously-owned	3.1	1.6	2.0
Externally-owned	0.0	0.0	0.0
All businesses	2.9	2.1	2.4

**Table A5.19  
Government Assistance with Exporting**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	7.0	3.9	4.7
20-99 employees	16.1	1.4	6.6
100 plus employees	7.4	2.4	3.8
All businesses	10.6	3.0	5.2
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	5.5	3.5	3.9
Computer & Related Activities, R&D & Other Business Services	12.0	2.7	5.7
All businesses	10.6	3.0	5.2
<b>C. Ownership Analysis</b>			
Indigenously-owned	13.2	3.2	6.0
Externally-owned	1.9	3.0	2.6
All businesses	10.6	3.0	5.2

**Table A5.20  
Government Assistance with Management Training**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	7.0	3.9	4.7
20-99 employees	17.9	4.4	9.2
100 plus employees	6.6	2.4	3.6
All businesses	11.2	3.9	6.0
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	5.5	3.5	4.0
Computer & Related Activities, R&D & Other Business Services	12.5	4.0	6.7
All businesses	11.2	3.9	6.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	11.7	3.2	5.6
Externally-owned	9.8	3.1	5.8
All businesses	11.2	3.9	6.0

**Table A5.21**  
**Government Assistance with Training for Service/Product Development Techniques**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	10.5	2.7	4.8
20-99 employees	10.3	5.9	7.4
100 plus employees	6.5	2.4	3.6
All businesses	9.9	3.6	5.5
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	4.4	1.4	2.1
Computer & Related Activities, R&D & Other Business Services	12.1	4.6	7.0
All businesses	9.9	3.6	5.5
<b>C. Ownership Analysis</b>			
Indigenously-owned	8.9	4.5	5.7
Externally-owned	13.8	0.0	5.5
All businesses	9.9	3.6	5.5

**Table A5.22**  
**Government Assistance with Best Practice or Benchmarking**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	1.8	0.0	0.5
20-99 employees	8.9	1.5	4.1
100 plus employees	3.3	0.0	0.9
All businesses	4.7	0.4	1.7
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	2.9	0.0	0.7
Computer & Related Activities, R&D & Other Business Services	5.2	0.6	2.1
All businesses	4.7	0.4	1.7
<b>C. Ownership Analysis</b>			
Indigenously-owned	5.7	0.6	2.0
Externally-owned	1.9	0.0	0.8
All businesses	4.7	0.4	1.7

**Table A5.23**  
**Using the Internet for Gathering Information**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	93.4	87.9	89.3
20-99 employees	94.0	98.6	97.0
100 plus employees	92.9	100.0	98.2
All businesses	93.6	92.6	92.9
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications Computer & Related Activities, R&D & Other Business Services	94.2	88.7	89.9
All businesses	94.3	94.3	94.3
	93.6	92.6	92.9
<b>C. Ownership Analysis</b>			
Indigenously-owned	91.8	92.2	92.1
Externally-owned	98.1	97.3	97.6
All businesses	93.6	92.6	92.9

**Table A5.24**  
**Using the Internet for Purchasing**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	67.5	43.8	49.6
20-99 employees	65.9	41.7	50.3
100 plus employees	72.0	48.7	54.6
All businesses	67.4	43.9	50.5
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications Computer & Related Activities, R&D & Other Business Services	62.3	35.8	41.6
All businesses	67.6	47.8	53.9
	67.4	43.9	50.5
<b>C. Ownership Analysis</b>			
Indigenously-owned	68.3	45.6	51.8
Externally-owned	71.0	42.1	52.6
All businesses	67.4	43.9	50.5



**Table A5.25**  
**Using the Internet for Sharing Information In-House**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	70.1	58.8	61.5
20-99 employees	83.1	71.4	75.6
100 plus employees	81.5	79.0	79.7
All businesses	76.8	65.1	68.4
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	85.9	58.0	63.8
Computer & Related Activities, R&D & Other Business Services	74.4	68.0	70.0
All businesses	76.8	65.1	68.4
<b>C. Ownership Analysis</b>			
Indigenously-owned	70.6	61.0	63.6
Externally-owned	93.6	81.8	86.2
All businesses	76.8	65.1	68.4

**Table A5.26**  
**Using the Internet for Raising Company Profile**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	0.0	8.6	7.1
20-99 employees	0.0	14.5	9.0
100 plus employees	0.0	18.5	14.4
All businesses	0.0	11.8	8.8
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	0.0	1.7	2.5
Computer & Related Activities, R&D & Other Business Services	0.0	16.1	11.9
All businesses	0.0	11.8	8.8
<b>C. Ownership Analysis</b>			
Indigenously-owned	0.0	10.5	8.0
Externally-owned	0.0	5.7	3.8
All businesses	0.0	11.8	8.8

**TableA 5.27**  
**Using the Internet for Advertising/ Marketing**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	81.3	65.2	69.1
20-99 employees	77.1	84.4	81.8
100 plus employees	78.7	87.5	85.3
All businesses	79.3	73.7	75.3
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	86.4	78.3	80.0
Computer & Related Activities, R&D & Other Business Services	78.3	71.1	73.4
All businesses	79.3	73.7	75.3
<b>C. Ownership Analysis</b>			
Indigenously-owned	73.7	70.5	71.4
Externally-owned	94.4	90.9	92.2
All businesses	79.3	73.7	75.3

**Table A5.28**  
**Using the Internet for Selling Products On-Line**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	58.6	48.2	50.7
20-99 employees	72.8	61.4	65.5
100 plus employees	68.5	74.5	72.9
All businesses	65.6	55.5	58.3
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	71.1	63.8	65.3
Computer & Related Activities, R&D & Other Business Services	64.3	51.3	55.4
All businesses	65.6	55.5	58.3
<b>C. Ownership Analysis</b>			
Indigenously-owned	60.7	53.0	55.1
Externally-owned	78.5	64.1	69.4
All businesses	65.6	55.5	58.3

**Table A5.29**  
Use website to obtain an overview of business

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	18.1	13.8	14.9
20-99 employees	25.3	9.9	15.4
100 plus employees	31.2	39.1	37.1
All businesses	22.6	16.1	17.9
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	49.5	27.3	32.1
Computer & Related Activities, R&D & Other Business Services	14.7	10.9	12.1
All businesses	22.6	16.1	17.9
<b>C. Ownership Analysis</b>			
Indigenously-owned	17.1	14.1	14.9
Externally-owned	39.5	22.4	28.8
All businesses	22.6	16.1	17.9

**Table A5.30**  
Use website to obtain details of a selection of firm's products

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	72.2	60.2	63.2
20-99 employees	72.4	72.5	72.5
100 plus employees	96.7	89.5	91.4
All businesses	75.4	67.9	70.0
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	88.6	70.2	74.3
Computer & Related Activities, R&D & Other Business Services	71.8	67.0	68.5
All businesses	75.4	67.9	70.0
<b>C. Ownership Analysis</b>			
Indigenously-owned	67.4	64.9	65.6
Externally-owned	97.4	79.0	85.9
All businesses	75.4	67.9	70.0

**Table A5.31**  
Use website to obtain details of all firm's products

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	55.5	47.0	49.1
20-99 employees	63.8	56.4	59.0
100 plus employees	65.5	77.7	74.4
All businesses	60.1	53.8	55.6
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	52.2	61.1	59.2
Computer & Related Activities, R&D & Other Business Services	62.6	50.7	54.5
All businesses	60.1	53.8	55.6
<b>C. Ownership Analysis</b>			
Indigenously-owned	57.7	51.7	53.3
Externally-owned	62.4	57.0	59.0
All businesses	60.1	53.8	55.6

**Table A5.32**  
Use website to make contact with company

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	77.6	61.6	65.6
20-99 employees	81.0	82.8	82.1
100 plus employees	93.5	91.9	92.3
All businesses	80.9	71.9	74.5
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	89.4	78.8	81.1
Computer & Related Activities, R&D & Other Business Services	79.5	68.9	72.3
All businesses	80.9	71.9	74.5
<b>C. Ownership Analysis</b>			
Indigenously-owned	76.5	68.5	70.8
Externally-owned	94.3	85.7	88.9
All businesses	80.9	71.9	74.5

**Table A5.33**  
Use website to obtain immediate pricing information

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	8.7	9.9	9.6
20-99 employees	8.9	8.4	8.6
100 plus employees	23.3	31.9	29.6
All businesses	10.6	12.4	11.9
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	26.6	21.6	22.6
Computer & Related Activities, R&D & Other Business Services	6.9	8.0	7.7
All businesses	10.6	12.4	11.9
<b>C. Ownership Analysis</b>			
Indigenously-owned	6.4	10.3	9.2
Externally-owned	22.0	15.7	18.0
All businesses	10.6	12.4	11.9

**Table A5.34**  
Use website to compile and place orders online

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	10.5	9.9	10.1
20-99 employees	8.9	2.8	4.9
100 plus employees	16.7	20.8	19.7
All businesses	10.7	9.3	9.7
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	23.5	17.4	18.6
Computer & Related Activities, R&D & Other Business Services	8.0	5.4	6.2
All businesses	10.7	9.3	9.7
<b>C. Ownership Analysis</b>			
Indigenously-owned	8.7	9.1	9.0
Externally-owned	22.0	10.4	14.6
All businesses	10.7	9.3	9.7

**Table A5.35**  
**Use website to provide secure systems for online payments**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	8.6	8.8	8.8
20-99 employees	3.1	7.0	5.6
100 plus employees	16.7	13.0	14.0
All businesses	7.4	8.9	8.5
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	23.2	12.4	14.6
Computer & Related Activities, R&D & Other Business Services	4.6	7.2	6.4
All businesses	7.4	8.9	8.5
<b>C. Ownership Analysis</b>			
Indigenously-owned	5.1	6.3	6.0
Externally-owned	19.4	19.4	19.4
All businesses	7.4	8.9	8.5

**Table A5.36**  
**Use website to allow order tracking**

	Northern Ireland	Republic of Ireland	Total
<b>A. Business Size</b>			
10-19 employees	4.8	4.1	4.3
20-99 employees	4.5	2.8	3.4
100 plus employees	10.1	8.1	8.6
All businesses	5.3	4.3	4.6
<b>B. Industrial Sector</b>			
Financial Intermediation, Post & Telecommunications	13.9	8.7	9.7
Computer & Related Activities, R&D & Other Business Services	3.1	2.1	2.4
All businesses	5.3	4.3	4.6
<b>C. Ownership Analysis</b>			
Indigenously-owned	4.7	2.4	3.0
Externally-owned	8.4	11.7	10.5
All businesses	5.3	4.3	4.6



**References:**

Cooke, P., M. G. Uranga, and G. Etxebarria (1998) Regional systems of innovation: an evolutionary perspective, *Environment and Planning A*, 30, 1563-1584.

DETI, (2002) A Consultation Paper on A Regional Innovation Strategy for Northern Ireland, Department of Enterprise Trade and Investment on behalf of the InterDepartmental Working Group, DETI, Belfast.

Lundvall, B.-Å. (1988) Innovation as an interactive process: from user-producer interaction to the national system of innovation, in: G. Dosi, C. Freeman, R.R. Nelson, G. Silverberg and L. Soete (Editors), *Technical Change and Economic Theory* (Pinter, London), pp. 349-369

OECD (2002) *Future Directions of Innovation Policy in Europe*, Innovation Papers No. 31, Innovation Directorate of the Enterprise Directorate-General, Brussels

Robertson, M., Swan, J. and Newell, S. (1996) The Role of Networks in the Diffusion of Technological Innovation, *Journal of Management Studies*, Vol.33, No.3, pp.333-359