Forfás

Research & Development Performance in the Business Sector Ireland 2005/6

Science and Technology Indicators Unit

THE NATIONAL POLICY AND ADVISORY BOARD FOR ENTERPRISE, TRADE, SCIENCE, TECHNOLOGY AND INNOVATION

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Science and Technology Indicators Unit

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Foreword

This report examines data and provides analysis on Research and Development activities performed across the business sector in Ireland in 2005 and 2006. It focuses on business sector spending on R&D performed, levels of human resources dedicated to R&D activities, and other performance variables including collaboration activities, and types and aims of R&D conducted. It can be used alongside other data gathered from R&D surveys conducted by Forfás of the Government and higher education sectors, to examine the total R&D performance across the Irish economy.

Data published and analysed in the report has been gathered from a large-scale survey of the business sector of R&D activity. The survey, "Business Expenditure on Research & Development" (BERD survey), continues a series of biennial surveys carried out by Forfás over the past two decades. The most recent survey was carried out in the period May to October 2006, with the reference year for data collected being the calendar year 2005, with estimates for 2006 also collected.

A more detailed methodological note on operational procedures including sampling, fieldwork procedures, re-weighting and analysis of the data is included in Appendix 1 of this report. It should be noted that the data gathered from this survey of business R&D activities adheres to the strict international rules and definitions laid down by the OECD and Eurostat and published in the "Frascati Manual". This ensures that the data and analyses in this Irish survey of business R&D activities are internationally comparable, and can be used for performance benchmarking.

Forfás would like to thank the many R&D performing firms across the Irish economy that assisted in the completion of this survey by answering the detailed questionnaires. The strong response rate achieved from businesses to the survey will allow rapid and accurate analysis to take place, paving the way for policymakers to respond to the needs of the business sector regarding the promotion of higher levels of R&D activity over the coming years. This is particularly relevant in the context of the BERD targets set out by the Government in the Strategy for Science, Technology & Innovation, launched in June 2006.

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Introduction

The Government's recently launched Strategy for Science, Technology and Innovation 2006-2013[1] outlined the importance that research and innovation activities will have in shaping our future economic and social progress. High levels of investment in these areas will help sustain future competitiveness performance, and facilitate economic growth and improved quality of life.

Governments have several roles in facilitating improved R&D performance in the business sector. As well as being a financial supporter of some R&D activities performed in the business sector to address market failures, they have a strong role in promoting a positive R&D environment for businesses. This includes supporting R&D infrastructure, promoting R&D education, training and skills development, facilitating international collaboration and creating a strong and supportive regulatory framework. As well as creating a positive R&D environment for Irish-owned firms, policy in a more globalised and competitive world must also be geared to improving the attractiveness of the country as a location to perform R&D activities by foreign-owned firms.

Specifically, improving Irish R&D performance will be one of the key drivers in attempts to further transform the economy to be a more competitive, dynamic and knowledge-driven economy. The business sector, being the largest performer of R&D in the economy at two-thirds of the total, will play a key role in this regard. Improved R&D performance in the business sector will result in the transformation of new and existing knowledge into innovative, higher value added and productive commercial activities.

This report focuses on the performance of R&D activities in the Irish economy in 2005 and 2006[2]. It includes all the R&D activities performed within the boundaries of the Irish State, but excludes the R&D activities of Irish firms carried out overseas. Data is gathered by a survey of R&D performers using the strict international rules and guidelines laid out in the OECD Frascati Manual.[3]

In particular, it should be noted that Business R&D activity is only measured where it is deemed as "Creative work undertaken on a systematic basis in order to create new or improved products, services or other applications". These R&D activities are therefore distinguishable from other non R&D business activities by the presence of an appreciable element of novelty and by the resolution of problems and uncertainties using scientific or technological means. Activities such as routine software development, routine monitoring and analysis or pre-production preparation which have no novelty or problem resolution are therefore excluded.

In this regard the survey is the definitive source of internationally comparable R&D performance. Data and analysis from this report is therefore crucial in measuring the trends and performance in achieving success in the goals of increasing R&D investment by the business sector, boosting overall R&D spending and driving forward productivity and economic gains in the future.

1 *http://www.entemp.ie/publications/science/2006/sciencestrategy.pdf*

2 *All 2006 figures are estimates*

3 *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development OECD, 2002*

Executive Summary

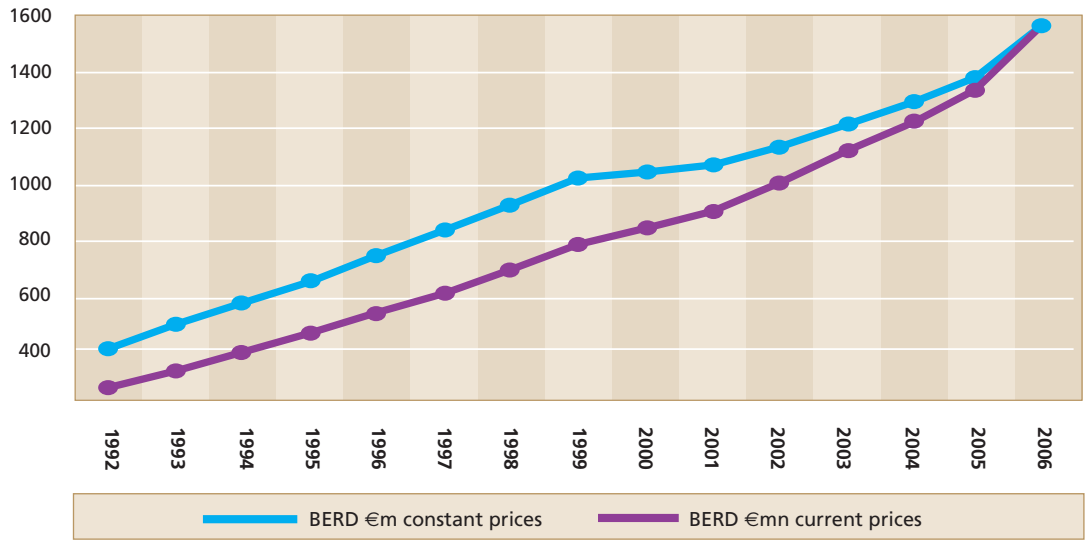
The Business Expenditure on Research and Development (BERD) report 2005/2006 examines research and development (R&D) spending and performance in the business sector in Ireland for 2005, with estimated results for 2006.

The key survey results from R&D performance in the business sector are:

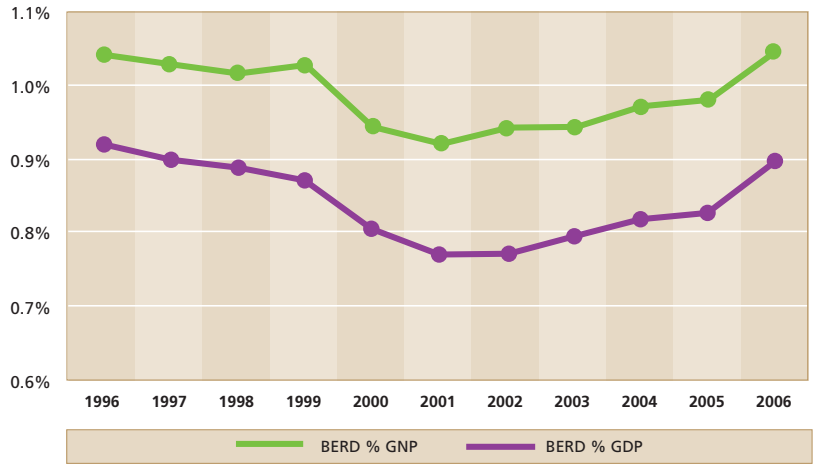
Spending

- Research & development expenditure performed by the business sector in Ireland rose to €1.33 billion in 2005. This represented an annual average increase of 9.7% between 2003 and 2005.
- Preliminary estimates for business R&D spending in 2006 indicate a further strong climb, with R&D expenditure growth expected to quicken to 17.3% to stand at an estimated €1.56 billion.
- Business R&D spending as a ratio of economic activity (Gross National Product) increased from 0.94% of GNP in 2003 to 0.98% in 2005. This ratio is expected to climb further in 2006 to 1.05% of GNP.
- Strong increases in business R&D spending and the level of BERD intensity has allowed for a narrowing of the gap between Ireland and the EU/OECD averages, which stood at 1.14% and 1.54% of GDP respectively in 2005.
- R&D spending in real terms in the business sector has nearly tripled in the last decade.

Business R&D spending in Ireland (1992-2006) €million

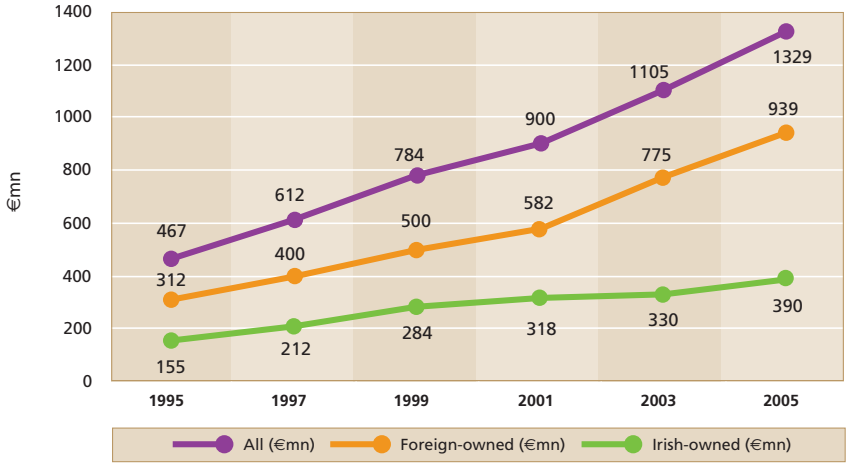


BERD intensity as a percentage of economic activity (1996-2006)



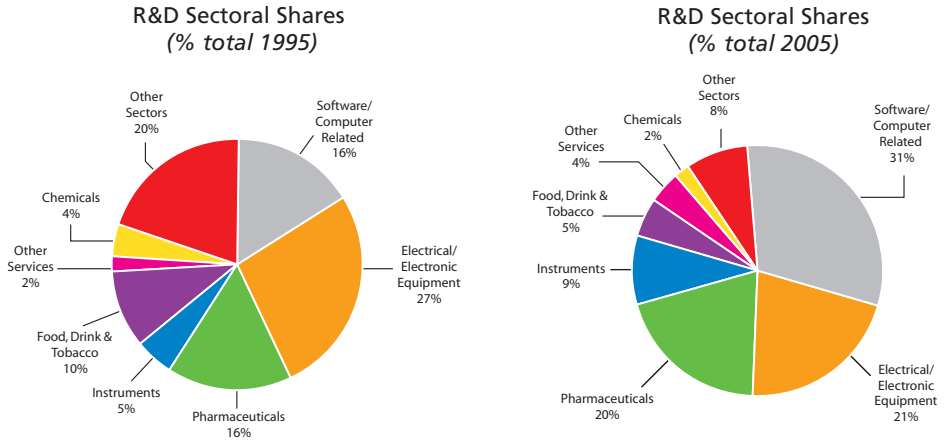
- R&D expenditure by foreign-owned firms rose to €939 million in 2005, with spending by Irish-owned firms increasing to €390 million. Spending growth of 10% per annum in foreign-owned firms slightly outpaced the overall 9% annual average increase for Irish-owned firms.

R&D spending in the business sector by ownership €million (1995–2005)



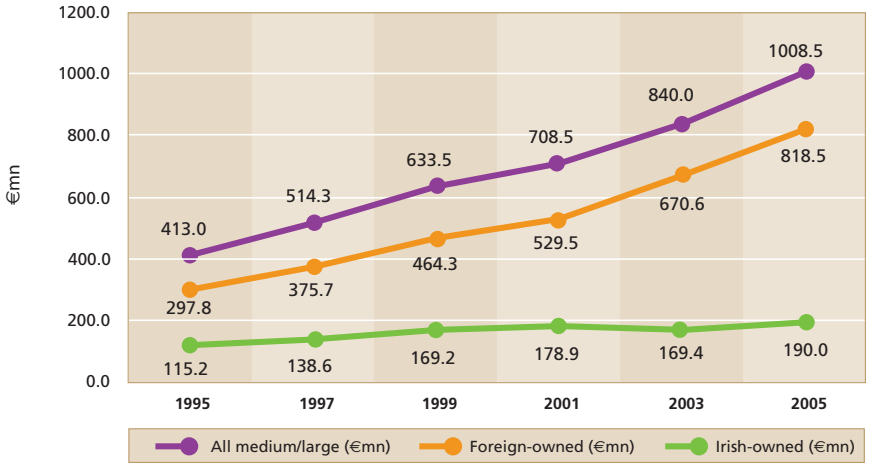
- The largest performing sector for business R&D in Ireland continued to be the Software/Computer Related areas accounting for 30.4% of all R&D investments in 2005. However, R&D spending growth in this sector was a relatively sluggish 6.8% between 2003 and 2005.
- R&D performed by business in the Irish Pharmaceuticals sector increased by 40.4% between 2003 and 2005. This sector now accounts for 20.1% of total business R&D.
- The Dublin region was the location for 41.2% of all business R&D performance in 2005, with the BMW accounting for 25.7% of the total and the rest of the country accounting for the remaining 33.1% of the total.

R&D sectoral share of total expenditure 1995 and 2005

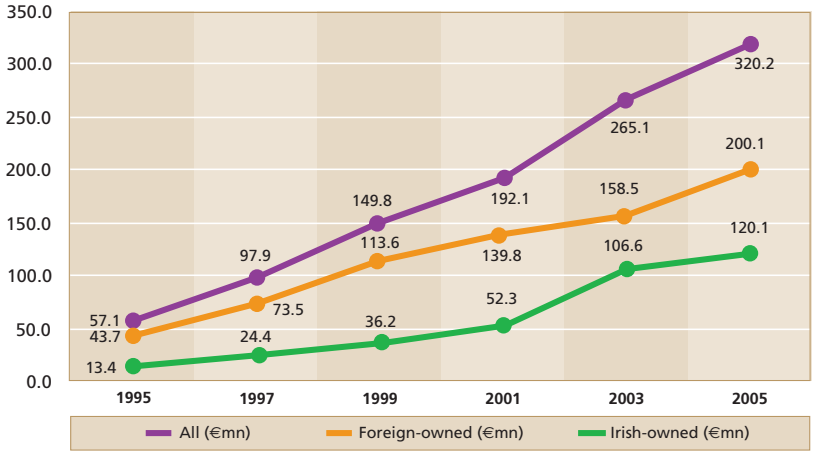


- R&D spending by medium/large sized firms (>50 employees) rose by 9.6% per annum on average between 2003 and 2005. Expenditure is expected to increase by a high of 19% between 2005 and 2006.
- Small firm R&D expenditure (<50 employees) climbed by 9.9% on average per annum between 2003 and 2005. Spending by small firms is anticipated to increase by 12.4% between 2005 and 2006.

Medium/large firms BERDs by ownership (1995-2005) €m



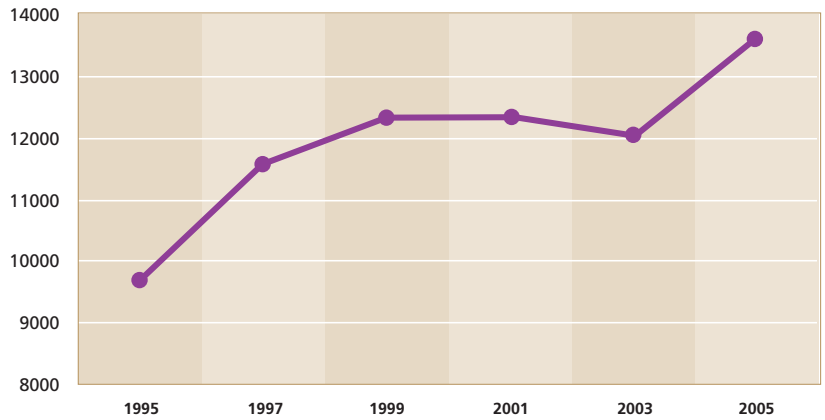
Small firms BERD spending (1995-2005) €m



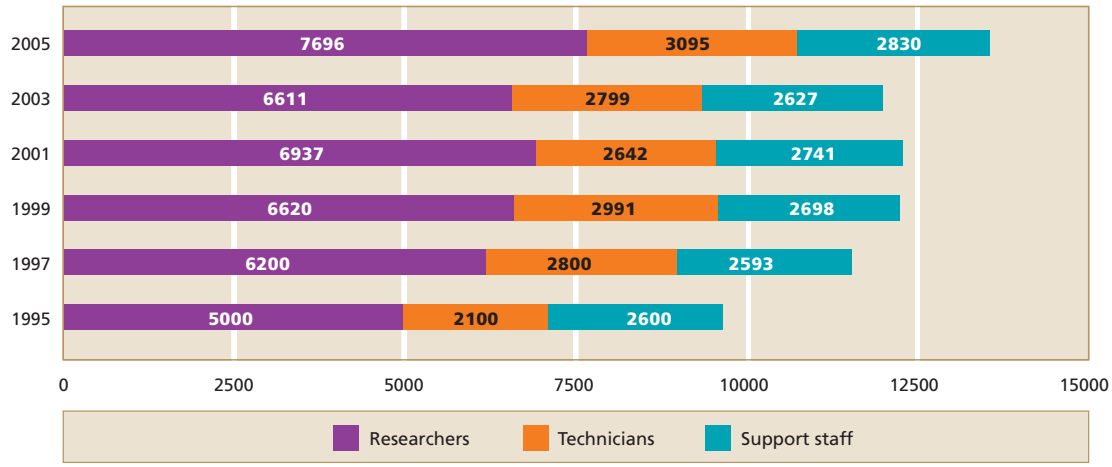
Human Resources

- The total number of research personnel (researchers plus technicians and support staff) engaged in R&D in Irish industry has risen to an all-time high of 13,621 in 2005. This represents a 13.2% increase in research personnel working in the business sector since 2003.
- The number of researchers working in the Irish business sector increased by 16.4% between 2003 and 2005 to 7,696.
- The ratio of the number of researchers employed in the business sector per thousand workers in industrial employment was 4.7 in 2005. This was an increase on the 2003 recorded ratio of 4.5, and above the EU25 average of 4.2 but below the OECD ratio of 6.6.

Total research personnel (headcount) (1995-2005)



Research personnel by occupation (1995-2005) (headcount)



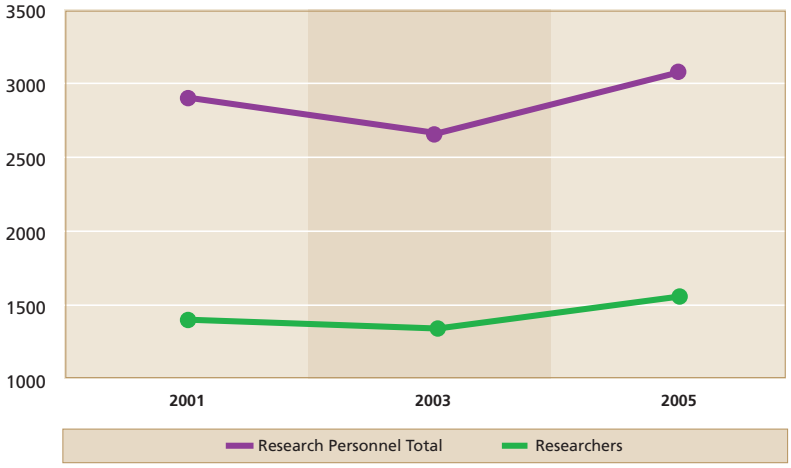
- The Software/Computer Related sector employed the largest number (4,586) of research personnel in 2005, though the rate of increase between 2003 and 2005 was weaker than for some other sectors.
- The next largest sectors of research personnel employment in 2005 were the Electrical/Electronic Equipment; Food, Drink & Tobacco; Instruments and Pharmaceuticals sectors.

Total research personnel by sector, 2003 and 2005 (headcount)

Sector	2003	2005
Software/Computer Related	4537	4586
Electrical/Electronic Equipment	2263	2624
Food, Drink & Tobacco	684	1085
Instruments	885	1058
Pharmaceuticals	742	996
Machinery & Equipment	813	815
Other Services	359	724
Chemicals	246	402
Basic & Fabricated Metals	320	355
Wood Products	178	225
Non-Metallic Minerals	151	211
Other Manufacturing	206	202
Rubber & Plastics	230	160
Transport Equipment	157	72
Paper, Print & Publishing	51	55
Textiles, Clothing & Leather	215	51
Total	12037	13621

- The number of female research personnel (researchers plus technicians and support staff) engaged in R&D has risen from 2,670 in 2003 to 3,079 in 2005. Female research personnel accounted for 22.6% of the total business R&D work-force in 2005. Some 20.2% of R&D personnel working as researchers in 2005 were female.

Female research personnel and researchers, 2001-2005 (headcount)



- About 61.2% of all research personnel are employed in medium/large firms compared to 38.8% of research personnel in small firms.
- 10.8% of all researchers employed in the Irish business sector in 2005 had a PhD qualification. Of this total, 21.8% are female PhD holders.

Other Data

- The bulk of the funding for business R&D continues to come from private sources with private funding representing 95.5% of total funding in 2005.
- Funding of €55.0 million for business R&D activities performed in Ireland was sourced from the Irish government (4.1% of the total, up from 2.9% in 2003).

Sources of funding for business R&D 2001, 2003 and 2005 €mn

	2001	2003	2005
Private Funding	870.0	1069.0	1268.5
Irish Government	24.5	32.5	55.0
EU Public Funding	5.9	3.7	5.2
Total BERD	900.0	1105.2	1328.7

- There were an estimated 1,370 R&D active firms in Ireland in 2005, ahead of the 1,264 recorded R&D performers in 2001.
- Of the total 1,370 R&D active firms in 2005, 1,025 were Irish-owned with the remaining 345 foreign-owned.
- 50 firms accounted for 57.7% of total R&D spending in 2005.
- There was evidence of a shift to higher value-added R&D activities in 2005, with 12% of all spending being classed as basic research, compared to the 4% share estimated in 2001.
- 35.8% of R&D active firms were involved in some type of collaboration activities. 17.4% of R&D active firms collaborated with other Irish firms.
- 49.3% of all R&D spending was aimed at developing new products, with 17.3% of expenditure aimed at developing new processes.

Table of Key Indicators: 1995-2005

		1995	2001	2003	2005
Resources (€mn and %)	BERD (Current Prices €m)	470	900	1,105	1,329
	BERD (Constant Prices 2006 €m)	658	1059	1,201	1,380
	BERD (% GNP) Ireland	1.00%	0.92%	0.94%	0.98%
	BERD (% GDP) EU	1.05%	1.17%	1.15%	1.14%
	BERD (% GDP) OECD	1.39%	1.57%	1.53%	1.54%
	BERD (% GDP) Ireland	0.89%	0.77%	0.80%	0.82%
Sectoral Data (% total BERD)	Electrical	26.4%	25.4%	19.7%	21.0%
	Software	15.6%	39.1%	35.2%	30.4%
	Pharmaceuticals	16.3%	7.9%	17.7%	20.1%
	Instruments	5.2%	6.6%	10.8%	9.4%
Ownership (% of total)	Irish Owned	33.2%	35.3%	29.9%	29.3%
	Foreign Owned	66.8%	64.7%	70.1%	70.7%
Performing R&D (Number of firms)	Total	1169	1264	1125	1370
	Irish	806	978	873	1025
	Foreign	363	286	252	345
	BERD Expenditure >€2mn		73	81	118
Human Resources (Number and %)	Researchers (FTE)	3400	5971	6012	6768
	Researchers (FTE) per 1000 industrial employment (Ireland)	3.5	4.5	4.5	4.7
	Researchers (FTE) per 1000 industrial employment (OECD)	5.0	6.1	6.4	6.6
	Research Personnel (FTE)	5680	9126	9281	10338
	Research Personnel (FTE) per 1000 industrial employment (Ireland)	5.9	6.9	7.0	7.2
BERD Funding (€mn and %)	Government funding of BERD (€m)	16.0	24.5	32.5	55.0
	% BERD financed by Government	3.4%	2.7%	2.9%	4.1%
Collaboration (% active)	% of R&D active firms involved in any collaboration activities		35.2%	34.9%	35.8%
	% R&D active firms who collaborated with Irish business		15.0%	11.0%	17.4%
	% R&D active firms who collaborated with Irish higher education		19.0%	17.0%	16.9%
Type of R&D spend % total)	% BERD spending on basic research		4.4%	8.9%	12.0%
Aims of R&D spend (% total)	% Spend on new product development		54.0%	53.0%	49.3%
	% Spend on new process development		10.0%	11.0%	17.3%

Chapter 1 - Business R&D Performance (all firms)

1.1 Introduction and summary

In this first chapter we will examine various aspects of research and development (R&D) spending and performance by **all** R&D active firms in Ireland for 2005/2006. This chapter takes a broad overview of aggregate business expenditure and performance and also examines trends over the past 10 years.

The first section focuses on the contribution of business R&D expenditure to economic activity over the past decade and benchmarks Ireland's performance against various countries internationally. The performance of Irish-owned companies is compared with that of foreign-owned companies and the sectoral composition of R&D spending is examined. A comparison of current and capital R&D related costs is also made. Finally a regional breakdown of spending by all R&D active firms is analysed.

- Research & development expenditure performed by the business sector in Ireland rose to €1.33 billion in 2005. This represented an annual average increase of 9.7% between 2003 and 2005. Preliminary estimates for business R&D spending in 2006 indicate a further strong climb, with R&D expenditure growth expected to quicken to 17.3% to stand at an estimated €1.56 billion.
- Business R&D spending as a ratio of economic activity (Gross National Product) increased from 0.94% of GNP in 2003 to 0.98% in 2005. This ratio is expected to climb further in 2006 to 1.05% of GNP.
- The largest performing sector for business R&D continued to be the Software/Computer Related areas accounting for 30.4% of all R&D investments in 2005. However, R&D spending growth in this sector was a sluggish 6.8% between 2003 and 2005.
- The Dublin region was the location for 41.2% of all business R&D performance in 2005, with the BMW accounting for 25.7% of the total and the rest of the country accounted for the remaining 33.1% of the total.

In the second section we look in detail at the human resources allocated by companies to R&D activities. We examine trends over the past 10 years, qualification levels and occupations of the research personnel, the percentage of time spent on R&D, international comparisons and gender breakdown information.

- The total number of research personnel engaged in R&D activity in Irish industry rose to an all-time high of 13,621 in 2005. This represents a 13.2% increase in research personnel working in the business sector since 2003.
- The Software/Computer Related sector employed the largest number (4,586) of research personnel in 2005, though the rate of increase between 2003 and 2005 was weaker than for some other sectors.
- The number of female research personnel engaged in R&D has risen from 2,670 in 2003 to 3,079 in 2005. Female research personnel accounted for 22.6% of the total business R&D work-force in 2005.

Other data focussed on in this chapter includes an examination of the current and capital R&D related costs. Overall R&D related expenditure per person employed and a sectoral breakdown of this expenditure is also included. The type and aim of the research undertaken is examined as well as sources of funding, regional distribution of R&D spending, numbers of firms and expenditure by ownership and degree of collaboration undertaken.

- Funding of €55.0 million for business R&D activities performed in Ireland in 2005 was sourced from the Irish government (4.1% of the total).
- 35.8% of R&D active firms were involved in some type of collaboration activities.

1.2 R&D Spending (all firms)

This section examines **expenditure** on R&D by the business sector in Ireland during the last decade. The figures are for all firms, incorporating information received for R&D spending and performance by small, medium and large firms.

Table 1 and Chart 1 below show the trend in business sector R&D spending for the past 10 years, in both nominal and real terms. Between 2003 and 2005 total R&D spending performed by all businesses in Ireland increased from €1.1 billion to €1.33 billion – an annual average increase of 9.7% in nominal terms. Stripping out the effects of inflation BERD rose by 7.5% on average per annum between 2003 and 2005 in constant prices. Firms were asked in the latest survey of expenditure on research and development to estimate spending for 2006. Initial data shows that current R&D spending is expected to accelerate to 17.3% to stand at €1.56 billion.

Table 1: Spending on R&D performed in the Business sector (1995-2006)[4]

	1995	1997	1999	2001	2003	2005	2006 (e)
Current (BERD) €mn	470	612	784	900	1105	1329	1560
% annual average ch		14.2%	13.5%	7.0%	11.0%	9.7%	17.3%
Constant (BERD) €mn	658	830	1022	1059	1201	1380	1560
% annual average ch		12.9%	11.0%	1.8%	6.2%	7.5%	13.1%

In the decade from 1995 to 2005, R&D spending by businesses in Ireland almost tripled from €470 million to €1.33 billion in current prices. Spending growth slowed between 1999 and 2001, but re-accelerated to record double-digit gains once more between 2001 and 2005. If the rate of increase in 2006 is confirmed by future surveys then that increase of 17.3% would point to a further quickening in the pace of business sector R&D spending growth. However, a re-acceleration of inflation in though would erode some of these spending gains in real terms. The rate of BERD growth over the last decade has been one of the strongest in Europe, only outpaced by the BERD gains in China, Israel, Hungary, Poland and Finland.[5]

4 All data comes from the survey of Business Expenditure of Research and Development 2005/2006 unless otherwise stated.

5 Main Science & Technology Indicators. Volume 2006/2, OECD

Chart 1: *Business R&D spending in Ireland (1992-2006) €million*

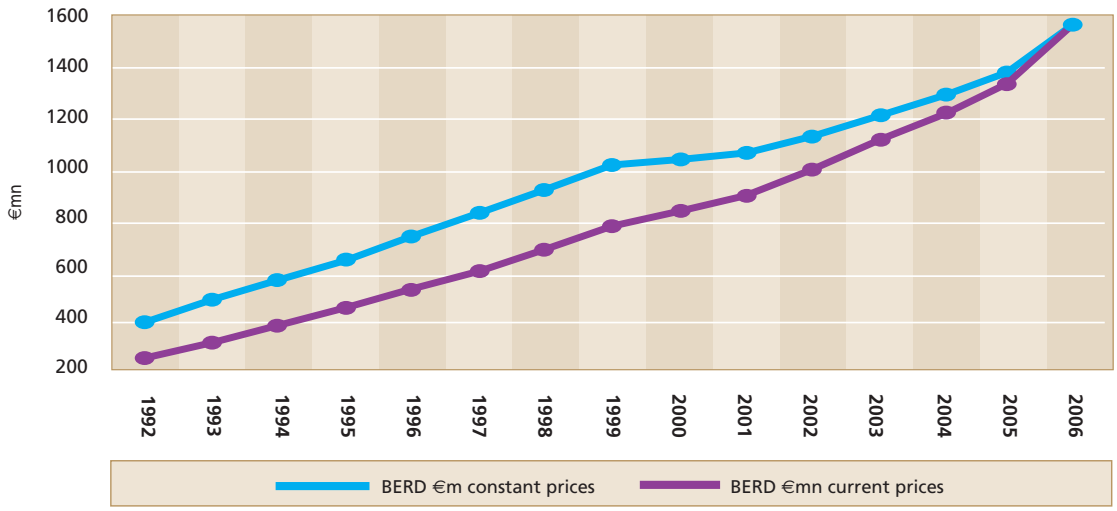


Chart 2: *Annual percentage change BERD 1996-2006*

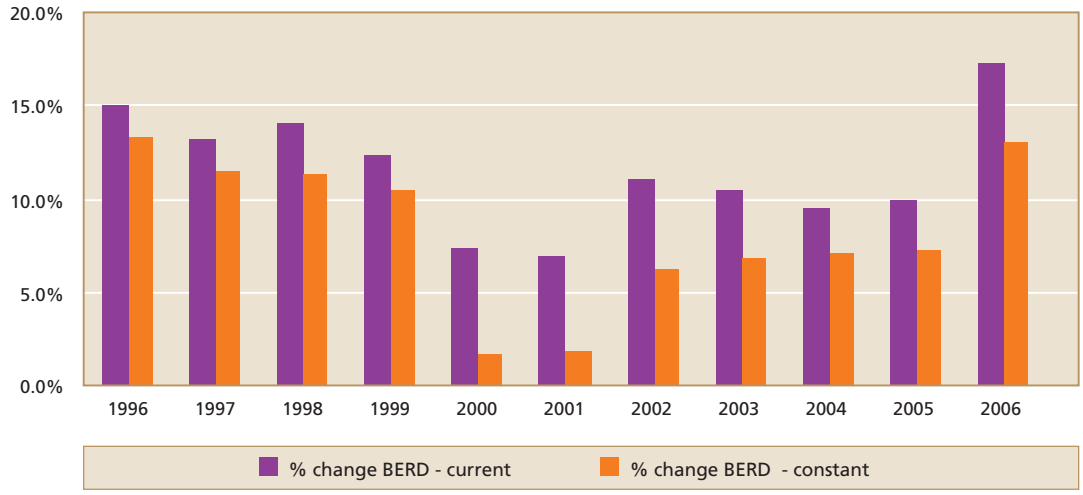


Chart 3 shows the ratio of business R&D expenditure to economic activity in the country over the past decade. The chart shows BERD intensity as measured by gross national product (GNP) and gross domestic product (GDP). GNP is the comparative measure usually used for Ireland as GDP figures include the profit repatriation of multinational companies.

Over the last decade, the business R&D intensity ratio has fluctuated between 0.9% of GNP and 1.1% of GNP. The intensity ratio rises when the growth rate of business R&D spending is quicker than the overall growth rate in the economy. If BERD expansion is slower than economic growth, then the intensity ratio falls. BERD growth has therefore had to be extremely strong to keep pace with the rate of economic expansion experienced during the "Celtic Tiger" period.

Between 1996 and 1999, BERD intensity was steady at just over 1.0% of GNP, as BERD growth of 14% matched the rate of expansion in the overall economy. Between 2000 and 2003, the intensity ratio edged down slightly to 0.94% of GNP as BERD growth rates slowed to around 8% and were outpaced by economic growth of 11%. Finally in the period 2003 to 2006, the BERD intensity has risen steadily once more to an estimated 1.06% of GNP as strong BERD growth outpaced overall gains in the economy.

Chart 3: *BERD intensity (as a percentage of economic activity) (1996-2006)*

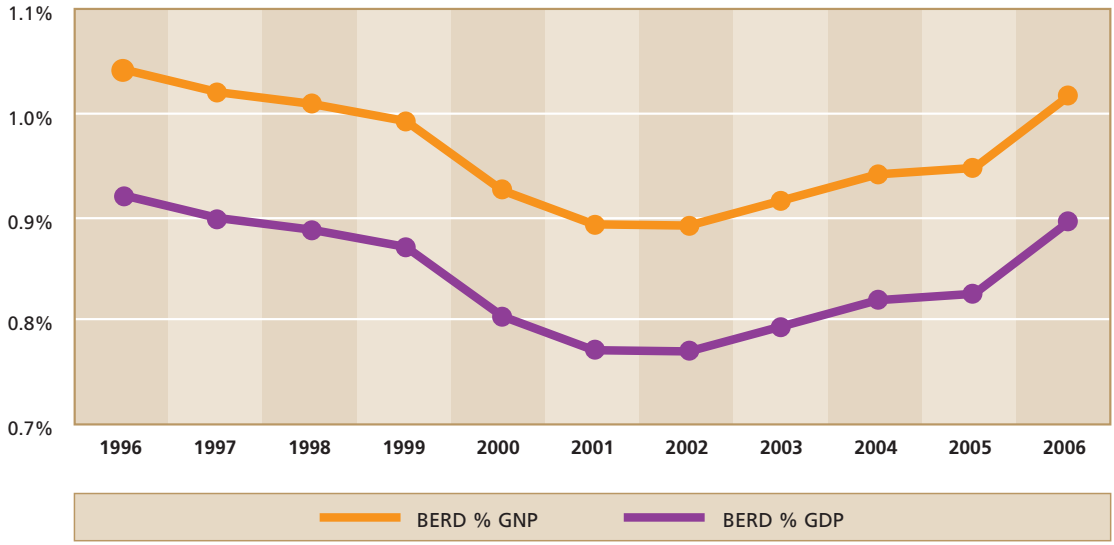
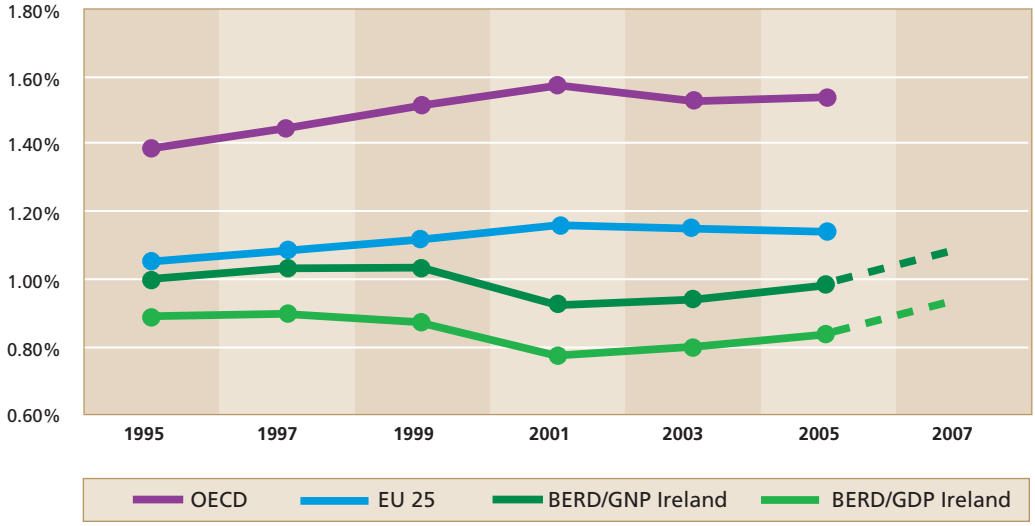


Chart 4 shows the BERD intensity ratio for Ireland discussed previously (in both GNP and GDP terms[6]) and benchmarks that performance against the EU25 and OECD average intensities (GDP). It can be seen that Ireland's BERD intensity ratio has lagged the EU25 and OECD averages over the last decade but that the gap is closing in more recent years. That said, BERD performance, although close to being on a par with the EU25 average, remains considerably below the OECD average intensity of 1.54% of GDP.

In the period 1997 to 2001 the gap between Irish BERD intensity and the EU and OECD average intensities widened as global R&D intensities rose and Irish intensity slowed, despite still strong domestic BERD growth. In the period from 2001 that gap has narrowed as global R&D intensities remained flat and Irish BERD intensity increased once more. If estimates of BERD in 2006 are borne out by data captured from future surveys, then Ireland's intensity ratio would rise further, and in all likelihood wipe out the intensity gap with the EU25 average.

6 Both GNP (Gross National Product) and GDP (Gross Domestic Product) are used for analytical purposes of economic activity in Ireland. The GDP measure includes the value-added from foreign-owned firms operating in Ireland which are not counted in the GNP measure. As a result GDP in Ireland is 18.5% higher than the GNP measure of economic activity

Chart 4: *International business R&D intensity as a percentage of economic activity, (1995 - 2005)*



Source: Main Science and Technology Indicators Vol. 2006/2, OECD

Chart 5 takes a closer look at cross-country BERD intensities in 2005 or for the latest year for which data was available on the OECD database. In 2005 Ireland's BERD intensity of 0.98% of GNP placed it in 16th place out of the 26 countries benchmarked.

The graph points to four different areas of R&D intensity performance. The first group identified is the "bottom" group of low performers with intensity between 0.2% and 0.6% of GDP. The next group up are countries "catching up" with BERD intensities between 0.6% and 1.2% of GDP. Ireland is a member of this group which also contains the average intensity for the EU25.

The third group of "strong" BERD performers are those with intensity ratios between 1.2% and 1.6% of GDP. This group includes the OECD average intensity of 1.54% of GDP. The final group is the selection of "top" performers of BERD intensity. This group includes the world leaders in business R&D performance and includes the USA, Korea, Japan, Finland, Sweden and Israel, which with a business R&D intensity of 3.59% of GDP, leads the world. It should be noted however, that some of these performances are exaggerated by the performance of single large R&D performers operating in the ICT sector or by large military R&D spending.

Chart 5: *R&D spending in the business sector as a percentage of GDP (2005 or latest year data is available from OECD)*

Source: Main Science and Technology Indicators Vol. 2006/2, OECD

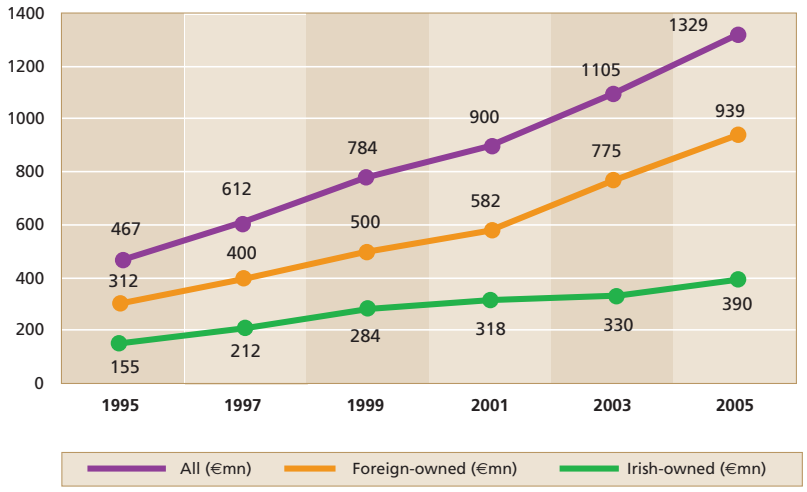
In Chart 6 we examine the R&D expenditure performance of all business firms by nationality (Irish and foreign). A firm is deemed to be foreign-owned if more than 50% of share ownership is controlled outside of Ireland. If this 50% share ownership threshold is not passed, then the firm, for the purposes of this set of analysis, is deemed to be Irish-owned. This definition is a harmonised definition used across all EU nations.

Foreign-owned R&D spending of firms programmes carried out in Ireland rose to €939 million in 2005, an annual average increase of 10% between 2003 and 2005. Although the pace of growth of foreign-owned firms has remained strong between 2003 and 2005, there was a slight easing in those growth patterns compared to the 2001 to 2003 period.

R&D spending by foreign-owned firms therefore accounted for 70.6% of the total in 2005, compared to the 66.8% foreign-owned share in 1995. This ratio of foreign-owned R&D performance in the country is amongst the highest in Europe and reflects the very particular industry structure in Ireland, with only Hungary reporting a higher ratio, and with most other countries clustered between a foreign-owned/total ratio pf between 20% and 40%.

Irish-owned companies' spending on business sector performed R&D rose to €390 million in 2005. This rise of 8.8% on average per annum compares to the high rate of increase of 10% per annum recorded for foreign-owned companies. The share of R&D performed in the business sector by Irish-owned firms stood at 29.4% in 2005, slightly below the 29.9% ratio posted in 2003, and even further below the 33.2% share recorded ten years earlier.

Chart 6: *R&D spending in the business sector by ownership (Irish-owned or foreign-owned) 1995–2005 (€mn.)*

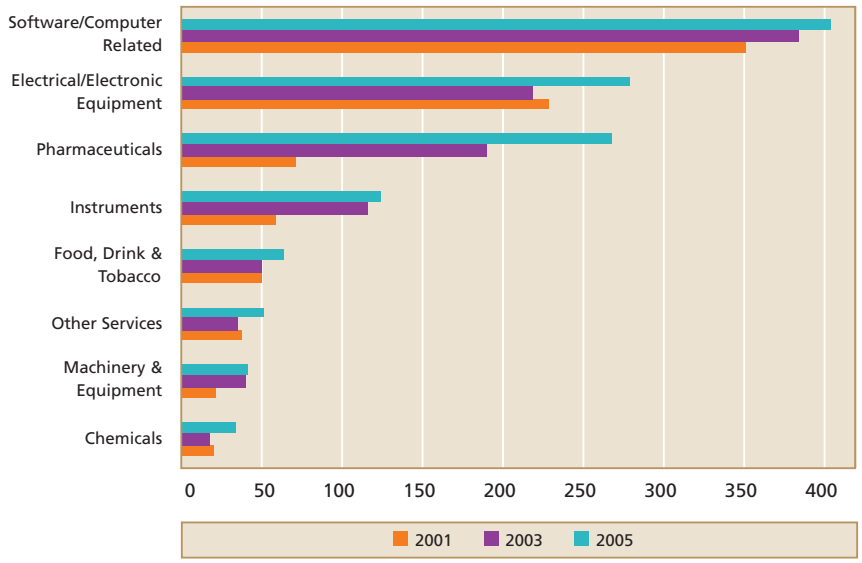


The industry sectors[7] which spent most on research and development in 2005 were the Software/Computer Related sector; the Electrical/Electronic Equipment sector and the Pharmaceuticals sector. Chart 7 shows that this trend has been maintained since 2001.

R&D spending performed in the Software/Computer Related sector rose to €404 million in 2005, although the 6.8% increase from 2003 was one of the slower sectoral growth rates. R&D expenditure by companies operating in the Electrical/Electronic Equipment sector climbed by 31.5% between 2003 and 2005, to stand at €279.0 million. R&D spending gains of 40.4% in the Pharmaceuticals sector saw the level of R&D spending in this sector rise to €267.1 million. R&D spending growth in the Food, Drink & Tobacco sector also strengthened to 50.4% in the two-year period up to 2005.

7 *Companies which are R&D active are classified into standardised OECD and Eurostat NACE sector.*

Chart 7: *R&D industry spending by selected sectors €mn. (2001-2005)*



The sectoral share of total research and development spending by all firms in 1995 and 2005 is illustrated in Chart 8. As can be seen clearly the Software/Computer Related sector has greatly increased its share from 15.6% in 1995 to 30.4% of the total in 2005, although this is below the peak of the 39% share recorded in 2001. That said, the sector remains the largest R&D performer.

The Pharmaceuticals sector increased its expenditure on R&D by 250% in the decade between 1995 and 2005. The share of total expenditure from this sector was 16.3% in 1995, and this share fell steadily to a low of 7.8% in 2001, before recovering strongly to take up a growing 20.1% share of the total in 2005, just narrowly behind the number two ranked sector in 2005 – the Electrical/Electronic Equipment sector's share of 21.0%.

In the Food, Drink & Tobacco sector the percentage share has fallen from 9.9% in 1995 to 4.8% in 2005, although this sector recorded strong growth between 2003 and 2005. Finally the Instruments sector now contributes 9.4% to total R&D performed in the Irish business sector, almost double the 5.2% share ten years previously.

Chart 8: *R&D sectoral share of total expenditure 1995 and 2005*

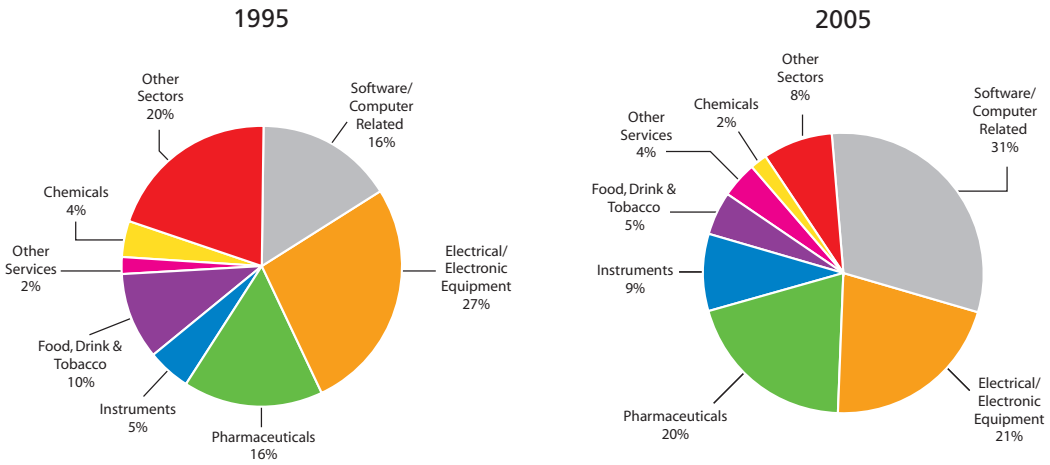


Table 2 examines the breakdown of overall R&D expenditure into current and capital costs for 2001, 2003 and 2005 and the percentage share of the total costs for these areas to overall R&D spending by all firms. Labour costs represent the largest share of total R&D costs and have been consistently around 55-57% of total costs over the 2001-2005 period. The next largest category are other current costs which represent 30-35% of total expenditure, but their share of the total has declined over the period from 35.3% to 29.5%.

Table 2: *Total R&D expenditure showing current and capital costs and percentage of total*

	2001 €mn	2003 €mn	2005 €mn	2001 % share	2003 % share	2005 % share
Labour Costs	515.3	612.5	747.6	57.2%	55.4%	56.3%
Other Current Costs	318.0	339.6	392.1	35.3%	30.7%	29.5%
Land and Buildings	15.6	81.5	55.9	1.7%	7.4%	4.2%
Equipment	51.3	71.4	133.1	5.7%	6.5%	10.0%
Total	**900.2**	**1105.0**	**1328.7**			

The remaining costs are made up of land, buildings and equipment which combined represent a relatively small percentage of total costs. However, R&D related expenditure on land and buildings has increased by 258% between 2001 and 2005 and spending on equipment has increased by 159%. More recently spending on land and buildings has eased somewhat as large-scale R&D building works come to an end and these firms begin the next stages of development including tooling up of these buildings with R&D equipment.

The regional and sectoral distribution of R&D spending by all business companies during 2005 is illustrated in Table 3. The country is divided into the Border, Midlands and West (BMW) region, Dublin city and county and the rest of the country (which excludes the BMW region and Dublin city and county) for the purposes of this analysis. Overall the largest region for R&D performance in 2005 was the Dublin region with 41.2% of total R&D spending performed in this region. However, Dublin's percentage of total spending decreased in 2005 to 41.2% from the 2003 share of 46.5%.

The next largest region was the rest of the country (excluding BMW and Dublin city and county) which was the location for 33.1% of all R&D spending. R&D spending located in the rest of the country region has decreased from a 38.1% share in 2003. Finally the BMW region was the location for 25.7% of total R&D in 2005 increasing its percentage of the total considerably from only 15.4% in 2003.

The top four spending sectors: Software/Computer Related; Electrical/Electronic Equipment; Pharmaceuticals and Instruments show differing regional R&D spending patterns. The bulk of the Software/Computer Related sector's spending took place in the Dublin (51%) and the BMW (31%) regions. The Electrical/Electronic Equipment and Pharmaceuticals industry's spending mostly took place in Dublin (38% and 54% respectively) and the rest of the country (44% and 37%). In contrast, 72% of the total spending by the Instruments sector took place in the BMW region.

Table 3: *Regional distribution of R&D spending by sector, 2005*

R&D sector	BMW €mn	Dublin €mn	Rest of Country €mn	Grand Total €mn
Software/Computer Related	124,656	207,989	71,495	404,140
Electrical/Electronic Equipment	48,653	107,154	122,771	278,578
Pharmaceuticals	23,072	144,573	99,515	267,160
Instruments	88,825	11,638	23,835	124,298
Food, Drink & Tobacco	9,706	16,270	37,715	63,691
Machinery & Equipment	20,167	10,637	19,996	50,800
Other Services	3,948	27,352	10,006	41,306
Chemicals	1,456	13,449	18,342	33,247
Non-Metallic Minerals	2,829	1,584	13,010	17,423
Basic & Fabricated Metals	3,630	839	9,766	14,235
Wood Products	2,359	0	6,746	9,105
Other Manufacturing	3,468	3,139	1,954	8,561
Rubber & Plastics	5,752	1,311	638	7,701
Transport Equipment	800	0	3,480	4,279
Textiles, Clothing & Leather	1,905	199	202	2,306
Paper, Print & Publishing	176	1,035	702	1,913
Grand Total	341,402	547,168	440,174	1,328,744
% Total	**25.7%**	**41.2%**	**33.1%**	**100.0%**

1.3 R&D Human Resources (all firms)

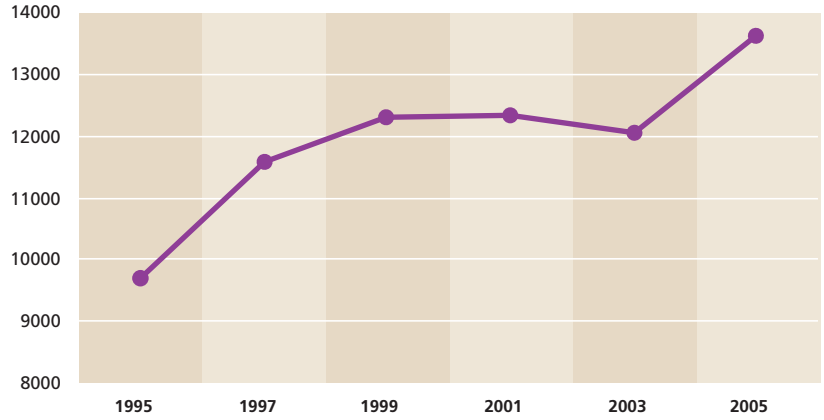
Introduction

In this section we change focus from R&D spending analysis of all firms to examine in detail trends on human resources dedicated to R&D activities. In particular, focus is placed on the number of research personnel[8] engaged in research and development over the past 10 years; the differing occupations of these personnel; the qualification level of the researchers; the percentage of time actually spent on R&D; international comparisons and gender breakdown information.

Chart 9 demonstrates the upward trend for the total number of research personnel (researchers, technicians and R&D support staff) engaged in R&D in the business sector in Ireland between 1995 and 2005. The very sharp rise in numbers between 1995 and 1999 from 9,700 to 12,309 levelled off in the two years between 1999 and 2001. After a brief and slight fall in business sector research personnel headcount after 2001, the numbers engaged in R&D in businesses rose to an all-time high of 13,621 in 2005. Between 2003 and 2005 the level of research personnel employed in the business sector increased by 13.2% mirroring the strong rise in R&D investment in that period.

8 *"Research Personnel" incorporates researchers, technicians and administrative/support staff engaged in R&D work.*

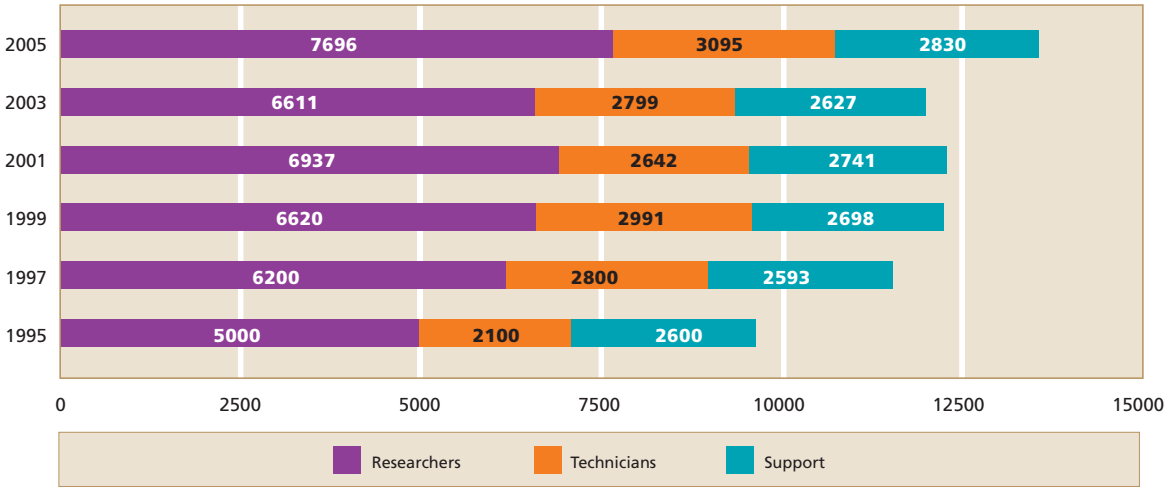
Chart 9: *Total research personnel 1995-2005 (headcount)*



We are able to break down the headcount information gained from the business R&D survey into the occupation of the research personnel (includes researchers, technicians and support staff -see Chart 10).

The number of researchers has increased from 5,000 in 1995 to 7,696 in 2005, a 53.9% rise over the decade. Researcher numbers in the business sector which had fallen slightly between 2001 and 2003, regained momentum to rise by 16.4% in the following period. The numbers of both technicians and support staff have fluctuated over the 10 year period but technicians reached an all-time high of 3,095 in 2005. The ratio of 4 technicians per 10 researchers employed in the business sector has remained relatively stable in the last decade. The level of R&D support staff reached a high of 2,830 in 2005.

Chart 10: *Research personnel by occupation, 1995-2005 (headcount)*



Respondents to the BERD survey were asked to estimate the average percentage of time spent by research personnel in carrying out research and development work. This information provides a measure of relevant full-time equivalent (FTE) employment, a standard metric of international comparison of R&D human resources performance. For example, someone who is recorded as having spent 50% of their time engaged in an R&D activity is regarded as 0.5 of a full-time equivalent research worker. Similarly, a technician spending 25% of their time conducting R&D activities is counted as 0.25 of a FTE.

Chart 11 provides information on the numbers of FTE research personnel engaged in R&D activities for the past 10 years in the Irish business sector. The number of FTE R&D human resources has increased sharply in the last 10 years from 5,680 FTE in 1999 to 10,338 FTE in 2005. There was a brief stalling in R&D FTE levels between 2001 and 2003 as R&D headcount numbers fell, although this drop was counterbalanced in FTE terms as more time was spent by those numbers conducting research activities.

Chart 11: *Total research personnel 1995-2005 (Full Time Equivalent)*

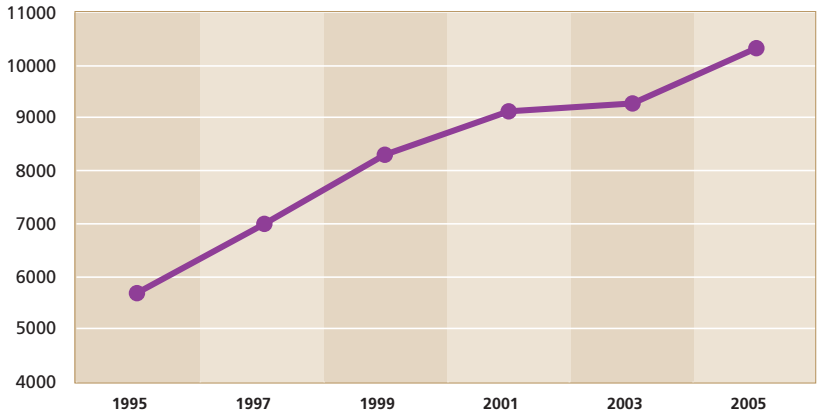
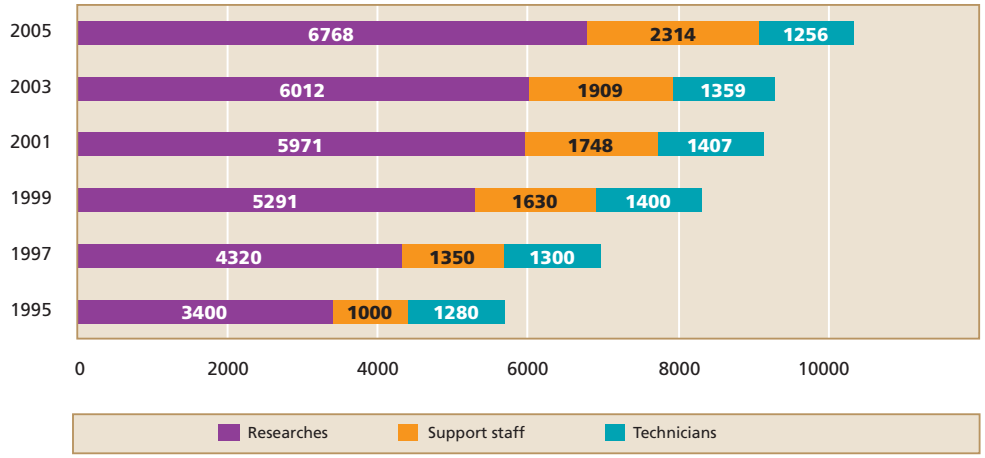


Chart 12 and Table 4 show that when broken down into types of research occupation, the total FTE personnel figures show a similar trend to the headcount personnel figures. Researchers are the largest employment category and their numbers have increased by 99% in the last decade from 3,400 in 1995 to 6,768 in 2005. The number of FTE technicians has also increased gradually since 1995. By contrast the number of FTE support staff rose from 1,280 in 1995 to 1,407 in 2001 but since 2001 the numbers have decreased to 1,256 just marginally above the 1995 number.

Chart 12: *FTE research personnel by occupation (1995-2005)*



The overall amount of average time spent on research and development in the business sector by research personnel has risen from 58.6% on average in 1995 to 75.9% in 2005 (Table 4). The time use of research personnel conducting research activities peaked in 2003 at 77.1%, before easing back a little in 2005.

Researchers have increased the amount of time spent on purely R&D activities from 68% in 1995 to almost 88% in 2005, though there has been a drop from the 2003 percentage. The percentage of time spent on R&D projects by technicians has also risen steadily from the 48% recorded in 1995 to 74.8% in 2005. Average time spent supporting research activities by other R&D support staff fell back to 44.4% in 2005 having peaked at a 51.9% rate in 1999.

Table 4: *Average R&D time use of business sector research personnel by occupation (1995-2005)*

	1995	1997	1999	2001	2003	2005
Researchers	68.0%	69.7%	79.9%	86.1%	90.9%	87.9%
Technicians	47.6%	48.2%	54.5%	66.2%	68.2%	74.8%
Support	49.2%	50.1%	51.9%	51.3%	51.7%	44.4%
Research Personnel Total	**58.6%**	**60.1%**	**67.6%**	**74.1%**	**77.1%**	**75.9%**

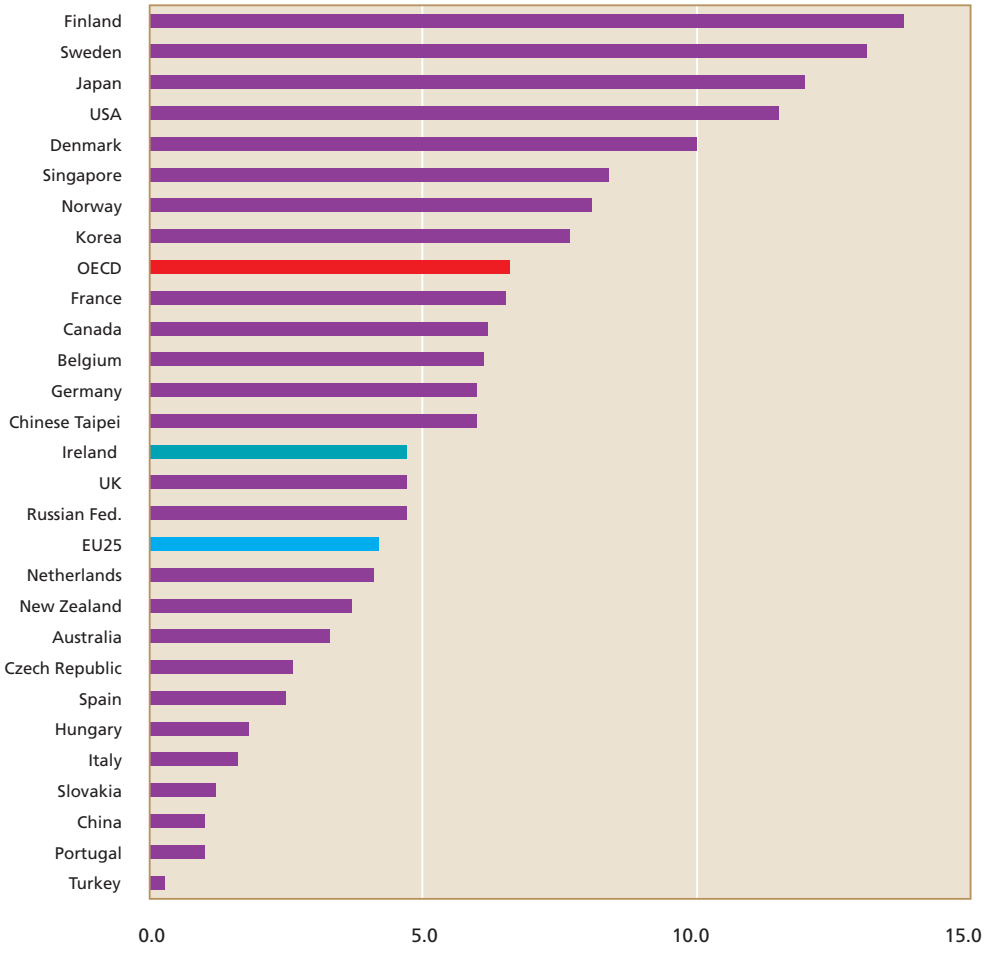
In table 5 we examine the number of business sector FTE researchers and research personnel (all R&D occupations) engaged in R&D activities, as a ratio of total industrial employment in Ireland and internationally. This ratio is a standard international benchmarking indicator.

Table 5: *Irish business sector researchers and research personnel 1995-2005 (FTE per 1000 industrial employment)*

	1995	1997	1999	2001	2003	2005
Researchers	3.5	4.2	4.3	4.5	4.5	4.7
Research Personnel	5.9	6.7	6.8	6.9	7.0	7.2

The ratio of FTE business sector researchers per thousand in industrial employment rose to 4.7 in 2005, boosted by strong relative rises in researcher employment. That ratio has risen from a level of 3.5 business researchers per thousand in industrial employment in 1995. Looking at the wider research personnel category which includes all types of R&D occupations, the ratio for that group per thousand in industrial employment increased to 7.2 in 2005, ahead of the 5.9 ratio estimated ten years previously. Chart 13 shows international comparisons of the number of business sector FTE researchers engaged in R&D activities as a ratio of the number in total industrial employment.

Chart 13: *International comparisons of business sector researchers 2005 (FTE per 1000 industrial employment)*

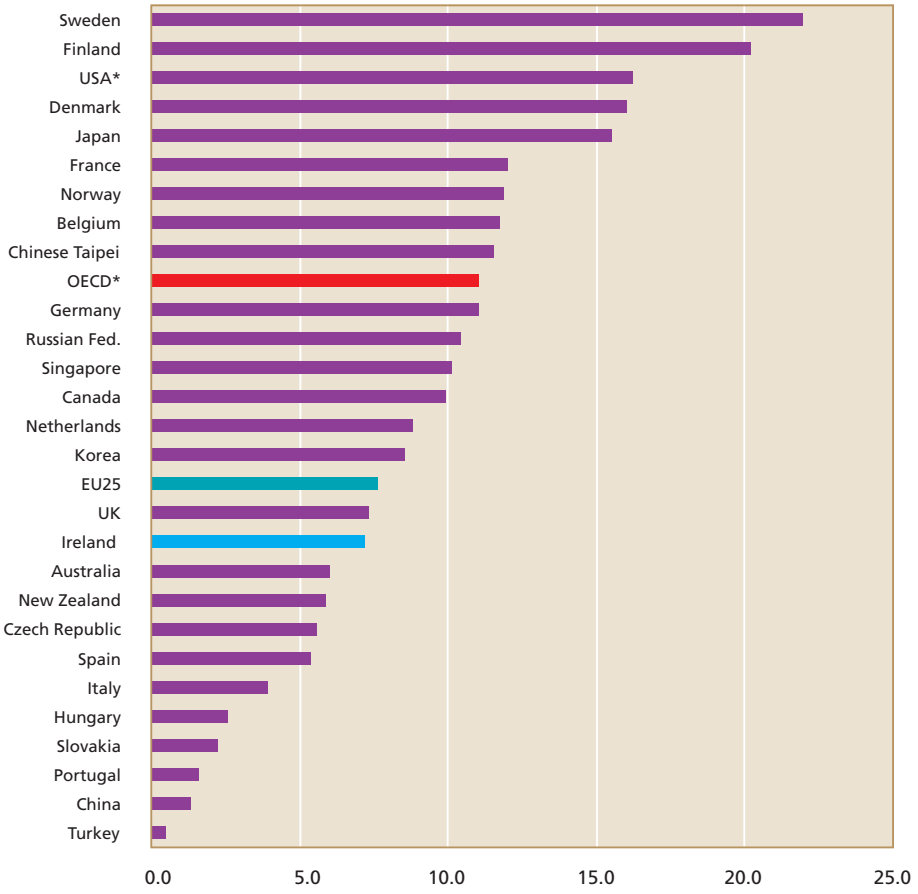


Source: Main Science and Technology Indicators, Volume 2006/2, OECD

In 2003 Ireland's ratio of 4.5 remained unchanged from 2001. This has now increased slightly to 4.7 in 2005 with the country continuing to rank above the EU25 average ratio of 4.2 (3.8 in 2003), though below the OECD average ratio of 6.6 (5.9 in 2003). Finland and Sweden remain the leading OECD countries with ratios of 13.8 and 13.1 researchers per thousand in industrial employment respectively for the latest year data was available.

Chart 14 provides similar international benchmarking data but this time for the wider research personnel category employed per thousand in industrial employment. Despite Ireland's ratio increasing to 7.2 in 2005 it still ranks below the EU25 average of 7.6 and the OECD average of 11.0 for this employment category. As with the international comparisons for researchers alone, the top ranking countries are Finland and Sweden, though Sweden's ratio of 21.9 is slightly above Finland's ratio of 20.2 for the latest year in which data was available.

Chart 14: *International comparison of business sector research personnel, 2005 (FTE per 1000 industrial employment)*



**Forfás estimates*

Source: Main Science and Technology Indicators, Volume 2006/2, OECD

The total number of research personnel employed in the business sector in Ireland in 2005 can be broken down into sectors of employment (table 6). The sector employing the largest number of research personnel in both 2003 and in 2005 was the Software/Computer Related areas which employed 4,586 research personnel in 2005. While the numbers employed in this area in 2005 have only increased very slightly over the 2003 figures (1.1% rise), the sector remains well ahead of the next largest R&D employment sector, the Electrical/Electronic Equipment sector which employed 2,624 research personnel in 2005, a 16.0% rise from 2003.

As a percentage of total R&D employment, the Software/Computer Related sector employed 38% of the total in 2003, which dropped to 33% of the total in 2005. By contrast R&D related employment in the Electrical/Electronic Equipment sector remained at the 2003 level of 19% of the total. The Food, Drink & Tobacco sector increased its employment of research personnel by 59% over the 2003 and 2005 period, overtaking the Instruments sector.

Table 6: *Total research personnel by sector, 2003 and 2005*

	2003	2005
Textiles, Clothing, Leather	215	51
Paper, Print & Publishing	51	55
Transport Equipment	157	72
Rubber & Plastics	230	160
Other Manufacturing	206	202
Non-Metallic Minerals	151	211
Wood Products	178	225
Basic & Fabricated Metals	320	355
Chemicals	246	402
Other Services	359	724
Machinery & Equipment	813	815
Pharmaceuticals	742	996
Instruments	885	1058
Food, Drink & Tobacco	684	1085
Electrical/Electronic Equipment	2263	2624
Software/Computer Related	4537	4586
Total	**12037**	**13621**

The average research and development related expenditure per person employed in R&D activities by sector for 2003 and 2005 is illustrated in Table 7 below.

Table 7: *Expenditure per person employed in R&D activities by sector, 2003 and 2005*

	2003 €	2005 €
Pharmaceuticals	256,334	268,173
Instruments	130,960	117,486
Electrical/Electronic Equipment	93,769	106,326
Software/Computer Related	83,381	88,116
Chemicals	70,325	82,587
Non-Metallic Minerals	56,954	81,991
Other Services	70,195	70,166
Food, Drink & Tobacco	61,842	58,618
Transport Equipment	37,580	58,333
Machinery & Equipment	48,462	50,675
Rubber & Plastics	47,391	48,125
Textiles, Clothing, Leather	25,116	45,098
Other Manufacturing	31,068	42,079
Wood Products	45,506	40,444
Basic & Fabricated Metals	25,625	40,000
Paper, Print & Publishing	25,490	34,545
Total	**89,358**	**97,548**

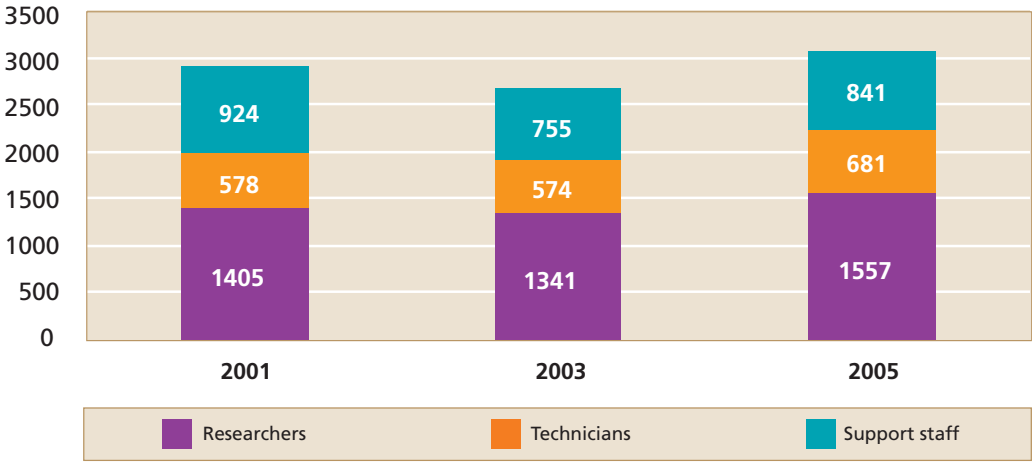
The next section of the analysis of human resources focuses on gender issues. The latest BERD survey allowed for the splitting of research personnel data within the business sector to be further sub-divided into a male-female split for all occupations.

The trend in the number of females engaged in R&D as research personnel (including technicians and support staff) and researchers over the 2001-2005 period is illustrated in Chart 15. The number of female researchers, technicians and support staff combined dropped from 2,907 in 2001 to 2,670 in 2003 before climbing to 3,079 in 2005. The ratio of female research personnel employed in the business sector has remained around 22-23% in the period 2003 to 2005. In terms of females employed in the specific researcher work category, those numbers have increased from 1,405 in 2001 to 1,557 female researchers in 2005. Females therefore accounted for 20.2% of all researchers employed in the business sector in 2005, a ratio which has remained largely unchanged since 2001.

Chart 15: *Female research personnel and researchers, 2001-2005 (headcount)*

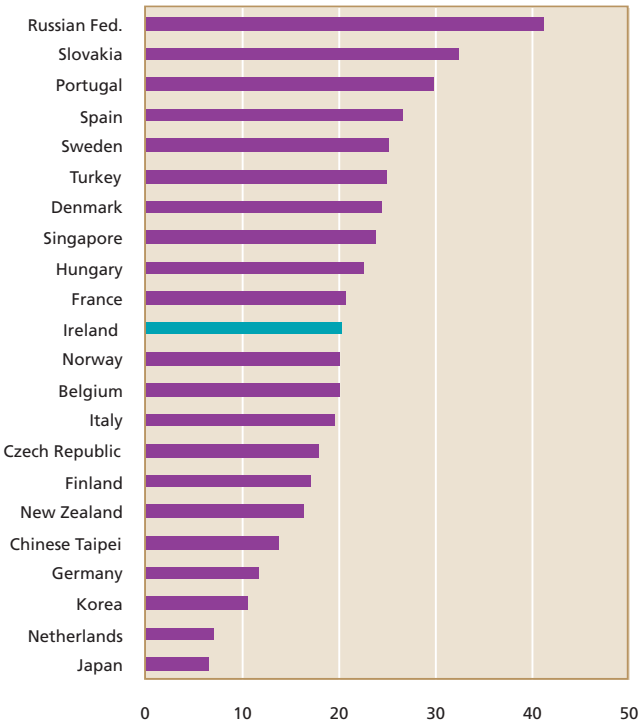
Chart 16 examines the total number of female research personnel broken down into the other types of R&D occupations for the period 2001-2005. All three categories of R&D employment underwent a drop in numbers in 2003. However all three categories increased their female headcount between 2003 and 2005, with female support staff increasing by 11.4%, female technicians increasing by 18.6% and researchers by 16.1%.

Chart 16 *Female research personnel by occupation, 2001-2005 (headcount)*



The percentage of female researchers in Ireland as a percentage of total female R&D workers in the business sector is benchmarked in Chart 17 against a selection of other countries internationally. Data for this benchmarking chart is taken from the OECD Main Science and Technology Indicators report which uses survey data gathered under a common methodology across EU and OECD countries. Countries are asked to supply data on a headcount basis of researchers working on R&D activities in the business sector split by gender. A ratio is then created by dividing the female researcher headcount by the total researcher headcount total.

Chart 17: *International comparison of female researchers as a percentage of total (headcount) female workers in the business sector*



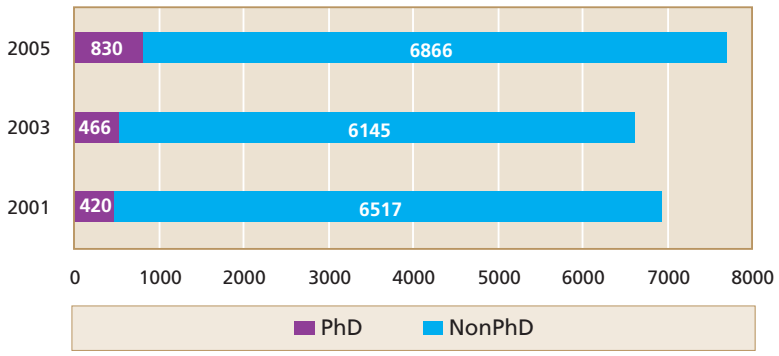
Source: Main Science and Technology Indicators, Volume 2006/2, OECD

Ireland's female BERD researcher employed ratio of 20.2% ranks mid-way on the chart above other EU countries such as Italy, Czech Republic, Finland, Germany and the Netherlands. The female researcher employed ratio for France, Belgium and Norway are almost on a par with Ireland's ratio. The Russian Federation and Slovakia show the highest percentage of female researchers as a percentage of total business sector researcher employed workers at 41.2% and 32.4% respectively.

The next section of the human resources section examines the qualifications of R&D staff employed in the business sector. Within the survey firms were asked to identify those people employed in R&D activities in the firm, and to break this down into those with a PhD qualification.

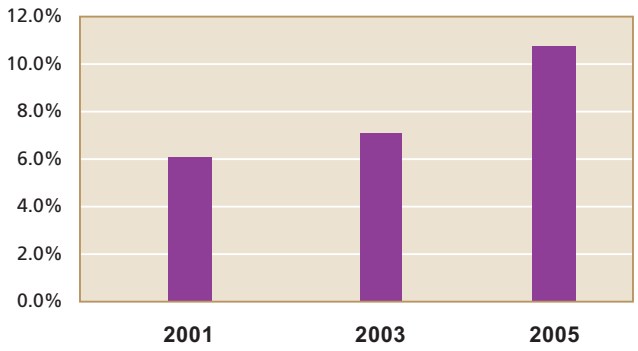
The total number (7,696) of researchers in the business sector (male and female) in 2005, with a PhD qualification rose to 830 in 2005. The number of PhD qualified researchers has therefore almost doubled between 2001 and 2005.

Chart 18 *Total researchers by qualification in the business sector 2001-2003 (headcount)*



The ratio of PhD qualified researchers to the overall number of researchers was 10.8% in 2005. This compares with a ratio of 10.4% in 2001 and 7.0% in 2003.

Chart 19 *PhD researchers as a percentage of total (headcount) researchers in the business sector, 2001 -2005*



1.4 Other R&D data (all firms)

In this section we examine data gathered from the business R&D survey on sources of funding for research and development; numbers of R&D active enterprises and distribution of expenditure by ownership; trends in spending by type of research, including a sectoral breakdown; R&D collaboration between the business sector and other areas and the aims of R&D projects carried out in the Irish business sector.

As can be seen in Table 8 the bulk of the funding for business R&D in 2005 continued to come from private sources, with private funding representing 97% of total funding in 2001 and 2003 and 95% in 2005. Irish Government sourced funding has increased its share of total BERD funding from 2.9% in 2003 to 4.1% in 2005 while the EU funding share has declined from 0.6% in 2001 to 0.4% in 2005.

Table 8: *Sources of funding for business R&D 2001, 2003 and 2005 (€mn)*

	2001	2003	2005
Private Funding	870.0	1069.0	1268.5
Irish Government	24.5	32.5	55.0
EU Public Funding	5.9	3.7	5.2
Total BERD	**900.0**	**1105.2**	**1328.7**

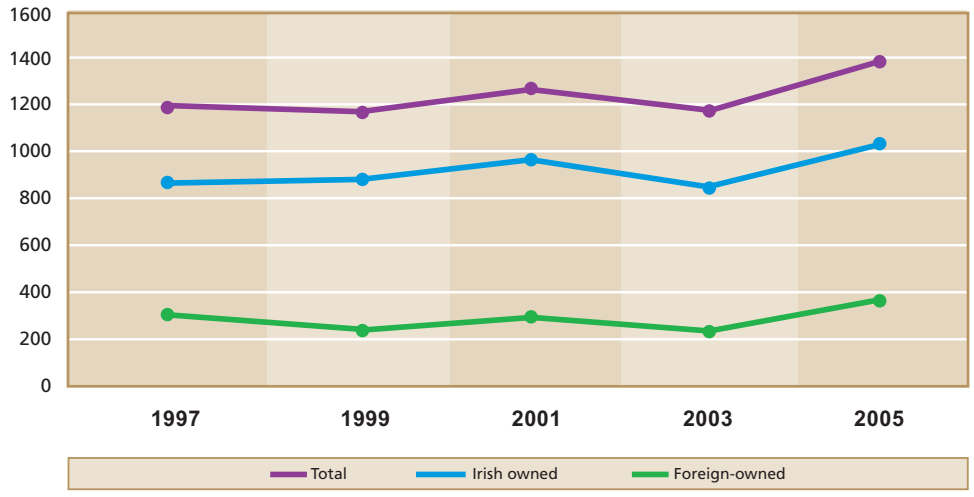
The number of firms engaged in research and development activities (R&D active) has increased by 17% in the last decade (see Table 9 and Chart 19). Irish-owned R&D performing companies have grown from 873 in 2003 to 1,025 in 2005 an increase of 17.4% in the period. The number of R&D active foreign-owned R&D companies rose to 345 in 2005 from the 252 estimated number in 2003.

Table 9: *R&D performing firms by ownership, 1995-2005*

	1995	1997	1999	2001	2003	2005
Irish-owned	806	890	905	978	873	1025
Foreign-owned	363	300	248	286	252	345
Total	**1169**	**1190**	**1153**	**1264**	**1125**	**1370**

Chart 19 shows clearly that the total number of R&D performing companies (both foreign and Irish-owned) has risen sharply by 17.4% between 2003 and 2005.

Chart 20: *Estimate of number of R&D active firms by ownership, 1997-2005*



In Table 10 and Charts 20 and 21 we examine the distribution of Irish and foreign-owned R&D active companies' and their expenditure attributed to differing sized firms in 2005. For Irish-owned industry in 2005, the largest number of R&D performing companies (470), were companies spending less than €100,000 on R&D projects. This represents almost 46% of the total number of Irish-owned companies who were classed as R&D active. The next largest grouping of firms, were companies located in the €100,000 to €500,000 R&D spending bracket, representing 35% of the total. 33 R&D performing Irish-owned companies spent more than €2 million on R&D in 2005. Compared to similar analyses for 2003, not only are the numbers of R&D active Irish-owned firms increasing, but the average spend is also rising as companies step up the size of R&D spending projects.

Table 10: *Irish-owned and foreign-owned distribution of R&D, 2005*

Irish-owned distribution of R&D						
	<€100k	**€100k-500k**	**€500k-2mn**	**€2mn-5mn**	**>€5mn**	**Total**
No. of firms	470	361	161	23	10	1025
Share of performers	45.9%	35.2%	15.7%	2.2%	1.0%	100%
Expenditure	19.1	83.4	147.9	59.9	79.7	390
Share of expenditure	4.9%	21.4%	37.9%	15.4%	20.4%	100%

Foreign-owned distribution of R&D						
	<€100k	**€100k-500k**	**€500k-2mn**	**€2mn-5mn**	**>€5mn**	**Total**
No. of firms	76	92	92	45	40	345
Share of performers	22.0%	26.7%	26.7%	13.0%	11.6%	100%
Expenditure	2.5	22	88.4	138.3	687.8	939
Share of expenditure	0.3%	2.3%	9.4%	14.7%	73.2%	100%

By contrast the biggest share of foreign-owned R&D performing firms are located in the €100,000 to €2,000,000 R&D expenditure categories representing 53.4% of the total. A total of 85 foreign-owned R&D active companies undertake projects with research spending greater than €2 million in 2005. R&D spending in this group represented 24.6% of the total number of R&D active foreign-owned firms, which undertook 87.9% of total spending. Large-scale R&D projects undertaken by a smaller relative number of R&D active firms therefore account for most of the overall R&D spend.

Chart 21: *Irish-owned firms' R&D performance*

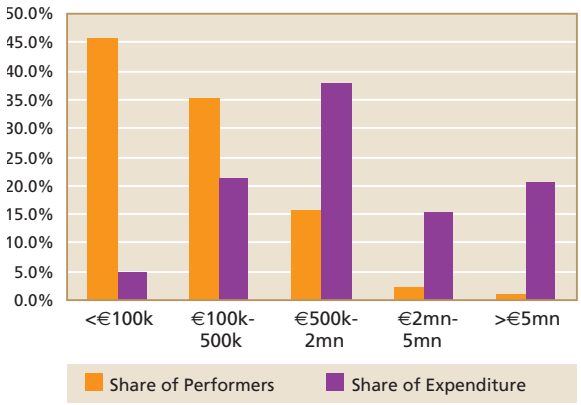
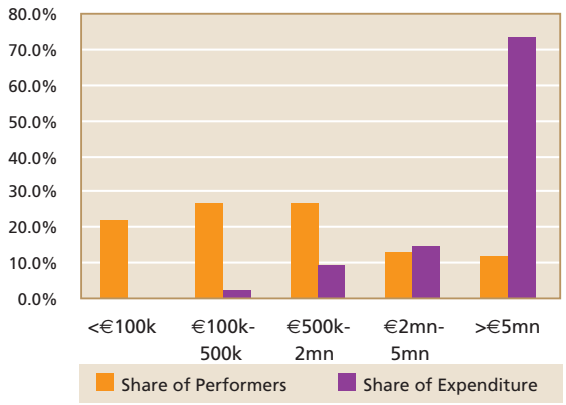


Chart 22: *Foreign-owned firms' R&D performance*



For the 2005-2006 business R&D survey, respondents were asked to identify the percentage of total research undertaken in 2005 classified by the following research types:

- Basic research – "involving the experimental or theoretical work undertaken primarily to acquire new knowledge without any particular application or use in view"
- Applied research – "the original investigation undertaken to acquire new knowledge primarily directed towards a specific practical aim or objective"
- Experimental development – "systematic work drawing on existing knowledge gained from research and practical experience that is directed to producing new materials, products and devices, to installing new processes, systems and services, or to improving substantially those already produced or installed".

Chart 22 illustrates the results, with half of all research spending undertaken by the business sector being classified as experimental development. Projects grouped under this category totalled €670.5 million in 2005 (50.5% of the total spending undertaken). Applied research accounted for 37.6% (€499 million) of total R&D spending in 2005, with basic research projects accounting for the remaining 12% of total R&D spending undertaken in the year (€159.3 million).

Chart 23: *Business R&D spending by type of research, 2005*

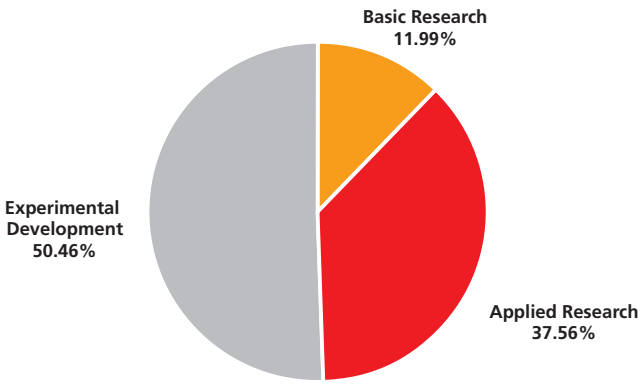
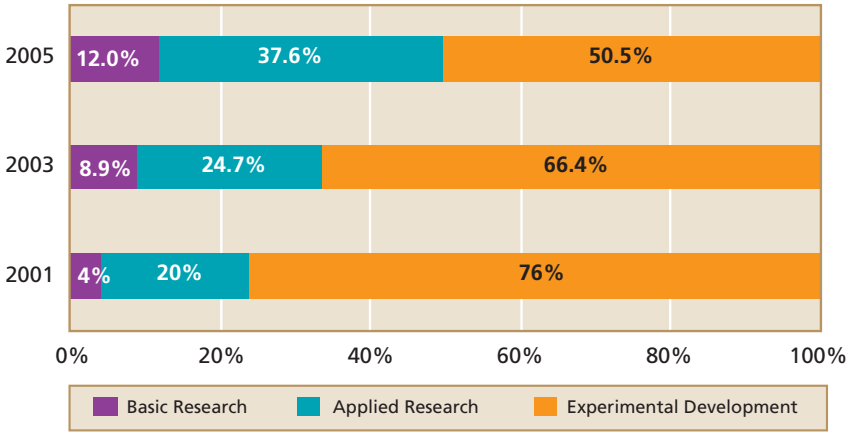


Chart 23 shows that R&D spending in the business sector in Ireland has been, in relative terms, more focused on basic and applied research programmes, with less relative focus on experimental development type projects. The share of total R&D spending accounted for by basic research projects has risen steadily from a 4% rate in 2001, climbing to 8.9% of total R&D spending in 2003, before increasing further to a 12.0% ratio in 2005. Similarly, the share of total R&D spending coming under the applied research category increased from a 20% total share in 2001 to a 37.4% total share in 2005. With the pace of R&D spending growth in the basic and applied categories outstripping R&D spending gains on experimental development driven projects, that share has fallen from 76% in 2001 to a 50.5% share in 2005.

Chart 24: *BERD spending by type of research as % of total spending, 2001-2005*



If we further analyse the type of research undertaken by type of business sector, we can see that in the Electrical/Electronic Equipment sector more than half the research undertaken was experimental, followed by applied research. Experimental research made up the highest percentage share of the total for every sector except the Instruments sector where applied research was over 50.9% of the total. Relative levels of basic research were strongest in the Software/Computer Related sector, with the spending ratio of 18.5% of total R&D spending in the sector recorded in 2005. In contrast basic research type projects accounted for just 5.1% of total R&D spending in the Electrical/Electronic Equipment sector in 2005.

Table 11: *Type of research by sector, 2005*

Type of Research	Basic	Applied	Experimental
Electrical/Electronic Equipment	5.1%	38.7%	56.2%
Software/Computer Related	18.5%	38.2%	43.3%
Pharmaceuticals	10.0%	36.5%	53.5%
Instruments	10.5%	50.9%	38.6%
Food, Drink & Tobacco	13.7%	29.4%	56.9%
Other Sectors	11.3%	30.0%	58.7%
Total	**12.0%**	**37.6%**	**50.4%**

The percentage levels of types of research by sector have changed since 2003 in line with the overall percentage changes in the three research types. The percentage of experimental research undertaken by all sectors dropped considerably in the 2003 to 2005 period with resultant increases in both applied, and to a lesser extent, basic research. This was most noticeable in the Software/Computer Related sector where the percentage of experimental research dropped from 71% to 43.3% and the Electrical/Electronic Equipment sector which recorded levels of 56.2% for experimental research in 2005 as opposed to 74% in 2003.

In the following table we examine the number of business firms who were classed as R&D active and who engaged in collaboration activities, such as joint research projects, with higher education institutions or other firms both inside and outside the country during 2005.

Of the total number of firms (1,370) who were R&D active in 2005, 490 firms (35.8%) were involved in some type of R&D collaboration activity. 239 R&D active firms collaborated with other Irish firms (17.4% of total active) slightly ahead of the 323 companies who collaborated with other companies outside of Ireland (23.6%). Looking at higher education R&D collaboration rates, 231 firms collaborated with higher education institutions in Ireland (16.9% of R&D active), ahead of the 116 firms that collaborated with higher education institutions outside of Ireland (8.5%).

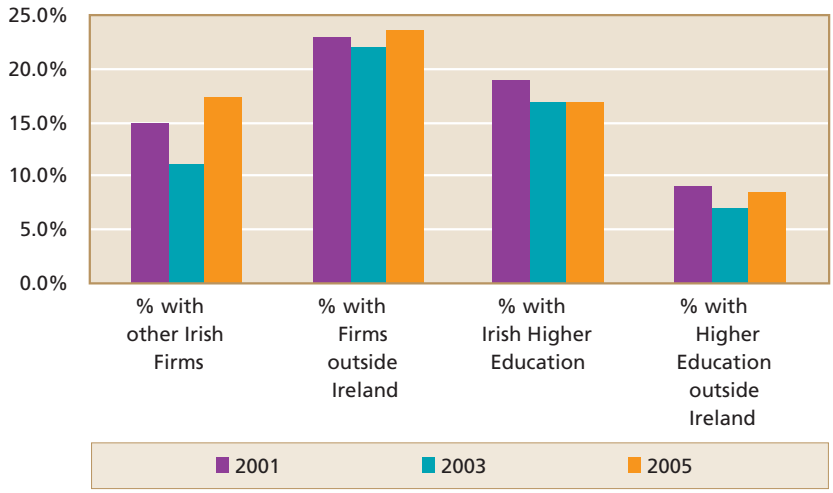
Table 12: *Collaborative activities of R&D active firms in 2005*

Collaboration	Other Firms in Ireland	Other Firms Outside Ireland	Higher Education in Ireland	Higher Education Outside Ireland	Any type of Collaboration
All Firms (1,370 active)	239	323	231	116	490
% active	17.4%	23.6%	16.9%	8.5%	35.8%

Chart 24 shows the percentage of research activities undertaken by Irish businesses in collaboration with other firms and with higher education institutions both inside and outside Ireland from 2001 to 2005. Collaborative research projects with companies outside Ireland has remained the area where most collaboration has taken place since 2001 with the Irish higher education sector being the next most popular choice for joint research projects.

The percentage of collaboration undertaken with other Irish firms has increased considerably to 17.4% in 2005 from 11% in 2003. Joint research collaboration between the business sector in Ireland and higher education institutions outside the country has remained low with levels of 9%, 7% and 8.5% respectively for 2001, 2003 and 2005.

Chart 25: *Percentage of R&D active companies which engaged in collaborative research, 2001-2005*



The highest level of collaborative research activity during 2005 was undertaken by the Electrical/Electronic Equipment sector with firms outside Ireland, which has remained unchanged since 2003. The next highest relative level of collaboration was between the Instruments sector and firms outside Ireland with collaboration levels of 32.7%. By contrast the lowest level of collaboration was between the Software/Computer Related sector and higher education institutions outside Ireland. This sector's highest levels of collaboration were with other firms both inside and outside Ireland.

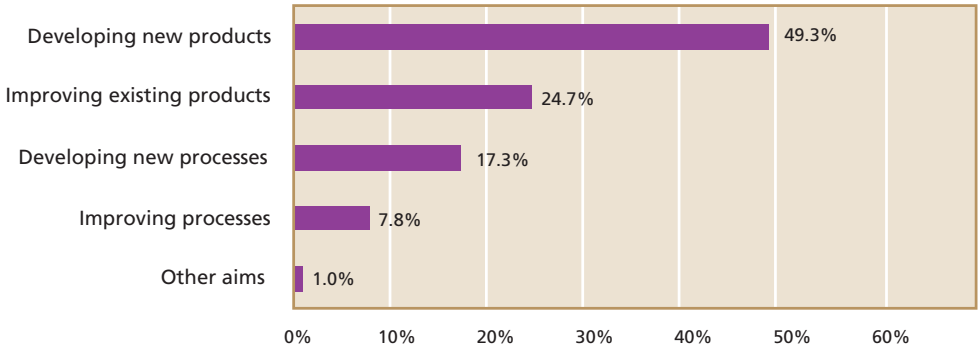
Table 13: *Percentage of BERD companies engaged in collaboration activities by sector, 2005*

	Other Firms in Ireland	Other Firms Outside Ireland	Higher Education in Ireland	Higher Education Outside Ireland
Electrical/Electronic Equipment	24.4%	35.3%	21.2%	15.4%
Software/Computer Related	17.6%	20.8%	13.1%	5.5%
Pharmaceuticals	25.8%	31.8%	27.3%	9.1%
Instruments	20.2%	32.7%	32.7%	8.7%
Food, Drink, Tobacco	17.0%	21.3%	16.5%	8.0%
Other Sectors	14.1%	19.9%	13.6%	8.1%
Total	**17.4%**	**23.6%**	**16.9%**	**8.5%**

The 2005 BERD survey asked companies carrying out R&D projects in Ireland in 2005, to specify their main aims when undertaking research. The aims were classified as:

- Developing new products
- Improving existing products
- Developing new processes
- Improving existing processes
- Other aims

Chart 26: *Aims of R&D spending as a percentage of total R&D spending*



As can be seen in Chart 25 development of new products in 2005 was the main motivation for undertaking research among business companies in Ireland, accounting for 49.3% of the total. Improving existing products accounted for 24.7% while developing new processes accounted for 17.3%. The remaining 8.8% of relevant expenditure was undertaken for the purposes of improving existing processes and other unspecified aims.

Chapter 2 - Business R&D Performance (medium/large firms)

Medium/Large firms >50 employees[9]

2.1 Introduction and Summary

This chapter brings forward the analyses of the first chapter and focuses further on the R&D performance of medium/large firms i.e. those employing more than 50 employees. Splitting the business R&D analysis into differing sizes of firms allows a closer look to be taken of the differing performance of varying firms. This analysis therefore allows R&D performance strengths and weaknesses to be identified for differing sizes of firms, which in turn facilitates better policymaking for these different areas of the economy.

The first section of this chapter focuses once more on the key area of R&D spending, though this time for medium/large sized firms. The second section examines the human resources allocated by medium/large firms to performing R&D activities. The final section looks at other R&D performance variables for medium/large firms including sources of funding for R&D activities, number of R&D active firms, types of research, collaboration and the aims of research programmes.

Like most developed nations a large majority of R&D spending is undertaken by medium/large firms. In 2005 the ratio of spending by these firms as a percentage of the total R&D spending was 75.8%. The growth rates of R&D spending by medium/large firms has therefore fallen behind the growth rates of R&D spending performed by small firms (those employing <50 employees). That said the ratio has been falling steadily from 1995 when it peaked at 87.9% of the total performance, although estimates for 2006 show an increasing ratio once more as larger projects by medium/large firms located in Ireland start to take effect.

Over the last five years strong R&D spending expansions by medium/large firms operating in the Pharmaceuticals sector has resulted in the sector rapidly challenging the previously dominant Software/Computer Related sector for the number one sectoral spending position.

Looking at human resources, 61.2% of all research personnel are employed in medium/large firms. Of this total 68.1% are employed in medium/large foreign-owned firms, with 31.9% employed in Irish-owned firms. Between 2001 and 2005 the strongest growth in R&D personnel employment has been in the Pharmaceuticals and Instruments sectors of the economy.

Among researchers an average 91.8% of working time in medium/large firms is spent conducting research, ahead of the 80.7% average research time spent by researchers employed in smaller firms. 58.7% of all PhD qualified researchers are employed by medium/large firms.

Some 45.4% of all R&D active medium/large firms were involved in collaboration with either other firms or with higher education institutions.

[9] *For analysis purposes firms which employ more than 50 employees are classified as medium/large firms.*

2.2 R&D Spending (medium/large firms)

Research & Development expenditure performed by medium/large firms in Ireland (those employing more than 50 employees) rose to just over €1.08 billion in 2005. This represented an annual average 9.6% increase between 2003 and 2005, slightly below the 9.9% annual rise in R&D spending by small firms in Ireland during that period.

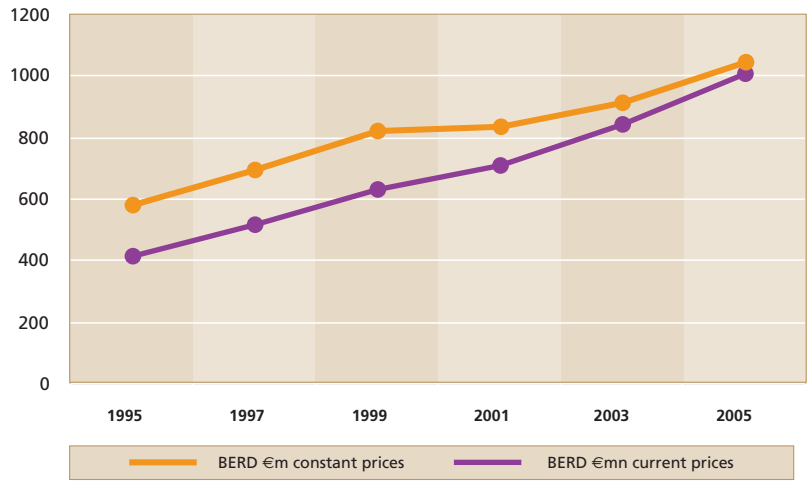
R&D spending growth by medium/large firms therefore accelerated from the 9% annual increase seen between 2001 and 2003.

Table 14: *Medium/large firms BERD, 1995-2006 (current and constant prices - €million)*

	1995	1997	1999	2001	2003	2005	2006 (e)
Current (BERD) €mn	413.0	514.3	633.5	708.5	840.0	1008.5	1200.0
% annual average change	-	11.8%	11.0%	5.5%	9.0%	9.6%	19.0%
Constant (BERD) €mn	577.9	697.7	825.9	833.9	913.0	1046.7	1200.0
% annual average change	-	9.9%	8.8%	0.5%	4.6%	7.1%	14.6%

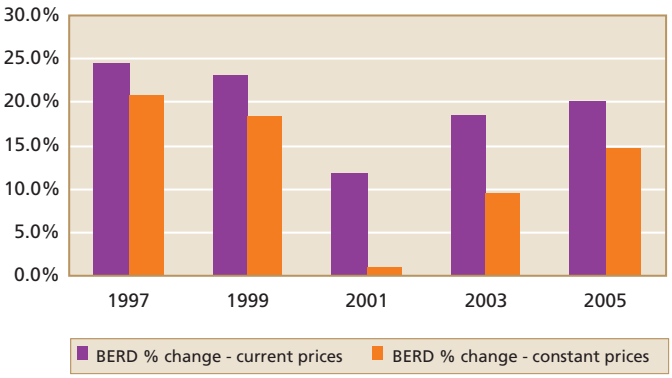
In real terms, BERD performed by medium/large firms in Ireland increased by an annual average 7.1% between 2003 and 2005, with spending growth quickening from the 4.6% annual average set between 2001 and 2003. This acceleration in real spending growth was a result of a quickening in current BERD spending by medium/large firms, alongside a slowdown in inflationary pressures during that time.

Chart 27: *Medium/large firms BERD spending, 1996-2005(€ million)*



Rates of growth for BERD spending by medium/large firms have quickened in each year between 2001 and 2006, following the deceleration in R&D spending growth between 1997 and 2001.

Chart 28: *Medium/large BERD growth rates (1997-2005) – 2 year change*

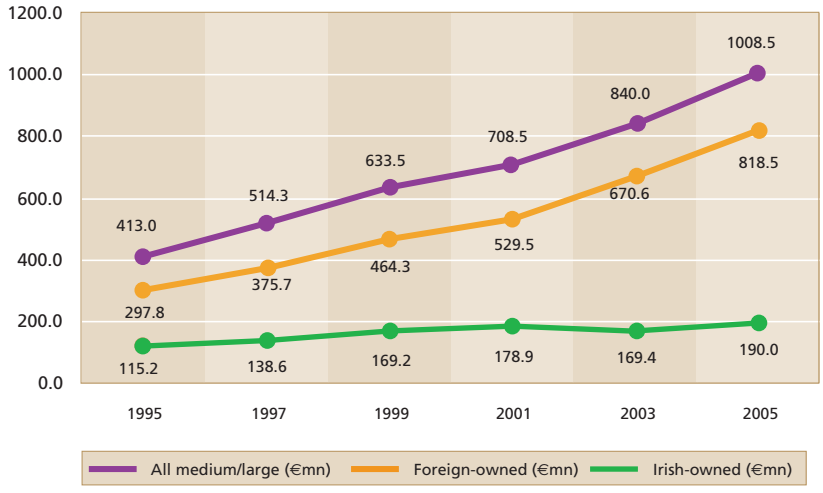


The business R&D questionnaire which was sent to all R&D performing firms in Ireland, as well as asking for R&D spending in 2005, asked an additional question concerning estimates of R&D expenditure in the current year – 2006. These R&D spending estimates by medium/large firms show that R&D expenditure growth is expected to quicken further in 2006, with firms predicting a sharp 19% increase in this period (in current prices).

If these spending patterns were to be realised and confirmed in the next BERD survey, then the rate of spending growth would represent one of the quickest rates of expansion recorded in the State. A 19% rise in medium/large business R&D spending growth in 2006, would also far outstrip the estimated 10% increase in gross national product in current prices, allowing for a rise in the BERD intensity ratio of an estimated 1.05% of gross national product.

Ireland's R&D spending has been dominated by medium/large firms. The amount of R&D conducted by medium/large firms as a percentage of total R&D spending would rise significantly to a ratio of 77% in 2006. The ratio of medium/large firms to total BERD was 88% in 1995 but fell back steadily to 78.7% in 2001 and 76% in 2003.

Chart 29: *Medium/large firms BERD by ownership (1995-2005) (Irish-owned/foreign-owned)(€mn)*



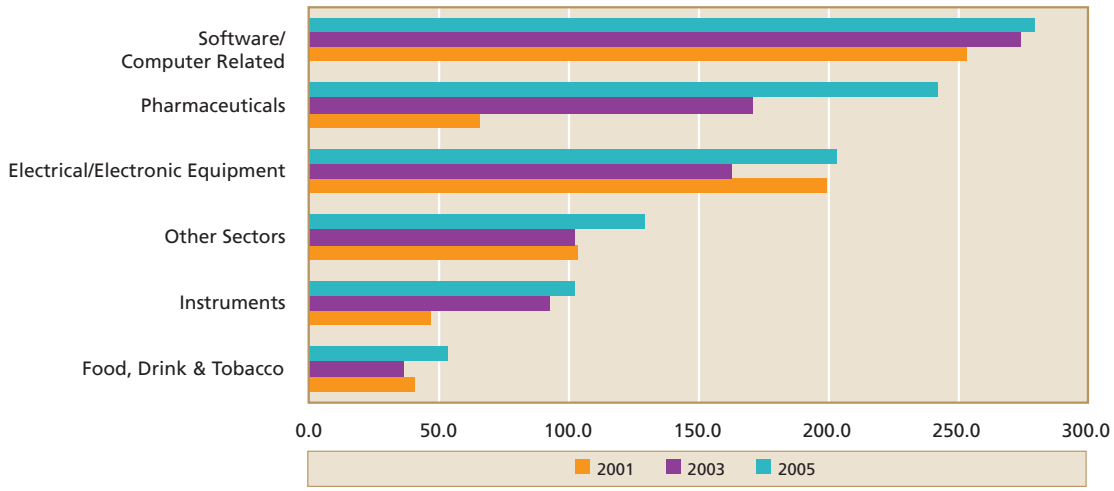
Spending on research and development activities by medium/large firms operating in the Irish business sector can be further broken down into areas of ownership. In the BERD questionnaire, firms were asked if most of the share ownership (>50%) in the company was Irish-owned. This is the standard statistical definition used by Eurostat which allows for comparable and accurate international benchmarking to take place around R&D and ownership.

Total R&D expenditure of medium/large firms of €1.08 billion in 2005 can be broken down into €818.5 million carried out by foreign-owned firms, with €190 million of R&D spending carried out by Irish-owned medium/large firms. Foreign-owned R&D expenditure for medium/large firms rose by 10.5% per annum on average between 2003 and 2005, ahead of the 6% annual average rise for Irish-owned medium/large R&D firms.

In 2005, R&D spending by medium/large firms was split into 81.2% performed by foreign-owned firms and 18.8% performed by Irish-owned firms. Ten years previously, 72.1% of total R&D spending of medium/large firms was performed by foreign-owned firms, and 27.9% by Irish-owned firms. Among medium/large firms there is an increasing, albeit slow, dominance by foreign-owned firms of total R&D.

Sectoral analyses of R&D spending by medium/large firms in Ireland, shows that the Software/Computer Related sector was the largest performing sector in 2005. This was followed by the rapidly growing Pharmaceuticals sector for medium/large firms and then the Electrical/Electronic Equipment sector.

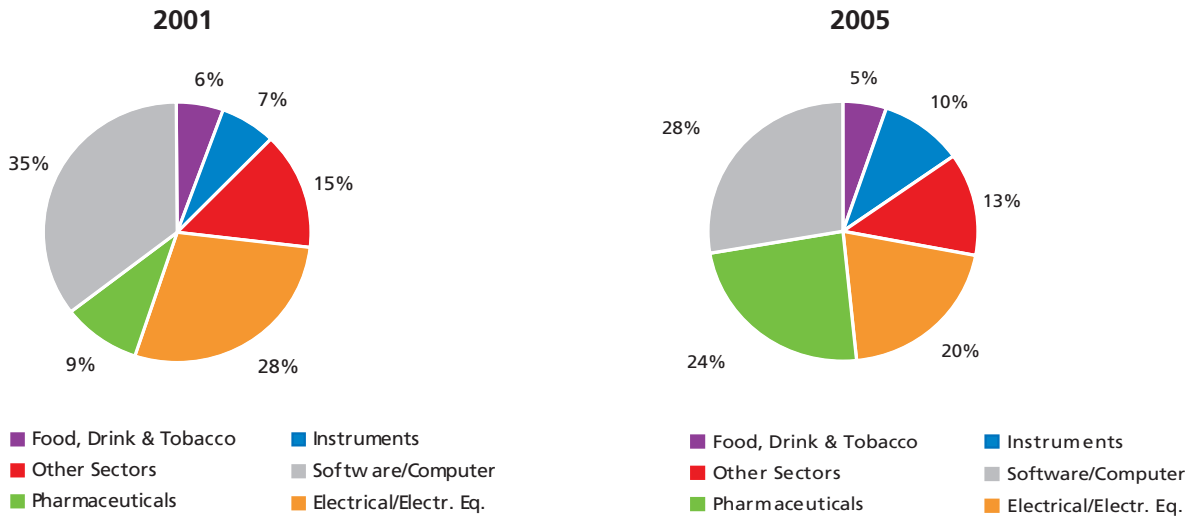
Chart 30: *R&D industry spending by medium/large firms by selected sectors (2001-2005) (€mn)*



Business sector R&D spending by medium/large sized firms in the Software/Computer Related sector rose by 1.8% between 2003 and 2005. The growth rate for medium/large firms in this sector was far outpaced by the R&D spending growth rates in other sectors including Electrical/Electronic Equipment (24.9%); Pharmaceuticals (41.3%); Food, Drink & Tobacco (44.0%) and Instruments (10.0%).

Strong growth in R&D spending by medium/large sized firms in the Pharmaceuticals sector has pushed up their sectoral share of the total from 9.3% in 2001 to 24% in 2005. The level of BERD growth recorded between 2003 and 2005 was 41.3% over the two year period, far ahead of the average 20.1% increase in medium/large BERD spending for all firms.

Chart 31: *Sectoral shares for medium/large firms 2001, 2005*



R&D spending by medium/large firms operating in the Software/Computer Related sector rose by a more moderate 1.8% in the two year period. As a result the share of total R&D performed by medium/large Software/Computer Related sector firms has fallen from 35.7% in 2001 to 27.7% in 2005. Similarly, the share of total R&D performed by medium/large firms operating in the Electrical/Electronic Equipment sector has also fallen between 2001 and 2005 from 28.1% to 20.2% of the total.

Table 15 shows the different types of R&D spending conducted by medium/large firms in the Irish business sector. Labour costs make up most of the R&D spend, followed by other current costs, equipment and then land and buildings.

Table 15: *Medium/large firm spending on R&D by type of cost, 2001-2005 (€mn)*

	2001	2003	2005
Labour Costs	395.6	450.4	537.0
Other Current Costs	262.3	252.4	312.6
Land and Buildings	10.0	78.0	47.3
Equipment	40.6	59.3	111.7
Total	**708.5**	**840.0**	**1008.5**

In 2005, the €1.01 billion of R&D spending by medium/large was distributed between labour costs - €537 million (53.2% of the total); other current costs - €312.6 million (31.0% of total); equipment - €111.7 million (11.1%) and finally land and buildings - €47.3 million 4.7%). Between 2001 and 2005 the ratio of labour costs to total R&D spending has fallen slightly from 55.8% of the total R&D expenditure in 2001 to 53.2% of the total in 2005. Spending in this category rose by 19.2% between 2003 and 2005. Spending on other current costs also posted strong gains in that period, increasing by 23.8%.

On the capital expenditure side for medium/large firms R&D spending has been more volatile over recent years. Between 2003 and 2005, spending on land and buildings for performing R&D activities fell by 39.3%, though the spending level remained above that posted in 2001. In contrast, spending on R&D equipment has continued to post strong gains between 2001 and 2005. In the last two years spending in this category has increased by 88.3%.

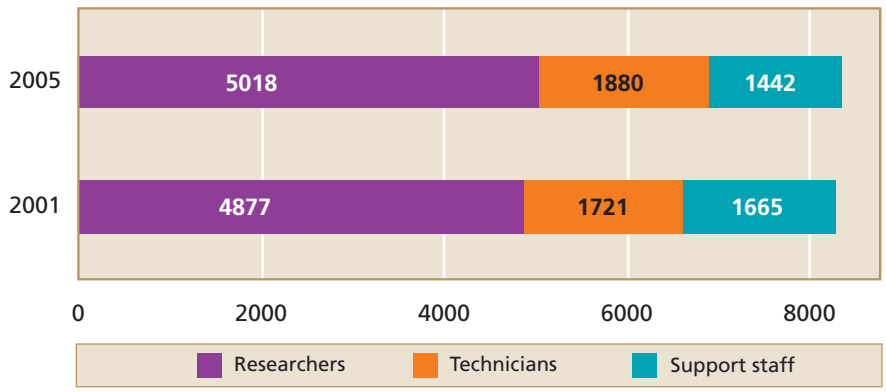
The spending volatility in the capital expenditure side is a result of expenditure on some large capital projects coming to an end and the beginning of the tooling-up process for these projects. Looking ahead there appears to be a growing momentum once more in R&D spending in the land and buildings category as more new R&D projects begin to come on-line.

2.3 R&D Human Resources (medium/large firms)

Alongside R&D spending indicators, it is important to evaluate progress on human resources for medium/large firms. In the BERD survey questionnaire, businesses were asked to outline the total headcount of personnel devoted to R&D activities, alongside what type of work the staff were completing – researcher, technician or admin./support work. Firms were also asked to split these results by gender and also to estimate the average time spent on research activities – this variable is used to convert the headcount to full-time equivalent estimates. Finally, firms were also asked to record how many researchers had PhD qualifications.

Chart 31 shows the amount of personnel in headcount terms operating in R&D areas for medium/large firms. In 2005, 8,335 people were performing R&D activities in Ireland for medium/large firms. Of this total, 5,018 were employed as researchers, 1,880 as technicians and 1,442 as support staff for R&D activities.

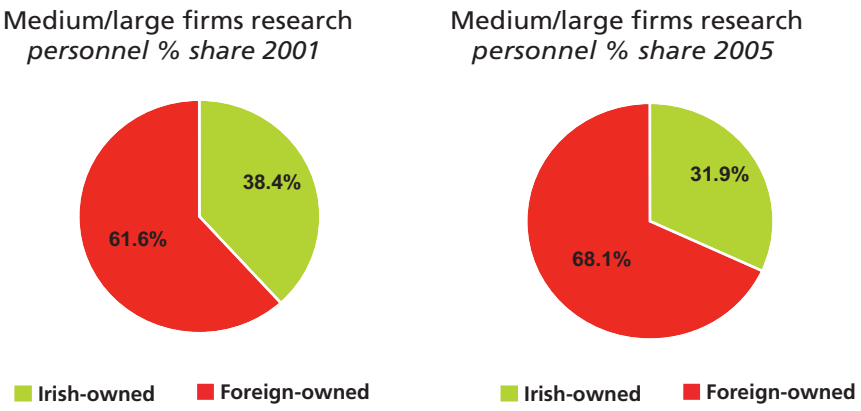
Chart 32: *Research personnel for medium/large firms (2001 and 2005 - headcount)*



Between 2001 and 2005 the total headcount of researchers employed in medium/large firms has increased by less than 1%. The total amount of researchers working in these firms has risen by 2.9% in the four-year period, with the total technicians operating in R&D areas rising by a stronger 9.2%. The amount of people supporting R&D activities for medium/large firms has fallen by 13.4% in the period.

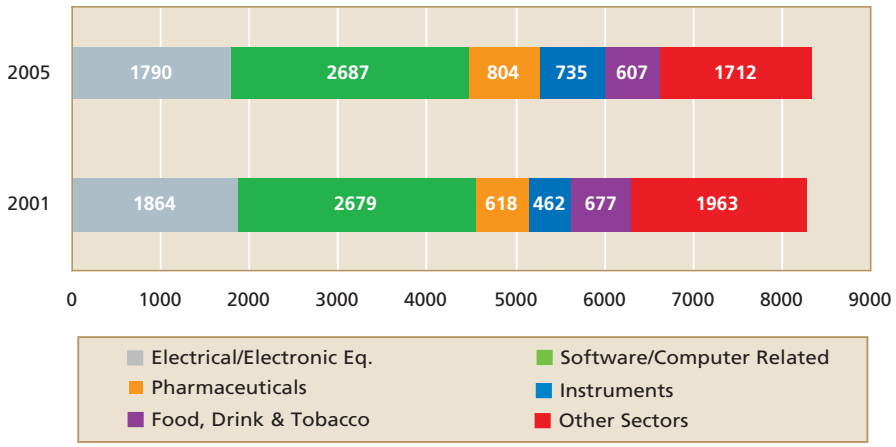
An examination of human resource numbers in medium/large firms by ownership of enterprise shows that 68.1% of total research personnel were employed by foreign-owned firms in 2005. This is above the 61.6% recorded share in 2001. The share of research personnel working in medium/large Irish-owned firms has fallen from 38.4% of the total in 2001 to 31.9% in 2005.

Chart 33: *Share of R&D personnel by type of ownership (2001, 2005)*



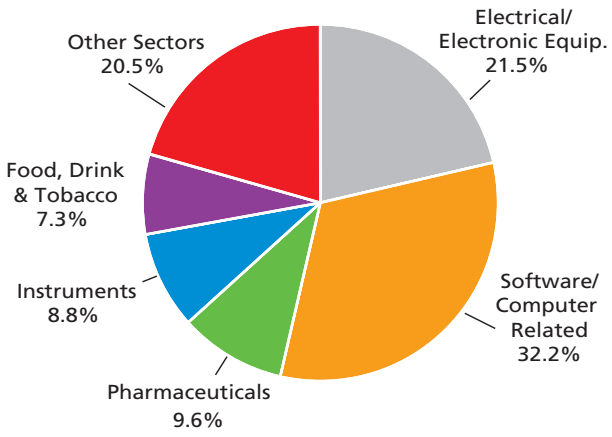
Human resources devoted to R&D activities in medium/large firms were spread across a wide range of sectors in the economy. Of the 8,335 personnel working in R&D areas of firms, the largest sector of employment was in Software/Computer Related areas with 2,687 employed in these areas (32.2% of the total).

Chart 34: *Sectoral breakdown of research personnel of medium/large firms (2001, 2005)*



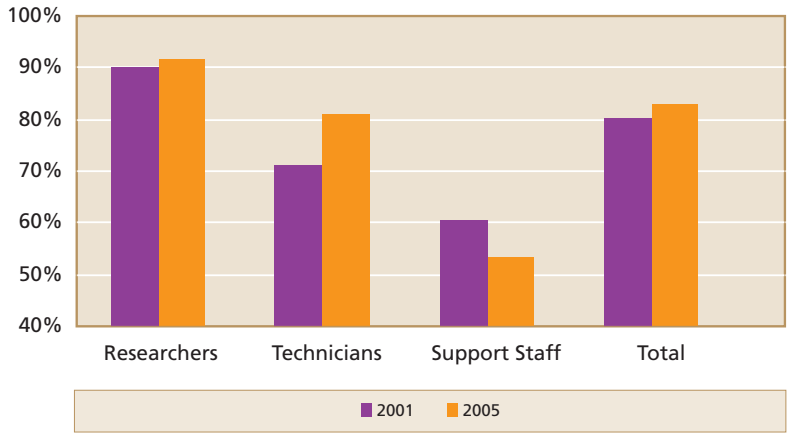
The next largest sector of employment for R&D personnel of medium/large firms in 2005 was in Electrical/Electronic Equipment areas – 1,790 people (21.5% of the total). Human resources devoted to R&D activities have grown strongly for medium/large firms operating in the Pharmaceuticals and Instruments sectors. These sectors now account for 9.6% and 8.8% of the total number of R&D personnel for medium to large firms.

Chart 35: *Sectoral shares of R&D personnel for medium/large firms in 2005*



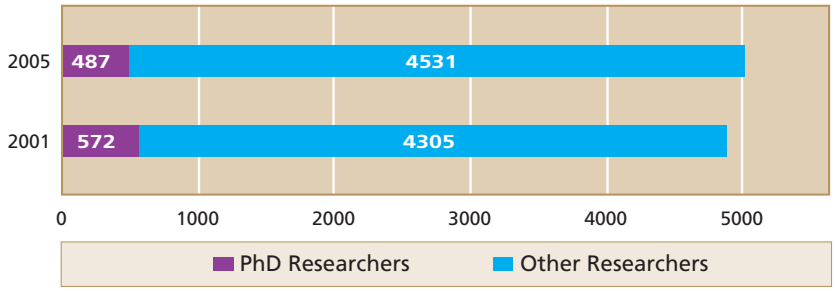
The average time spent on research activities by all research personnel in medium/large firms rose from 80.1% in 2001 to 82.8% in 2005. For staff employed as researchers the ratio rose from 90.0% in 2001 to 91.8% in 2005. There has also been a strong increase in the time spent on research activities by staff employed as technicians, with this ratio climbing from 71.2% in 2001 to 81.1% in 2005. In contrast, time spent on research activities by support staff has fallen from 60.6% of total time in 2001 at work to 53.4% in 2005. This type of employee has demonstrated most volatility in results in recent years.

Chart 36: *Time spent on research by occupation in medium/large firms (2001 and 2005)*



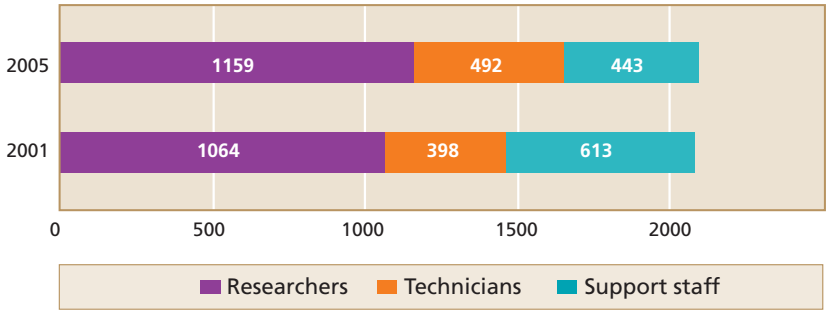
Of the 5,018 staff employed as researchers by medium/large firms operating in the Irish business sector in 2005, an estimated 487 had a PhD qualification (9.7% of total researchers). This represents a fall from the 572 PhD qualified researchers operating in the Irish business sector in 2001.

Chart 37: *Researchers in medium/large firms by type of qualification (2001 and 2005)*



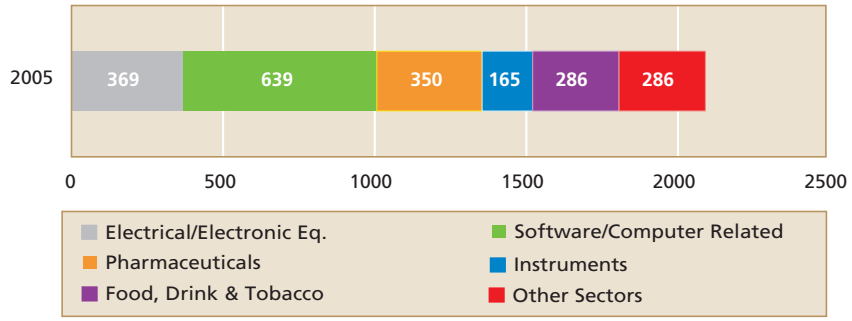
The next section of this chapter examined research personnel by gender and focuses on female human resources devoted to R&D activities by medium/large firms. Chart 37 shows the total female research personnel involved in R&D between 2001 and 2005. Total female research personnel for medium/large firms increased from 2,076 in 2001 to 2,094 in 2005. Female technicians rose from 398 to 492 in the two year period. Female support staff fell from 613 in 2001 to 443 in 2005.

Chart 38: *Female research personnel by type of job (2001, 2005)*



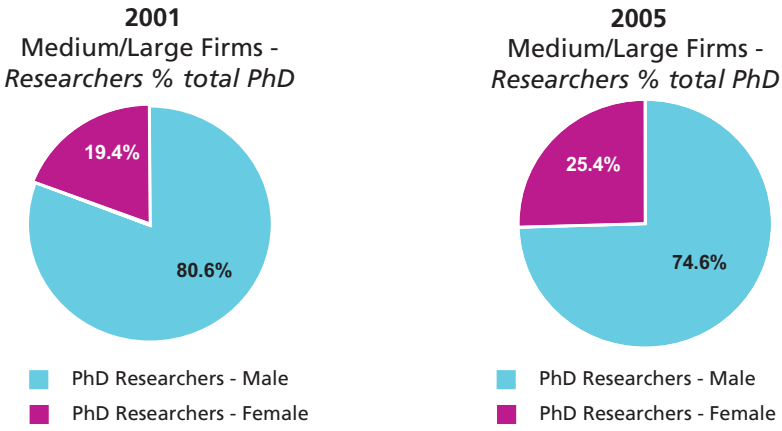
On a sectoral basis, most female research personnel operate in the Software/Computer Related sector – 639 or 23.8% of the total male and female research personnel employed in this area. The next largest sector for employment of female research personnel was the Electrical/Electronic Equipment sector, with 369 females employed in R&D areas (20.6% of the total). The largest sectoral ratio of females to total research employed, was in the Food, Drink & Tobacco sector, with 47.2% of researchers employed being female, slightly ahead of the gender ratio in the Pharmaceuticals sector which stood at 43.5 % in 2005.

Chart 39: *Female research personnel by sector, 2005*



The time use of female research personnel rose to 84.5% in 2005. Of that total, female researchers spent 92.2% of their average time conducting research in medium/large firms. Chart 39 shows the ratio of PhD qualified researchers by gender in 2001 and 2005. With female PhD researchers employed by medium/large firms increasing in that period, against the drop in male PhD researchers, the female PhD ratio has risen from 19.4% in 2001 to 25.4% in 2005.

Chart 40: *Male/female PhD researchers as % of total PhD's (2001, 2005)*



2.4 Other R&D Data (medium/large firms)

This section of the chapter focuses on medium/large firms R&D performance and looks at several other variables including sources of funds, number of performing firms, type of R&D activity, collaboration and aims of R&D programmes.

Table 16 shows the total R&D expenditure of medium/large firms broken down into sources of funding in 2005. Of the total €1.01 billion spent on R&D activities by medium/large firms, €970.4 million was funded from private sources including own company funds and other private sources (96.2% of the total). Funding for medium/large firms from Irish government sources accounted for an additional €36.7 million (3.6% of the total), and a further €1.4 million was sourced from EU public funds.

Table 16: *Sources of funding of R&D expenditure for medium/large firms (2001 2005) €mn*

	2001	2003	2005
Private Funding	693.4	829.3	970.4
Irish Government	13.2	12.2	36.7
EU Funding	2.0	0.5	1.4
Total BERD	**708.5**	**842.1**	**1,008.5**

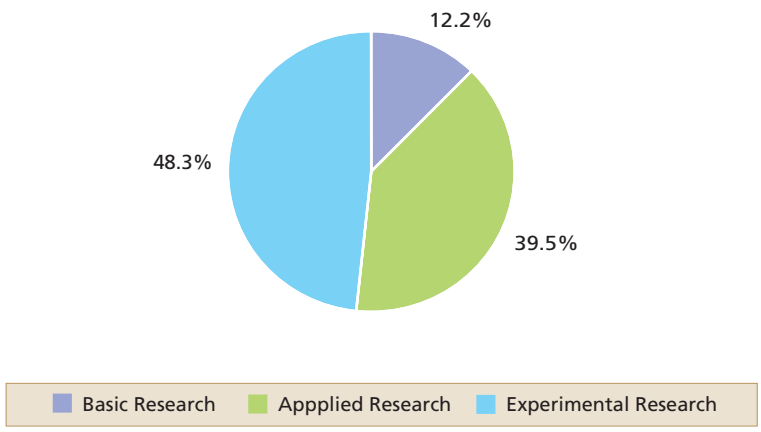
The total number of R&D performing medium/large firms was estimated to be 412 in 2005, below the estimated 476 medium/large performers recorded in 2001. Of the 412 R&D active medium/large firms, 208 were Irish-owned and 204 were foreign-owned. The largest fall in the number of R&D performing firms was posted between 2001 and 2005 for Irish firms.

Table 17: *Number of medium/large R&D active firms (2001-2005)*

	2001	2005
Irish Owned	264	208
Foreign Owned	212	204
Total Number	**476**	**412**

Medium/large businesses were asked to divide their R&D spending into three different types – Basic Research, Applied Research and Experimental Development. Definitions of these activities which follow strict international guidelines are contained in Section 1.4 p. 28. Chart 40 shows the spending of medium/large firms broken down into these three areas.

Chart 41: *Types of R&D spending by medium/large firms (% total 2005)*



Of the €1.08bn invested in R&D activities in 2005 by medium/large firms, €487.3 million was spent in experimental development (48.3%). The next largest type of R&D spending was in the applied research area were €398.4 million was spent (39.5%). Basic research type R&D accounted for an

additional €122.8 million in medium/large firms (12.2%). This was slightly ahead of the basic research spend ratio for small firms. Spending on basic research activities for medium/large firms has jumped sharply between 2001 and 2005.

Looking at the sectoral breakdowns of the types of spending for medium/large firms we can see that the largest basic research ratio is performed in the Software/Computer Related sector (21.7%). Medium/large firms operating in the Food, Drink & Tobacco sectors carry out 12.2% of spending in basic research, with the Instruments and Pharmaceuticals sectors performing 9.7% each. The smallest ratio of basic research to total R&D spending is in the Electrical/Electronic Equipment sector at 4.2% of total R&D.

Chart 42: *Sectoral spending on basic research by medium/large firms (% total 2005)*

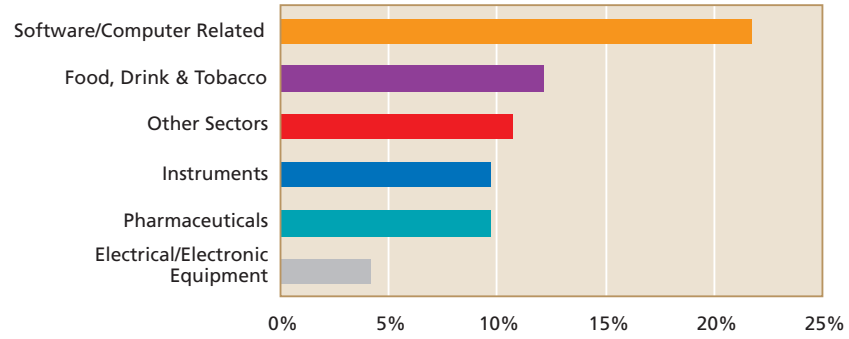


Table 18: *Sectoral breakdown of type of research for medium/large firms (2005)*

	Basic Research	Applied Research	Experimental Research
Electrical/Electronic Equipment	4.2%	38.9%	56.9%
Pharmaceuticals	9.7%	39.4%	50.9%
Instruments	9.7%	52.7%	37.6%
Software/Computer Related	21.7%	42.5%	35.8%
Food, Drink & Tobacco	12.2%	28.9%	58.9%
Other Sectors	10.7%	28.1%	61.3%

Firms were asked if they undertook any collaboration when completing R&D projects. This collaboration was defined as with other businesses inside or outside of Ireland, and also with higher education institutions inside or outside of Ireland.

Table 19 shows the total number of R&D collaboration activities undertaken by medium/large firms in 2005, alongside the activity rate relative to all R&D performing and active firms. Of all active medium/large R&D performing firms, 45.4% were involved in some type of collaboration activity, either with business or higher education.

Table 19: *R&D collaboration activities of medium/large firms (% total active 2005)*

	Other Firms in Ireland	Other Firms Outside Ireland	Higher Education in Ireland	Higher Education Outside Ireland	Any type of Collaboration
No. of Medium/Large Firms	91	125	102	50	187
% active	22.1%	30.3%	24.8%	12.1%	45.4%

Collaboration with other firms in Ireland was undertaken by 22.1% of R&D active medium/large firms. This was below the ratio of active firms collaboration in R&D projects with other firms outside of Ireland which was an estimated 30.3%. Collaboration with higher education institutes in Ireland was undertaken by 24.8% of R&D active medium/large firms, ahead of the 12.1% collaboration ratio with higher education institutes outside of Ireland.

Chart 43: *Sectoral R&D firm to firm collaboration activities of medium/large firms (% total active 2005)*

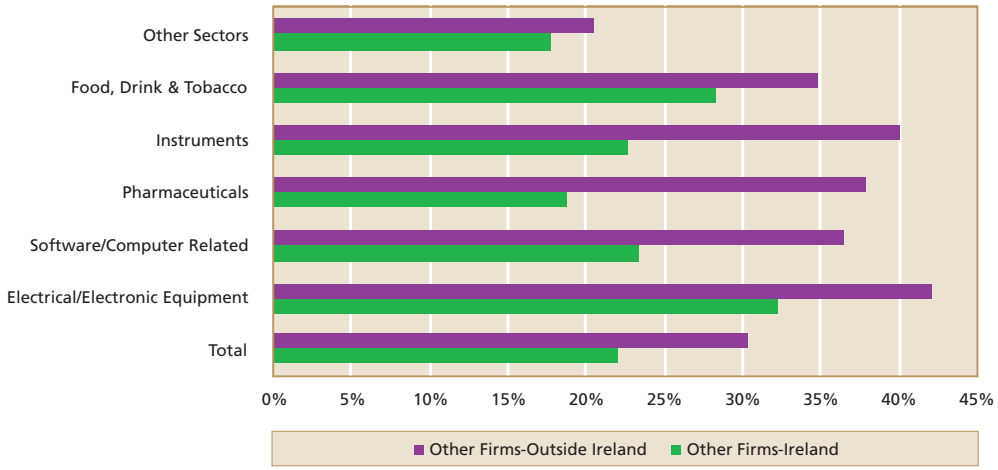
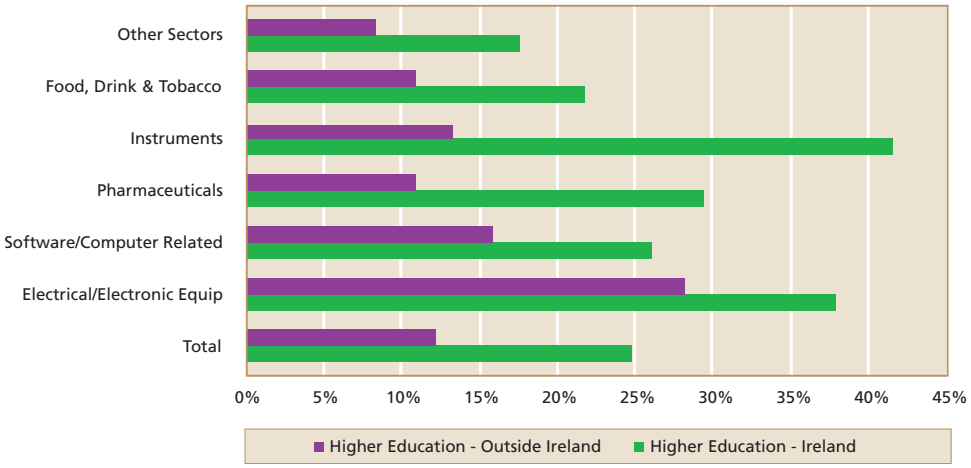


Chart 44: *Sectoral R&D collaboration firm to higher education activities of medium/large firms (% total active 2005)*

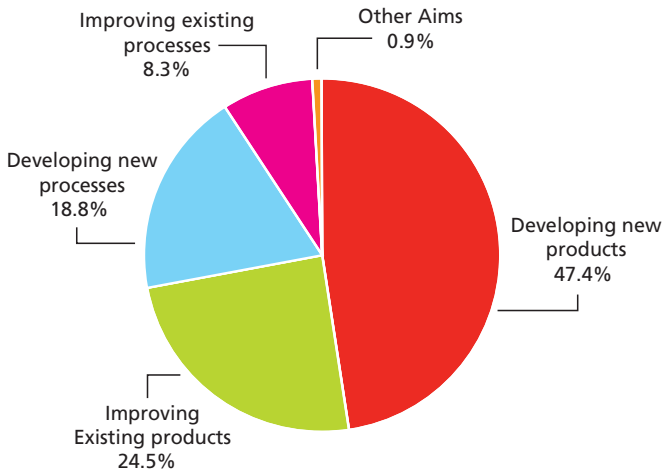


Looking at the sectoral breakdown of collaboration activities of medium/large firms shows that most firm to firm collaboration was undertaken in the Electrical/Electronic Equipment sector. 32.2% of firms in this sector collaborated on R&D projects with other firms in Ireland and 42.1% of Electrical/Electronic Equipment firms collaborated with other firms outside of Ireland. Just 18.8% of medium/large R&D active firms operating in the Pharmaceuticals sector were involved in collaboration with other firms in Ireland, although 37.9% collaborated with other firms outside of Ireland.

Regarding sectoral collaboration with higher education institutes in Ireland (chart 43), the highest collaboration ratios were posted in the Instruments and Electrical/Electronic Equipment sectors at 41.7% and 38% respectively. This was well ahead of the ratio of R&D active firms in the Food, Drink & Tobacco sector collaborating with higher education in Ireland at 21.7%. The weakest area of collaboration for all sectors was with higher education institutions outside of Ireland.

The final area examined in this chapter, focusing on medium/large firms, is R&D expenditure by aim of spending. Firms were asked in the latest BERD survey to divide their spending on R&D activities into five different areas: developing new products; improving existing products; developing new processes; improving existing processes and other aims. Chart 44 shows the total R&D spend of medium/large firms posted in 2005 broken down into these five categories.

Chart 45: *R&D Spending by medium/large firms by aim (2005)*



Of the total €1.08 billion spent on R&D by medium/large firms in Ireland in 2005, €478 million was aimed at developing new products – 47.4% of the total spend. A further €189.2 million (18.8% of total) was spent developing new processes.

In 2005, €247.5 million of R&D spending was for the purpose of improving existing products (24.5% of the total expenditure). This was above the €84.1 million expenditure on improving existing processes (8.3%). An additional €9.5 million of spending was recorded by medium/large firms as being aimed at other areas (0.9% of total R&D expenditure).

Chapter 3 - Business R&D Performance (small firms)

Small firms <50 employees[10]

3.1 Introduction and Summary

This chapter brings forward the analyses of the first chapter and focuses further on the R&D performance of small firms i.e. those employing less than 50 employees. Quite often the performance and policy needs of small firms are different from those of much bigger companies. Closer analysis therefore of the R&D performance of small firms can help identify specific strengths, weaknesses and opportunities for companies operating in these areas of the economy.

The first section of this chapter focuses once more on the key area of R&D spending, this time for small firms. The second section examines the human resources allocated by small firms to performing R&D activities. The final section looks at other R&D performance variables for small firms including, sources of funding for R&D activities; number of R&D active firms; types of research; collaboration and the aims of research programmes.

Spending by small R&D active firms in Ireland was 24.2% of the total R&D expenditure. This ratio of spending has risen steadily from 2003 when the quantity of total R&D spending performed by small firms was 12.1%. R&D spending growth rate for small firms remained strong between 2003 and 2005, with an annual average rise of 9.9% recorded, outpacing the 9.6% average spending rises posted by medium/large firms. Initial estimates for R&D expenditure by small firms in 2006 points to an acceleration in average annual growth to 12.4%, though this is below the anticipated 19.0% increase for medium/large companies.

On a sectoral basis, R&D spending by small firms operating in the Electrical/Electronic Equipment areas was strong between 2003 and 2005, with a 52.4% increase recorded. Spending by small R&D firms in the Pharmaceuticals sector climbed by 32.6% between 2003 and 2005, and this sector now accounts for 7.8% of all R&D spending by small firms. This is higher than the 2.5% share undertaken by small firms in the Pharmaceuticals sector in 2001 and mirrors the sectoral share increase recorded for medium/large firms.

Turning to the performance of human resources dedicated to R&D projects by small firms in 2005, some 38.8% of all staff working in R&D in the Irish economy work in small firms. Of this number, 77.4% work in small Irish firms, with 22.6% employed by foreign-owned companies. Between 2001 and 2005, there were strong increases in research personnel employed by small firms operating in the Electrical/Electronic Equipment, Pharmaceuticals, Instruments and Food, Drink & Tobacco sectors. Female researchers are well represented in small firms in the Food, Drink & Tobacco and Pharmaceuticals areas.

A higher share (5.7%) of small firms' R&D spending was sourced from the Irish government than for medium/large firms (3.6%). Over 85% of small R&D active firms were Irish-owned in 2005. An estimated 31.7% of R&D active small firms were involved in collaboration activities, below the 45.4% collaboration ratio for medium/large companies.

10 For analysis purposes firms which employ less than 50 employees are classified as small firms.

3.2 R&D Spending (small firms)

Research & development expenditure performed by small firms in Ireland (those employing less than 50 employees) rose to just over €360 million in 2005, compared to the €320.2 million spent on R&D in 2003. This represented an annual average 9.9% increase between 2003 and 2005, slightly ahead of the 9.6% annual rise in R&D spending by medium/large firms in Ireland during that period.

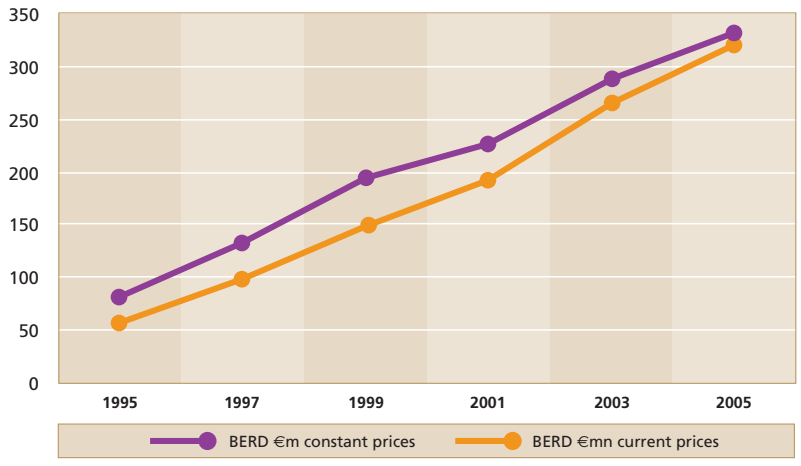
R&D spending growth by small firms therefore decelerated from the 17.4% annual increase posted between 2001 and 2003. Spending on R&D by small firms now accounts for 24.1% of the total spend on R&D, compared to the 12.1% in 1995.

Table 20: *Small firm BERD, 1995-2006 (current and constant prices € million)*

	1995	1997	1999	2001	2003	2005	2006 (e)
Current (BERD) €mn	57.1	97.9	149.8	192.1	265.1	320.2	360.0
% annual average change		32.2%	23.6%	13.3%	17.4%	9.9%	12.4%
Constant (BERD) €mn	79.9	132.8	195.3	226.1	288.2	332.3	360.0
% annual average change		28.9%	21.2%	7.6%	12.9%	7.3%	8.3%

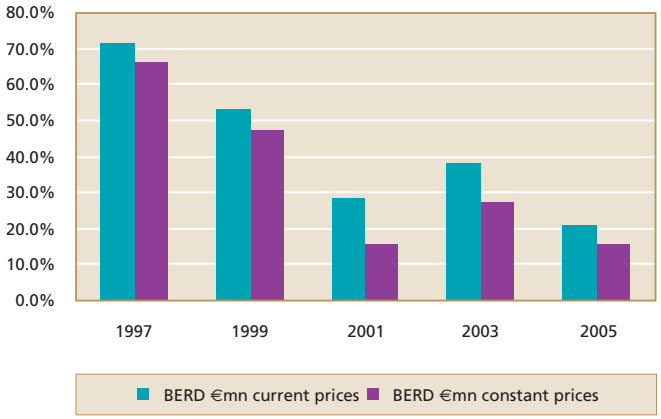
In real terms, BERD performed by small firms in Ireland increased by an annual average 7.3% between 2003 and 2005, with spending growth slowing from the 12.9% annual average growth in real terms set between 2001 and 2003.

Chart 46: *Small firm BERD spending, 1995-2005 (€mn)*



Rates of spending growth on research and development by small firms as shown in Chart 45 have steadied somewhat from the strong growth catch-up phase between 1997 and 1999.

Chart 47: *Small firm BERD growth rates (1997-2005) – 2 year change*



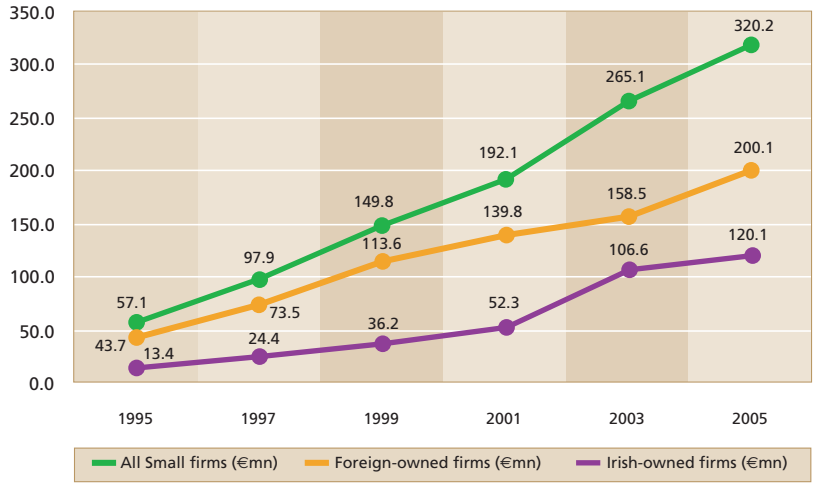
Spending estimates of R&D for small firms in 2006, point to a re-acceleration in growth trends. Current R&D spending is anticipated to increase by 12.4% compared to 2005. In real terms, stripping out the effects of inflation, this would result in an 8.3% rise in 2006.

Although this quickening growth rate for R&D spending by small firms is robust, it is still some way below the forecast 19% rise in R&D spending by medium/large firms in the same period. That said the 12.4% rise in small firm R&D would represent a stronger rise than the estimated 10% increase in gross national product in current prices in 2005. This would allow for a rise in the BERD intensity ratio to an estimated 1.05% of gross national product.

Total R&D expenditure of small firms of €320.2 million in 2005 can be broken down into €200.1 million performed by Irish-owned firms, with €100.1 million of R&D spending carried out by foreign-owned small firms.

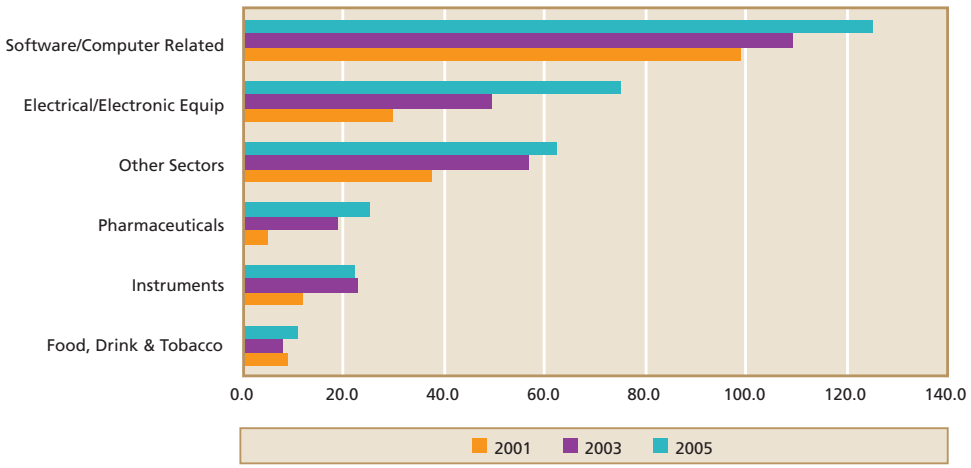
Between 2003 and 2005, strong R&D spending growth was recorded for small Irish-owned firms. Irish-owned R&D expenditure for small firms rose by 12.5% per annum on average between 2003 and 2005, ahead of the 6.1% annual average rise for Irish-owned medium/large R&D firms. Irish-owned small firms conducting R&D now account for 62.5% of all R&D small firm expenditure. This is somewhat below the 76.5% R&D spending share of small Irish-owned firms recorded in 1995, though ahead of the 59.8% R&D spending share posted in 2003.

Chart 48: *Small firms' BERD by ownership (1995-2005) €mn.*



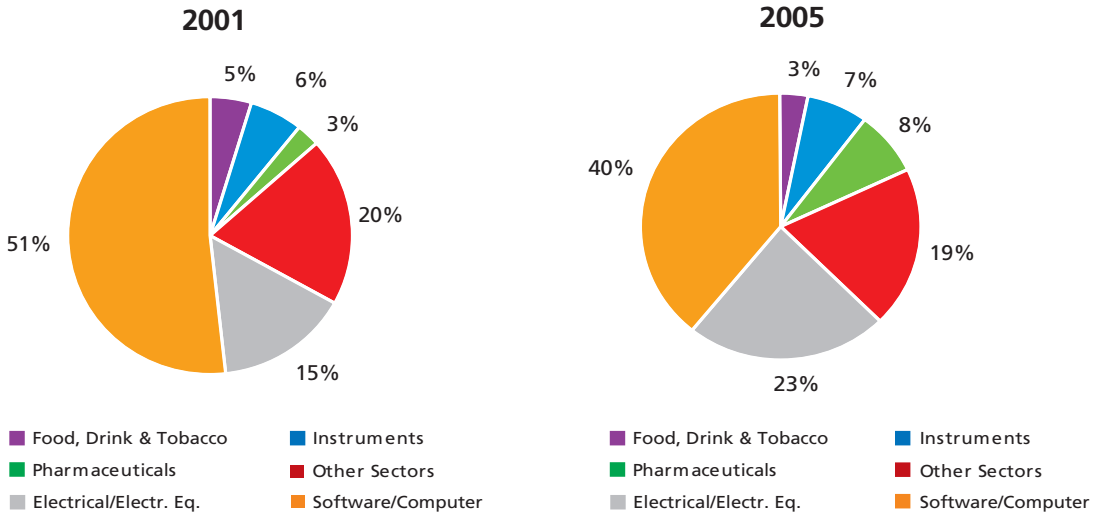
The Software/Computer Related sector continued to dominate overall R&D spending for small firms, with growth of 14.5% posted between 2003 and 2005. This sector accounts for 39.1% of total R&D spending by small firms, below the 51.6% share measured in 2001.

Chart 49: *Small firms' R&D spending by selected sectors (2001, 2003, 2005) €mn*



R&D expenditure by small Electrical/Electronic Equipment firms remained strong between 2003 and 2005, growing by 52.4%. Spending by small firms on R&D in this sector now accounts for 23.4% of the total R&D expenditure. This share of spending has risen from the 15.3% share recorded in 2001. R&D spending by small Pharmaceuticals firms rose by 32.6% between 2001 and 2005, and this sector now accounts for 7.8% of total R&D spending by these types of companies.

Chart 50: *Sectoral share for small firms' R&D spending, 2001 and 2005*



The last spending variable examined in this section for small firms' R&D performance is the type of expenditure. Between 2003 and 2005 labour costs of R&D activities climbed 29.9% per annum, and above the 19.2% two-yearly rise in labour costs for medium/large firms. Labour costs for small R&D performing firms now account for 65.8% of total R&D spending, a rise from the 62.4% ratio posted in 2001. The ratio in 2005 is above the labour cost to total R&D spending ratio recorded for medium/large firms at 53.2%.

Table 21: *Small firms' spending on R&D by type of cost 2001, 2003, 2005 (€mn)*

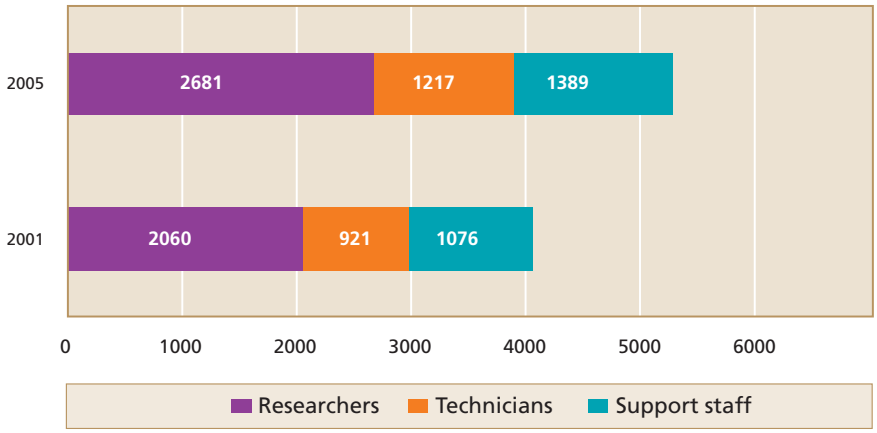
	2001	2003	2005
Labour Costs	119.7	162.1	210.6
Other Current Costs	55.7	87.2	79.5
Land and Buildings	5.6	3.5	8.6
Equipment	10.7	12.1	21.4
Total	**191.7**	**265.0**	**320.2**

3.3 R&D Human Resources (small firms)

Another key area of examination of the performance of small R&D active companies is human resources. As outlined in section 2.3 firms were asked several questions on the human resources input to R&D activities. As well as outlining the total headcount devoted to R&D, small firms are also asked to provide details on types of job; gender breakdowns of staff; qualifications and time spent on research.

Chart 50 shows the total headcount of R&D staff employed in small R&D active companies in 2001 and 2005. During 2005, 5,286 people were carrying out research activities in small firms. Of the total personnel headcount involved in R&D in Ireland in 2005, 38.8% were working in firms with less than 50 employees. Total research employees in small firms grew strongly between 2001 and 2005, rising by 30.3%.

Chart 51: *Total R&D personnel for small firms (2001 and 2005)*

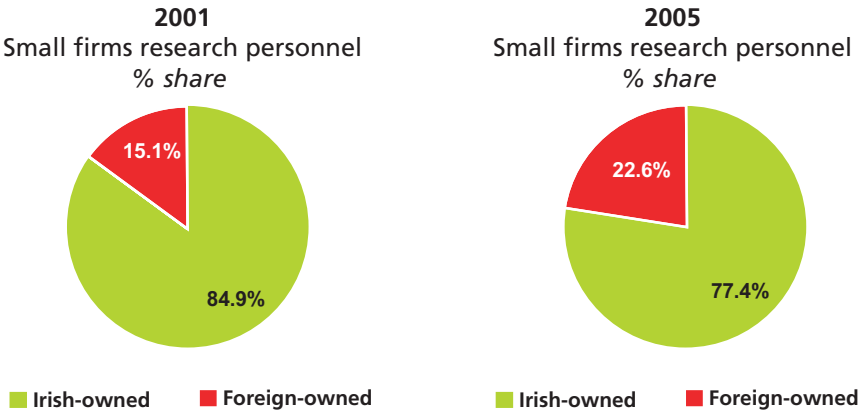


The total headcount of staff employed as researchers grew by 30.1% between 2001 and 2005, with 2,681 working as researchers in that year (50.7% of all types of research occupations). The equivalent ratio of researchers to all types of personnel was 60% in 2005 for medium/large firms.

The headcount of technicians working in small firms increased by 32.1% between 2001 and 2005, to total 1,217. This growth rate was well ahead of the 9.2% rise in employment of technicians in medium/large companies operating in Ireland. Finally 1,389 people were working in support areas of R&D activity in small firms in 2005.

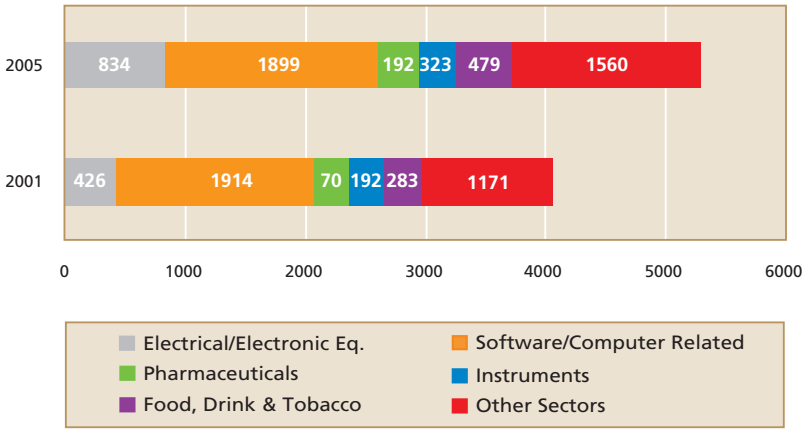
Looking at research personnel working in small firms by ownership reveals that in 2005 77.4% of all research personnel were working in Irish-owned small firms. This was below the 84.9% of research workers who were employed in Irish-owned firms in 2001. The share of research personnel working in small foreign-owned companies has risen from 15.1% in 2001 to 22.6% in 2005.

Chart 52: *Share of R&D personnel by type of ownership of small firms (2001, 2005)*



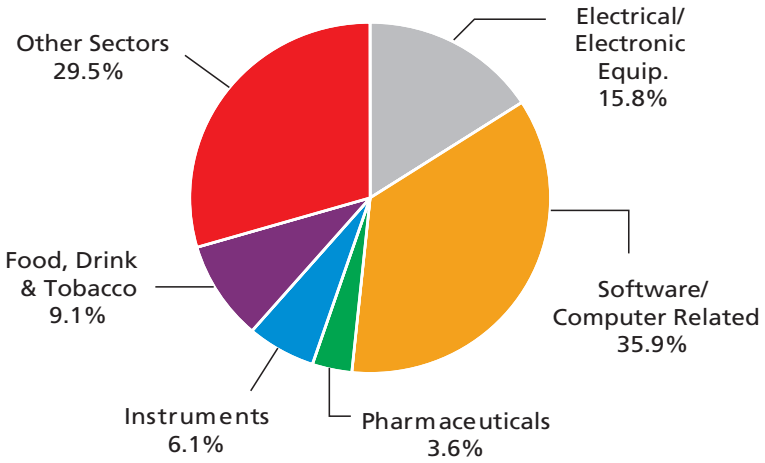
Levels of research personnel employment in small R&D active firms varied across a wide range of sectors in 2005. Of the total 5,286 research personnel working in small firms, the largest sector of employment continued to be the Software/Computer Related areas. The total headcount of researchers working in this are for small firms totalled 1,899 in 2005 (35.9% of the total).

Chart 53: *Sectoral breakdown of R&D personnel of small firms (2001 and 2005)*



The next largest sector of employment for small business researchers was the Electrical/Electronic Equipment area, followed by those employed in the Food, Drink & Tobacco sectors. These areas employed 15.8% and 9.1% of the total personnel employed by small firms respectively. Between 2001 and 2005 there have been strong increases in research personnel numbers across all sectors, with the exception of the Software/Computer Related sector small firms.

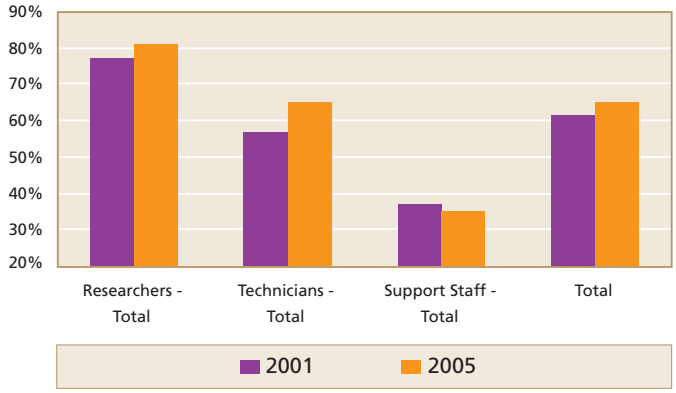
Chart 54: *Sectoral share of R&D personnel for small firms in 2005*



The average time spent on research activities by research personnel employed in small firms was 65.1% in 2005, rising from the 61.7% average time use recorded for research personnel in 2001. Despite increasing average time spent by research personnel in small firms, the average still lagged behind the 82.8% time use average recorded for personnel in medium/large companies.

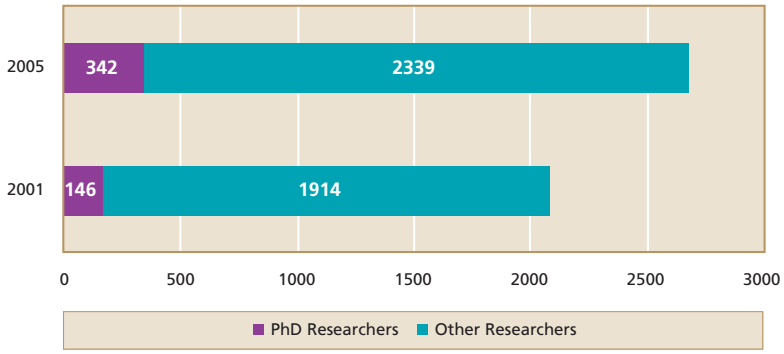
Personnel classed as researchers in small firms spent 80.7% of their time on research activities in their businesses. Technicians spent a rising 64.9% of their time involved in R&D activities, while support staff spent 35% of their time working on research in small firms.

Chart 55: *Time spent on research in small firms by occupation (2001 and 2005)*



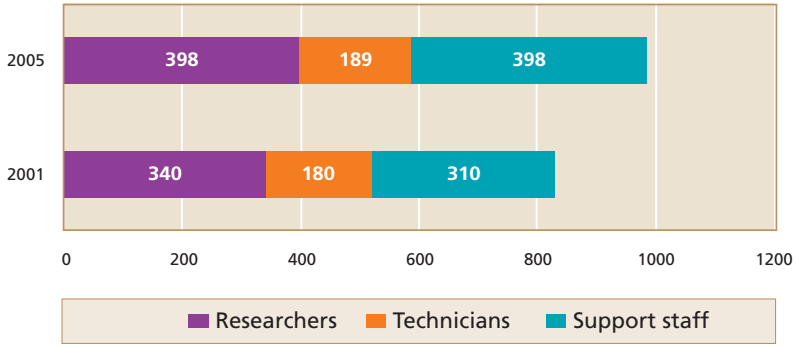
Looking at qualifications of researcher occupations employed by small firms reveals that 342 of the 2,681 total had PhD degrees (12.7% of the total). This is a higher ratio than the 9.7% of researchers with PhD qualifications employed in medium/large firms. The number of PhD researchers working in small firms rose strongly between 2001 and 2005 in contrast to the fall recorded in PhD numbers in medium/large firms.

Chart 56: *Researchers in small firms by type of qualification (2001 and 2005)*



Turning to analyses of human resources and gender, chart 56 shows that of the 5,286 total staff involved in R&D activities in small firms, 985 were female (18.6%). This was below the 25.1% female personnel ratio in medium/large firms. The total number of female research personnel increased from 831 to 985 between 2001 and 2005, an increase of 18.5%.

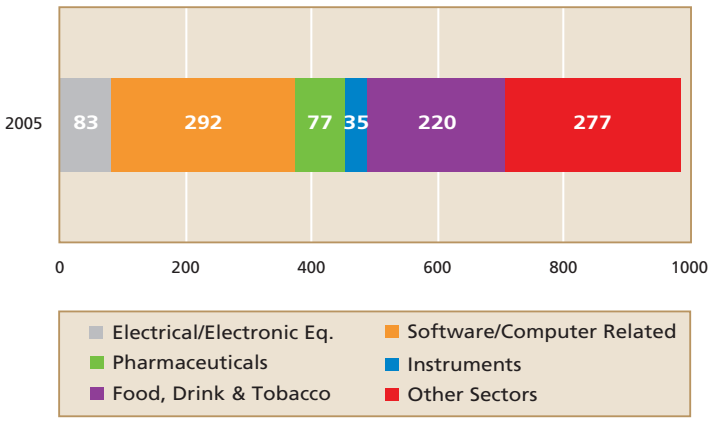
Chart 57: *Female Research Personnel in small firms by type of job (2001 and 2005)*



In 2005 there were 398 female researchers employed in small firms, 189 technicians and 398 female support staff. Across all small firms the ratio of female researchers to total researchers was 14.9%. Females made up 15.5% of all technicians working in the R&D areas of small firms while female support staff made up 28.6% of the total in 2005.

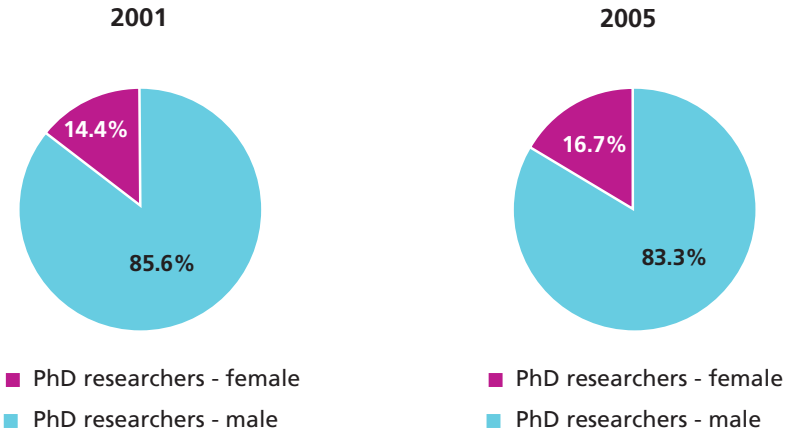
Chart 57 examines the sectoral breakdown of female research personnel working in R&D activities for small firms in Ireland in 2005. Of the 985 total female research personnel, the largest sector of employment was in the Software/Computer Related sector. This sector employed 292 female research personnel, slightly ahead of the 220 females working in Food, Drink & Tobacco companies.

Chart 58: *Female sectoral research personnel, small firms 2005*



There were wide differences in the ratio of female research personnel to total R&D personnel working in small firms in 2005. The highest ratio was found in the Food, Drink & Tobacco sector where 45.9% of research personnel employed by small firms were female. This was closely followed by the 40.2% female ratio recorded for research personnel across small firms in the Pharmaceuticals sector. Just 10% of research personnel in small Electrical/Electronic Equipment firms were female in 2005, while in small companies in the Instruments sector in Ireland 10.9% of total R&D personnel were female. The ratio of female PhD qualified researchers rose to 16.7% across small firms in 2005.z

Chart 59: *Female PhD researchers in small firms as % of total PhDs (2001 and 2005)*



3.4 Other R&D Data (small firms)

The final section of analyses of R&D performance for small firms looks at several other variables. These include, sources of funding; numbers of R&D active companies; types of R&D activity; collaboration and aims of R&D programmes.

Table 22 in the section looks at research and development expenditure by small firms according to sources of funding. Of the €320.2 million spent on R&D projects by small firms in 2005, €298.2 million was sourced from private funds including own company funds and other private sources of money. R&D spending sourced from private sources by small firms therefore contributed 93.1% of the total spend, slightly below the 96.2% share sourced from private sources by medium/large companies. An additional €18.3 million (5.7% of the total) was sourced from the Irish government, with a smaller €1.4 million sourced from EU public funds.

Table 22: *Sources of funding of R&D expenditure for small firms (2001, 2003, 2005) €mn*

	2001	2003	2005
Private Funding	176.8	241.7	298.2
Irish Government	11.4	20.2	18.3
EU Public Funding	3.9	3.1	3.8
Total BERD	**192.1**	**265.0**	**320.2**

The total number of R&D active small firms was estimated to be 957 in 2005. Small R&D firms (employing <50 employees) therefore made up 70% of the total R&D active firms. The number of small R&D active firms rose by 21.6% between 2001 and 2005. The number of Irish-owned small R&D active firms increased to 818 in 2005, with the number of foreign-owned R&D active small firms rising to 139. While the number of medium/large R&D active firms was split evenly between ownership, 85.4% of small R&D active firms were Irish-owned.

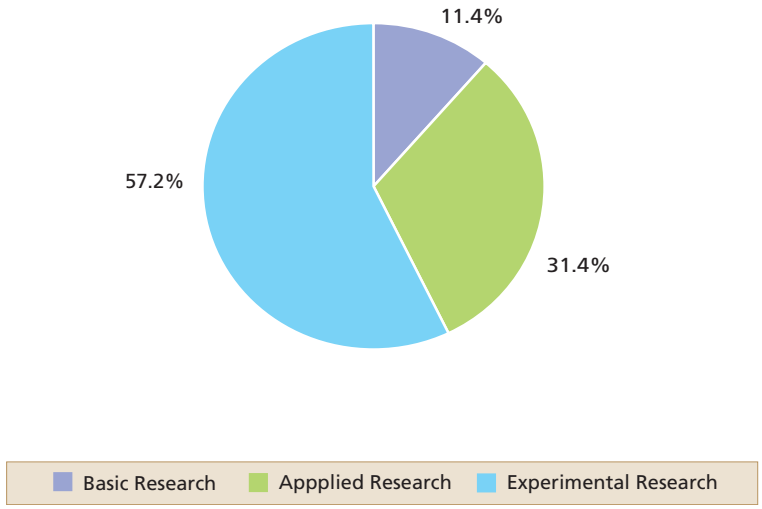
Table 23: *Number of small R&D active firms (2001 and 2005)*

	2001	2005
Irish Owned	713	818
Foreign Owned	74	139
Total Number	**787**	**957**

The division of R&D expenditure by small firms by type of expenditure (chart 59), shows that €36.5 million of R&D budgets was spent conducting basic research (11.4% of the total). An additional €100.6 million was spent carrying out applied research in small firms in 2005 – accounting for 31.4% of the total spend by small firms on R&D. Finally, €183.1 million was spent carrying out experimental research (57.2% of the total). When compared to medium/large firms, more spending as a share of total spending was spent by small firms on experimental research, with less on applied research and basic research.

If we examine basic research by small firms by sector of performance (chart 60), it can be seen that the Food, Drink & Tobacco sector had the largest concentration of basic research spending in 2005 relative to total R&D spending. In this sector 21.6% of all R&D spending was dedicated to basic research projects. This was well ahead of the basic research spending ratios of all other sectors which ranged from 11.4% to 14.2% with the exception of the Electrical/Electronic Equipment sector which had a basic research spending ratio of 7.7% in 2005.

Chart 60: *Types of R&D spending by small firms (% total 2005)*



When comparing sectoral ratios of basic research, it can be seen that the basic research ratio in the Software/Computer Related sector for small firms at 11.4% was well behind the ratio for medium/large firms in the same sector at 21.7%. In contrast the basic research spending ratio was 21.6% in the Food, Drink & Tobacco sector for small firms compared to 12.2% for medium/large firms.

Chart 61: *Small firms' sectoral spending on basic research (% total 2005)*

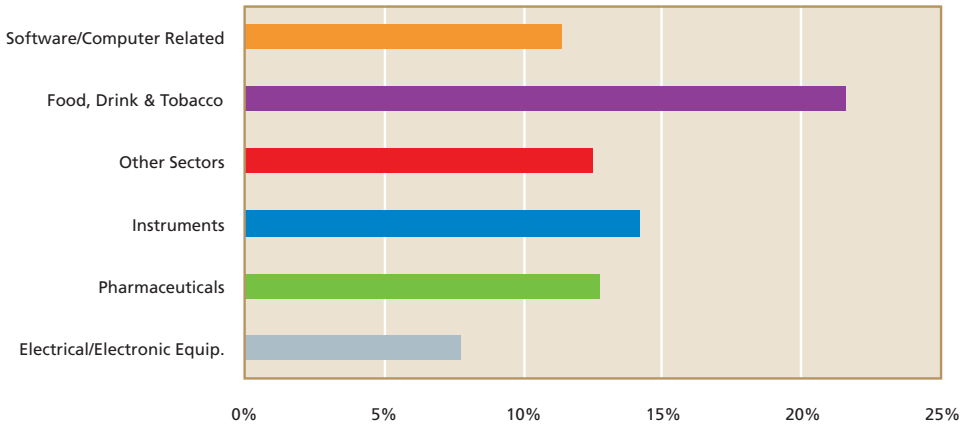


Table 24: *Sectoral breakdown of type of research for small firms (2005)*

	Basic Research	Applied Research	Experimental Research
Electrical/Electronic Equipment	7.7%	38.2%	54.0%
Pharmaceuticals	12.7%	8.7%	78.6%
Instruments	14.2%	42.4%	43.4%
Other Sectors	12.5%	33.9%	53.6%
Food, Drink & Tobacco	21.6%	31.9%	46.5%
Software/Computer Related	11.4%	28.7%	59.9%

In the latest survey of R&D activities in the business sector in 2005/6, small firms were asked alongside medium/large companies to provide details of collaboration activities. A firm was recorded as being active in collaboration if it was involved in collaboration in a R&D project with any of the following four areas – businesses in Ireland, foreign businesses, higher education in Ireland and higher education outside of Ireland. Table 25 shows the ratio of R&D active small firms who were involved in a collaboration activity in 2005.

Table 25: *R&D collaboration activities small firms (% total active 2005)*

	Other Firms in Ireland	Other Firms Outside Ireland	Higher Education in Ireland	Higher Education Outside Ireland	Any type of Collaboration
No. of Small Firms	148	198	129	66	303
% active	15.5%	20.7%	13.5%	6.9%	31.7%

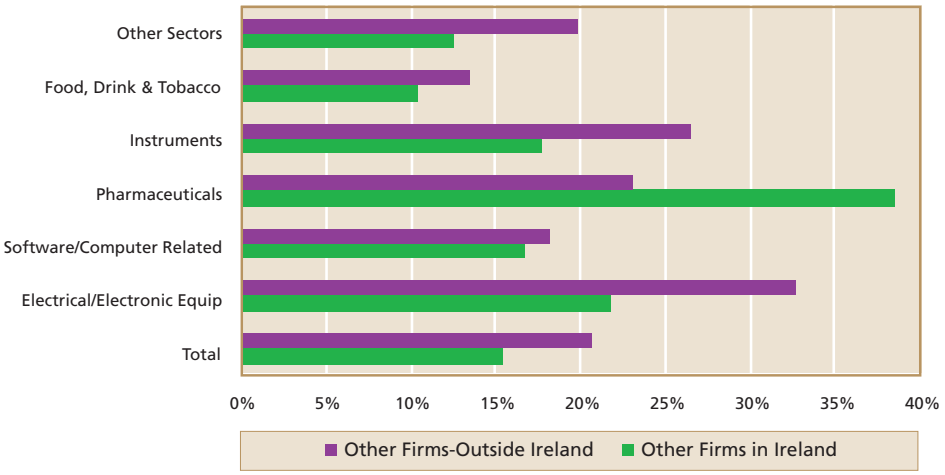
An estimated 31.7% of R&D active small firms were involved in collaboration in 2005, compared with the 45.4% of medium/large firms collaborating on R&D projects. Of all active small R&D performing firms, 15.5% were involved in collaborative projects with other businesses in Ireland. 20.7% of small firms collaborated with other businesses outside of Ireland, though this was below the 30.3% of R&D active medium/large firms collaborating in the same period.

Fewer small firms were involved in R&D collaboration with higher education compared to collaboration with businesses. The collaboration ratio for small firms with higher education in Ireland was 13.5% in 2005, well below the 24.8% collaboration recorded for medium/large firms. The level of collaboration between small firms and higher education institutions outside of Ireland was 6.9% in 2005.

Chart 61 examines the sectoral breakdown of collaboration activities between small businesses and other businesses for R&D projects in 2005. Small business to other business in Ireland collaboration in the Pharmaceuticals sector was strong in 2005, with 38.5% of R&D active firms operating in these areas, involved in collaboration. This collaboration ratio was well ahead of all other sectors with small Electrical/Electronic Equipment firms being the next most active area of collaboration. 21.7% of R&D active small Electrical/Electronic Equipment firms collaborated with other Irish firms in 2005.

For collaboration between small R&D active firms and other businesses outside of Ireland, the strongest sector of collaboration was Electrical/Electronic Equipment firms with 32.6% involved in some kind of co-operation. This was well ahead of the 13.4% collaboration ratio for small Food, Drink & Tobacco firms with other firms outside of Ireland.

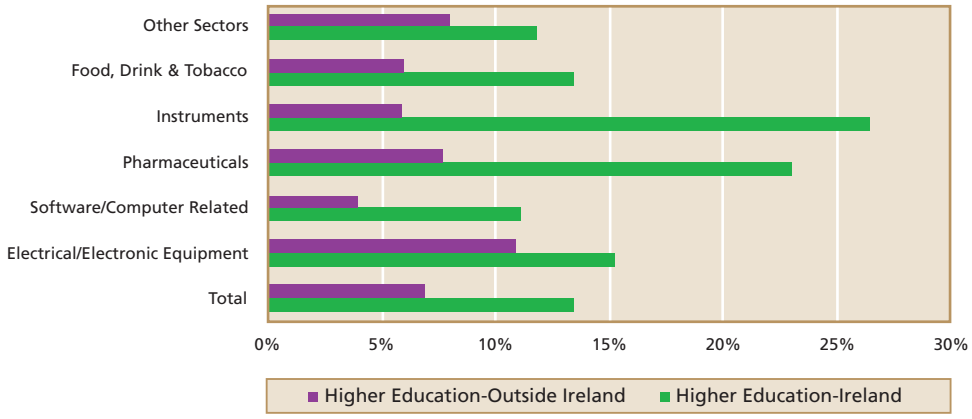
Chart 62: *Sectoral R&D firm to firm collaboration activities of small firms (% total active 2005)*



Collaboration ratios of small R&D active firms with higher education institutions tended to be much lower than for co-operation activities with businesses. In 2005 the highest sectoral collaboration ratio for small firms with higher education in Ireland was recorded in the Instruments sector. 26.5% of small firms carrying out R&D in this sector collaborated with higher education institutions in Ireland. Small firms in the Pharmaceuticals sector also had a relatively high level of Irish higher education co-operation in 2005, with 23.1% involved in these types of projects. The weakest ratio of small firm collaboration with other Irish higher education institutes was in the Software/Computer Related sector, with just 11.1% of these firms involved in joint projects.

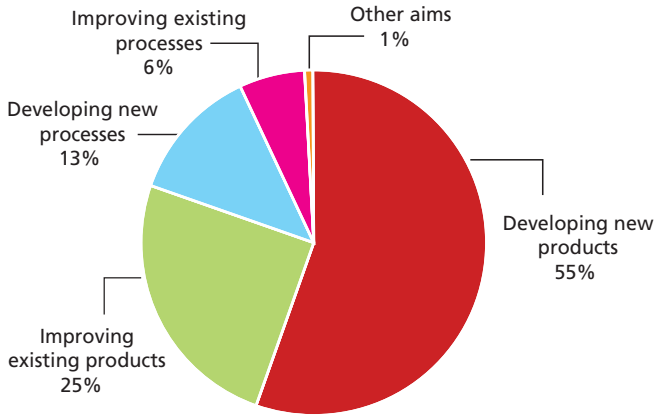
Co-operation with higher education institutions outside of Ireland was the weakest area of collaboration across most small firm sectors in 2005. The strongest performing sector was the Electrical/Electronic Equipment sector with 10.9% of small R&D performing firms co-operating with higher education institutions outside of Ireland. This ratio was some way ahead of the Software/Computer Related sector, were just 4% of small firms carrying out R&D projects collaborated with higher education bodies located outside of Ireland in 2005.

Chart 63: *Sectoral R&D collaboration of small firms to higher education*



The final section examined for small firm R&D performance involves the aims of R&D projects undertaken. Of the total €320.2 million spent on R&D by small firms in 2005, 55.4% was for the purpose of developing new products (a higher ratio than for medium/large firms which was 47.4%). 25% of small firm R&D spending was aimed at improving existing products, with 12.7% aimed at developing new processes.

Chart 64: *R&D Spending by small firms by aim (2005)*



Annexes

Annex 1: Methodology

A1.1 Introduction

The Economic and Social Research Institute (ESRI) were commissioned by Forfás to undertake the fieldwork for the 2005 BERD survey. The population to be surveyed consisted of all firms undertaking research and development activities in Ireland identified from various sources including the Forfás database of R&D active firms. The survey design and methodology were determined by Forfás, following the international rules and guidelines set down in the EU and OECD's Frascati Manual which governs the gathering of international R&D statistics. Regular meetings were held between Forfás and ESRI during the data gathering process to monitor the robustness of the survey results. More detailed information concerning the sample frame, response rates and weighting procedures is listed below.

A1.2 Sample

A total of 3,750 firms were identified as the target sample from a wide range of sources including firms who:

- Responded to 2003/4 BERD survey as having R&D
- Didn't respond in 2003/4 but were thought likely to have R&D
- Were identified by Forfás from the Business Information System as having undertaken R&D in 2004
- Indicated in the 2004 Annual Business Survey that they undertook some kind of R&D activity
- Were large firms drawn from other intelligence sources in September 2006 from sectors which were assumed to have a high level of R&D activity
- Were extra companies that emerged during the course of the fieldwork as likely to undertake R&D
- Internet searches

A1.3 Response Rates

	Number of firms	% of totals
Completed	1697	55.5%
Non response	1303	42.6%
Refused and others	56	1.9%
Total Active sample	**3056**	**100.0%**
Out of Business	267	
Unknown	94	
Duplicate	158	
No phone for follow-up	175	
Total	**3750**	

Of the total 3,750 firms sampled in the 2005/6 BERD survey, 694 were identified as not part of the main sample frame as a result of being either deemed out of business, unknown or without a phone number, or as a duplicate and part of a business already surveyed. Of the 3,056 active companies in the effective sample frame, responses were received from 1,697 firms giving an overall survey response rate of 55.5%. This response rate was above the response rate of 47.2% recorded in the 2003/4 survey.

A1.4 Re-weighting the data

In common with all statistical surveys the data were re-weighted or statistically adjusted prior to analysis. The purpose of this is to ensure that they are fully representative of the entire population from which they have been selected. In carrying this out for the current survey the basic weighting metric was the number of employees.

The first step in the weighting process was to make an estimate of the probability of the non-respondents to the survey having actually carried out in-house R&D activity in 2005. We worked out the probability of the number of employees involved in R&D and applied it to the non-respondents giving us a total number of employees involved in R&D. This probability was based on a 3-way classification of firms according to industrial sector, employee size and the source of the firms (as discussed above).

Responses were then statistically adjusted or re-weighted to that population of companies who didn't respond to the main questionnaire. This provided us with a weight for the survey.

Annex 2:
BERD Questionnaire 2005/6

Forfás

Business Expenditure on Research and Development (BERD) Survey 2005/2006

IDA IRELAND

ENTERPRISE IRELAND

Purpose of collection
This survey provides comprehensive data on Ireland's industrial R&D effort and is used by government, international organisations such as the OECD and Eurostat, businesses, economists and others. Your co-operation is sought in completing and returning this form.

The questionnaire....

- Measures the R&D activity of companies in the Republic of Ireland in 2005. Please do not include R&D activities of related companies operating elsewhere, unless specified.
- Should be completed by companies who perform R&D or have R&D performed on their behalf by other parties.
- If your company does **not** engage in R&D please answer **questions 1-8 only.**

Note for Groups

- If your company is part of a group or if you have more than one plant in the Republic of Ireland, please complete this form in respect of the full group and all outlets or plants within the group.

Data Confidentiality

- The information you provide will be treated in strict confidence and will be used for statistical purposes only.
- Data will not be published in any form which might identify individual businesses.

Definition of Research and Experimental Development (R&D) in Industry

R&D is **creative work undertaken on a systematic basis in order to create new or improved products, processes, services or other applications. R&D is distinguishable from other activities by the presence of an appreciable element of novelty and by the resolution of problems and uncertainties** using scientific or technological means.

Routine activities, such as routine software development, routine monitoring/analysis or pre-production preparation, where there is no appreciable novelty or problem resolution, are not considered to be R&D for the purposes of this survey.

Please return the questionnaire in the reply paid envelope provided. If you have any queries in relation to the survey, please contact either Sylvia Blackwell at Sylvia.blackwell@esri.ie **or Dr. Dorothy Watson at** dorothy.watson@esri.ie **Tel: (01) 6071525**

Thank you for your time and co-operation

GENERAL CLASSIFICATION DATA

		Yes	No
Q1	Given the above definition, did your company perform any in-house R&D in 2005?		

		Yes	No
Q2	Was any R&D performed on your behalf by other parties in 2005? (i.e. sub-contracted R&D performed by other companies/institutes)		

		Yes	No
Q3	Does your company have a formal R&D department? (i.e. R&D as a separate cost centre with its own dedicated personnel)		

Q4	In what year did your company,	
	- commence R&D in Ireland?	
	- first establish a formal R&D department?	

		2005	2006
Q5	Estimated total sales turnover (this will be used to compute R&D as a percentage of sales)		
Q6	Total number of permanent full-time employees at the end of 2005		

Q7 Please describe the nature of your business including products and services provided

		Yes	No
Q8	Are most (>50%) of the shares in your company Irish-owned?		

If NO to Q1 and Q2 above please go directly to Q17

RESOURCES ALLOCATED TO IN-HOUSE PERFORMED R&D

The next section aims to measure the financial resources allocated by your company to in-house performed R&D. Please use the following general rules to decide what should be included as R&D and what should be excluded from R&D. In general terms, if the primary objective of the work is to make technical improvements to products or processes, then the work comes within the definition of R&D. If, on the other hand, the product, process or approach is substantially set and the primary objective is to develop markets, to do pre-production planning or to get a production or control system working smoothly, then the work is not R&D.

Include in R&D
- ✓ Development of prototypes for new or improved products or processes
- ✓ Construction and development of pilot plants
- ✓ Industrial design and drawing directly linked to R&D projects
- ✓ Industrial engineering and tooling up directly associated with the development of new or improved products or processes
- ✓ Trial production (if it implied full-scale testing and subsequent further design and engineering)
- ✓ Software development with an element of novelty.

Exclude from R&D
- ✗ Patent and licence work which is not related to any R&D project
- ✗ Routine testing, standardisation and pre-production preparation
- ✗ After-sales service and trouble-shooting
- ✗ General purpose data collection, including market research
- ✗ Feasibility studies
- ✗ Enforcement of standards and regulation
- ✗ Routine software modifications.

EXPENDITURE ON IN-HOUSE R&D

Q9 Please specify your expenditure in 2005 and an estimate of expected expenditure on in-house R&D for 2006 under each of the following headings.

	2005 €000s	2006 €000s
Current Expenditure on in-house R&D		
Labour costs (wages, salaries and all costs of personnel directly associated with R&D)		
Other current costs (materials, supplies and equipment, literature and subscriptions, overheads associated with R&D		
Capital Expenditure Directly Linked to R&D	2005 €000s	2006 €000s
Land and buildings (sites for laboratories and pilot plants, buildings purchased, constructed and repaired directly for R&D)		
Instruments and equipment excl. software (major instruments and other capital equipment acquired wholly for R&D purposes)		
Total Expenditure on in-house R&D		
	2005 %	**2006 %**
Please estimate what % of your total R&D relates to Biotechnology[1]		
Please estimate what % of your total R&D relates to Nanotechnology[2]		

[1] Biotechnology – refers to the application of S&T to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

[2] Nanotechnology – refers to the manipulation of matter on an atomic or near-atomic scale to develop materials and devices with novel properties.

SOURCES OF FUNDS FOR IN-HOUSE R&D IN 2005

Q10 Please specify the source of funds for in-house R&D undertaken in 2005

Funding from:	€'000s
Own company/internal funds	
Other companies in Ireland (for R&D performed on their behalf)	
Government grants for R&D (including RTI scheme)	
Other Irish sources (please specify briefly)	
Direct funding from EU (e.g. Framework Programme)	
Other foreign sources (specify)	
Total funding for in-house performed R&D in 2005 (Please ensure this figure is the same as the total R&D expenditure supplied in Q9 above)	

R&D EXPENDITURE IN 2005

Q11 Please specify how much, if anything, you paid to the following parties for R&D performed on your behalf outside the company in 2005. This expenditure is in addition to the in-house expenditure recorded at Q9 above.

Payments made to:	**Within the Republic of Ireland** €'000s	**Outside the Republic of Ireland** €'000s
Related Companies (Parent, Subsidiary, Other Affiliates)		
Non-Related Companies		
Government Research Institutes		
Higher Education Institutes/Universities		
Private R&D Institutes/Laboratories		
Other		
Total		

Q12 Please estimate the approximate breakdown of total R&D expenditure in 2005 in terms of the following aims.

	R&D Expenditure
• Developing new products or services	%
• Improving existing products or existing services	%
• Developing new processes	%
• Improving existing processes	%
• Other (please specify briefly)	%
Total R&D expenditure	**100%**

IN-HOUSE R&D PERSONNEL

Q13a Please specify the number of staff (male and female) in each category involved in in-house R&D during 2005
Q13b As staff may share their time between R&D and non-R&D activities, please estimate the average percentage of time spent on R&D for each of these categories of staff.

Employed as	Q13a (number of staff) Male	Female	Total	Q13b (average % of time spent on R&D)
1. Researcher (scientists and engineers employed as researchers with a degree level qualification)				
1b - of which qualified to PhD level				
2. Technicians (technically qualified personnel (lab. technicians, drafts people)				
3. Support Staff (all other R&D supporting staff (including R&D managers, administrators and clerical staff)				
Total R&D Staff[1]				

[1] Please do not include the figure quoted for PhD researchers (category 1b) into the total figure as it is already included in category 1.

NATURE OF R&D ACTIVITY

Q14 Please indicate the breakdown of total R&D expenditure in terms of the following categories as defined below:

• Basic Research[4]	%
• Applied Research[5]	%
• Experimental Development[6]	%
	100%

Q15 Did your company engage in joint research projects with any of the following parties in 2005?

	Yes	No
• Other firms in Ireland		
• Other firms outside Ireland		
• Higher education or other institutes in Ireland		
• Higher education or other institutes outside Ireland		

Q.16 Please state the number of patents applied for and granted to your company (if any) in 2005 in the appropriate box.

	Patents Applied For	Patents Granted
Republic of Ireland		
Rest of Europe (including European Patent Office)		
USA		
Elsewhere		

COMPANY DETAILS

Q17 Is your company an independent enterprise or part of a wider enterprise group?

	Yes	No
Independent enterprise (If Yes – end of questionnaire)		
Part of a wider group (If Yes - go to Q18)		

Q.18 If your company is part of a wider group please state in which country your group headquarters is located?

_____

Q.19 If your company is part of a wider group in the Republic of Ireland or has more than one plant within the Republic of Ireland, please specify for which companies/plants this form has been completed.

	Company/Plant Name	Address
1.		
2.		
3.		
4.		

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE

[4] Experimental or theoretical work undertaken primarily to acquire new knowledge, without any particular application or use in view.
[5] Original investigation undertaken in order to acquire new knowledge, primarily directed towards a specific practical aim or objective.
[6] Systematic work, drawing on existing knowledge gained from research and practical experience, that is directed to producing new materials, products and devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

Annex 3: Other International data

Table A3.1: *BERD as a percentage of GDP*

	1995		2001		2003		2005/ latest	
Country	**value**	**rank**	**value**	**rank**	**value**	**rank**	**value**	**rank**
Australia	0.84	16	0.84	17	0.91	17	0.95	16
Belgium	1.19	10	1.51	10	1.31	11	1.24	11
Canada	1.00	13	1.31	12	1.13	13	1.02	13
Czech Republic	0.62	17	0.74	18	0.76	18	0.92	17
Denmark	1.04	11	1.64	9	1.77	7	1.67	8
Finland	1.43	7	2.41	2	2.42	2	2.48	2
France	1.39	8	1.39	11	1.36	10	1.32	10
Germany	1.45	6	1.72	8	1.76	8	1.76	7
Greece	0.14	25	0.21	26	0.20	25	0.18	25
Hungary	0.32	22	0.38	23	0.34	22	0.41	22
Iceland	0.50	19	1.79	7	1.48	9	1.48	9
Ireland (GNP)	**1.00**	**12**	**0.92**	**16**	**0.94**	**16**	**0.98**	**15**
Italy	0.52	18	0.53	19	0.52	20	0.56	20
Japan	1.89	2	2.26	3	2.40	3	2.39	3
Korea	1.75	4	1.97	5	2.00	5	2.30	4
Netherlands	0.99	14	1.05	14	1.01	14	1.02	14
New Zealand	0.26	23	0.42	22	0.49	21	0.49	21
Norway	0.96	15	0.96	15	0.99	15	0.82	18
Poland	0.25	24	0.23	25	0.15	26	0.18	26
Portugal	0.12	26	0.27	24	0.25	24	0.29	23
Slovak Republic	0.50	20	0.43	21	0.32	23	0.25	24
Spain	0.38	21	0.48	20	0.57	19	0.61	19
Sweden	2.46	1	3.28	1	2.93	1	2.92	1
Switzerland	1.50	5	1.95	6	2.10	4	2.16	5
United Kingdom	1.27	9	1.24	13	1.14	12	1.09	12
United States	1.77	3	2.00	4	1.87	6	1.88	6
Total OECD	**1.38**		**1.57**		**1.52**		**1.53**	
EU25	**1.04**		**1.14**		**1.12**		**1.12**	

Source: Main Science & Technology Indicators Volume 2006/2 OECD

Table A3.2: *BERD "Researchers" per 1000 industrial employment**

	1995		2001		2003		2005/ latest	
Country	**value**	**rank**	**value**	**rank**	**value**	**rank**	**value**	**rank**
Australia	2.6	16	2.7	16	3.3	17	3.3	17
Belgium	4.6	9	6.4	7	5.9	11	5.9	11
Canada	5.0	6	6.6	6	6.6	7	6.6	8
Czech Republic	1.2	20	1.5	19	1.7	19	2.6	18
Denmark	3.9	12	5.4	10	8.4	5	10.0	5
Finland	4.8	7	13.4	1	15.1	1	13.8	1
France	4.4	10	5.4	11	6.1	9	6.1	9
Germany	4.8	8	5.7	8	6.0	10	6.0	10
Greece	0.5	24	1.3	23	1.4	22	1.4	22
Hungary	1.1	21	1.4	22	1.6	20	1.8	20
Ireland	**3.5**	**14**	**4.5**	**13**	**4.5**	**14**	**4.7**	**14**
Italy	1.7	17	1.6	18	1.6	21	1.6	21
Japan	8.6	2	10.6	3	11.9	2	11.9	3
Korea	3.9	13	5.7	9	6.3	8	7.7	7
Netherlands	2.8	15	3.9	15	3.5	16	4.1	15
New Zealand	1.7	18	2.4	17	3.7	15	3.7	16
Norway	6.0	4	7.9	5	8.2	6	8.1	6
Poland	0.8	23	0.8	24	0.7	25	0.9	25
Portugal	0.3	25	0.7	25	1.0	24	1.0	24
Slovak Republic	1.4	19	1.5	20	1.3	23	1.2	23
Spain	1.1	22	1.5	21	2.1	18	2.5	19
Sweden	7.7	3	10.5	4	10.9	4	13.1	2
Switzerland	5.4	5	5.4	12	5.4	12	5.4	12
United Kingdom	4.3	11	4.4	14	4.8	13	4.8	13
United States	9.3	1	11.3	2	11.3	3	11.3	4
EU25	**3.0**		**3.7**		**4.0**		**4.1**	
OECD	**5.0**		**6.2**		**6.4**		**6.5**	

Source: Main Science & Technology Indicators Volume 2006/2, OECD

** Data includes PhD and non-PhD researchers but excludes support staff*

Table A3.3: *BERD research personnel per 1000 industrial Employment**

	1995		2001		2003*		2005/ latest	
Country	**value**	**rank**	**value**	**rank**	**value**	**rank**	**value**	**rank**
Australia	4.5	15	4.9	15	5.7	16	5.7	16
Belgium	9.3	8	12.7	5	11.4	8	11.4	8
Canada	8.4	10	10.4	9	10.5	10	10.5	10
Czech Republic	2.7	20	3	21	3.5	20	5.6	17
Denmark	10.1	7	14.3	3	15.5	3	16	3
Finland	12.9	2	19.2	1	20.4	1	20.2	2
France	10.8	5	11.3	7	11.8	6	11.8	7
Germany	10.5	6	11	8	11	9	11	9
Greece	1	23	3.7	19	3.8	19	3.5	20
Hungary	2.6	21	2.4	22	2.5	21	2.6	21
Ireland	5.9	13	6.7	13	6.9	14	7.2	14
Italy	3.9	16	3.9	17	3.9	18	3.9	19
Japan	12.8	3	13.9	4	15.1	4	15.1	4
Korea	5.6	14	6.7	14	7.3	13	8.5	12
Netherlands	7.7	11	8.4	11	8	11	8.8	11
New Zealand	3	18	4.1	16	5.9	15	5.9	15
Norway	9.2	9	10.4	10	11.5	7	11.9	6
Poland	2	22	1.4	23	1.1	24	1.3	24
Portugal	0.5	24	1	24	1.5	23	1.6	23
Slovak Republic	3.1	17	3.2	20	2.4	22	2.2	22
Spain	2.8	19	3.7	18	5	17	5.4	18
Sweden	16.9	1	18.5	2	18.5	2	21.9	1
Switzerland	11.2	4	12	6	12	5	12	5
United Kingdom	7.5	12	7.4	12	7.6	12	7.5	13
EU25	**6.7**		**7.3**		**7.5**		**7.6**	

Source: Main Science & Technology Indicators Volume 2006/2, OECD

** Data includes all research staff and also research support staff*

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