Forfás

# RESEARCH & DEVELOPMENT IN THE BUSINESS SECTOR 1999

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

# Research & Development in the Business Sector 1999

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- *advise the Minister on matters relating to the development of industry in the State*
- *to advise on the development and co-ordination of policy for Enterprise Ireland, IDA Ireland and such other bodies (established by or under statute) as the Minister may by order designate*
- *encourage the development of industry, technology, marketing and human resources in the State*
- *encourage the establishment and development in the State of industrial undertakings from outside the State, and*
- *advise and co-ordinate Enterprise Ireland and IDA Ireland in relation to their functions.*

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# FOREWORD

This report presents the findings of a survey of R&D performers in the business sector relating to 1999 and updates a regular series on Business Expenditure on Research and Development (BERD) produced by Forfás. The survey relies on the co-operation of R&D performing enterprises in the country and special thanks is given to all of the enterprises that participated in the most recent survey.

If you require further information about this survey, please contact:

Dr. Rhona Dempsey,

Science, Technology and Innovation Division,

Forfás,

Wilton Park House,

Wilton Place,

Dublin 2,

Ireland.

Telephone: 01 607 3052

Fax: 01 607 3260

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# SUMMARY

This report represents the findings of the latest survey of research and development (R&D) performed in the business sector during 1999. The survey itself was undertaken on behalf of the Science and Technology Indicators Unit in Forfás by the Economic and Social Research Institute (ESRI) during 2000 and 2001. This was the first time ESRI has been involved in the survey and they recommended a number of methodological changes to improve the accuracy of the estimation procedures used. These changes have been retrospectively applied to the 1997 and 1995 surveys and have resulted in minor modifications to the results.

Key points from the survey are:

- *R&D activity in aggregate terms in the business sector (BERD) continued to grow between 1997 and 1999. Total expenditure on R&D amounted to €784 million in 1999, up from €612 million in 1997. This represents 0.88% of GDP in 1999, compared with 0.90% in 1997. The 1999 EU average was 1.2% and the OECD average 1.5%.*
- *Although international comparisons are based on the BERD/GDP ratio, in Ireland Gross National Product (GNP) is significantly lower than GDP because of transfer payments made by foreign-owned firms here. The BERD/GNP ratio for Ireland in 1999 was 1.03% and in ways this is a more accurate reflection of business sector performance.*
- *The annual growth rate of BERD for the period 1997 - 1999 was 11%, compared with 14.6% overall from 1991 to 1999.*
- *The number of firms spending significant amounts of money (€1.3m or £1m) on R&D increased from 75 in 1997 to 98 in 1999. The number of foreign-owned firms increased from 50 to 55, while 43 indigenous firms spent more than this amount compared to 25 in 1997.*
- *R&D activity in the context of numbers of business sector researchers sees Ireland at 3.1 researchers per 1000 labour force, which is above the EU average of 2.5 and is ranked 10th out of 25 OECD countries.*
- *On a sectoral basis the key indicator of the level of research is the ratio of R&D to total output. For manufacturing industry as a whole this ratio is low at 0.8%, compared to the EU average of 2.4%. The 'Electrical and Electronic Equipment' sector is of particular concern. In Ireland this high tech sector accounts for 40% of the total BERD and the R&D intensity (1.2%) is only one quarter of the OECD average (5.6%). Finland, a major competitor in this field, has an R&D intensity in this sector of 9.8%. The picture is much the same in the pharmaceutical sector.*
- *There are two major reasons why research intensities overall in the business sector are below international norms:*

  - Almost two thirds of business sector R&D is performed in foreign-owned industry. The majority of these firms in sectors such as pharmaceuticals and electronics are manufacturing branch plants attracted to Ireland in the past by low tax rates, generous grants and relatively low wage rates. R&D performed here is mainly related to manufacturing process improvements and is small relative to gross industry output.
  - A very high proportion (about 50%) of the output of indigenous industry is in the food sector. This sector has a low R&D intensity internationally and Irish levels are at about OECD average. Hence, total R&D performance by the indigenous sector will be low relative to sectoral output.

- *The indigenous sector consistently out-performs foreign-owned firms in terms of research intensity. Overall there is not a great difference between them (0.9% for indigenous and 0.8% for foreign) but in the key sectors of Electrical and Electronic Equipment and of Instruments the indigenous firms are investing on a much more significant scale in R&D (6.7% of output against 1.2% in Electrical and Electronics and 9% against 1% in Instruments). Clearly foreign-owned firms are still dependent for their innovation performance on R&D performed in their home countries.*
- *Knowledge-based industries account for a high proportion of industrial R&D internationally, so it is not surprising that both Irish-owned and foreign-owned firms R&D are concentrated in these industries. R&D intensities are continuing to improve for Irish-owned companies. In contrast, the R&D intensities have fallen for foreign-owned companies. Dramatic increases in BERD in future will necessitate a much greater involvement in R&D by high tech multinationals here.*
- *The Government financing of R&D generally lies at around 5-6% over the period 1991 - 1999. This compares to an OECD average of almost 10% in 1999.*

# 1 TOTAL BUSINESS EXPENDITURE ON R&D

## 1.1 INTRODUCTION

The Business Sector Research and Development 1999 survey continues a series of biennial surveys run by Forfás and its predecessors for over two decades. This 1999 reference year survey was conducted in the 2000/2001 period. The fieldwork was carried out by the Economic and Social Research Institute, the first time ESRI were involved with this survey. The ESRI recommended a change in the procedures used to take account of non-respondents to the survey and this is outlined in a methodological note included in the appendix. The data from the reference years 1995 and 1997 were revised to bring them into line with the 1999 data.

## 1.2 BUSINESS EXPENDITURE ON RESEARCH AND DEVELOPMENT (BERD) - AGGREGATE FIGURES

Business expenditure on research and development (BERD) continued to grow in aggregate terms between 1997 and 1999. Total BERD amounted to €784 million in 1999 which is equal to 0.88% of GDP, compared to €612 million in 1997 (0.9% of GDP).

Figure 1 illustrates the increase in BERD for the period 1991 to 1999. There has been an upward trend in expenditure on R&D in real terms. The annual rate of growth over this time was 14.6%. For the period 1997-1999 growth was at a rate of 11% per annum. Figure 2 shows BERD as a percentage of Gross Domestic Product (GDP) and as a percentage of Gross National Product (GNP) during the same period. BERD as a percentage of GDP increased over the period 1991 to 1995 but has remained around 0.9% from 1995 - 1999. The GNP figure excludes 'net factor income' which takes into account the profit repatriation of multinational firms. This is a significant figure in Ireland compared to other countries and thus the BERD expressed as a percentage of GNP is substantially higher (1.03% for 1999) and in ways is more reflective of the national R&D performed.

Figure 1: *Business Expenditure on Research & Development 1991 - 1999 in constant and current prices in Euro.*

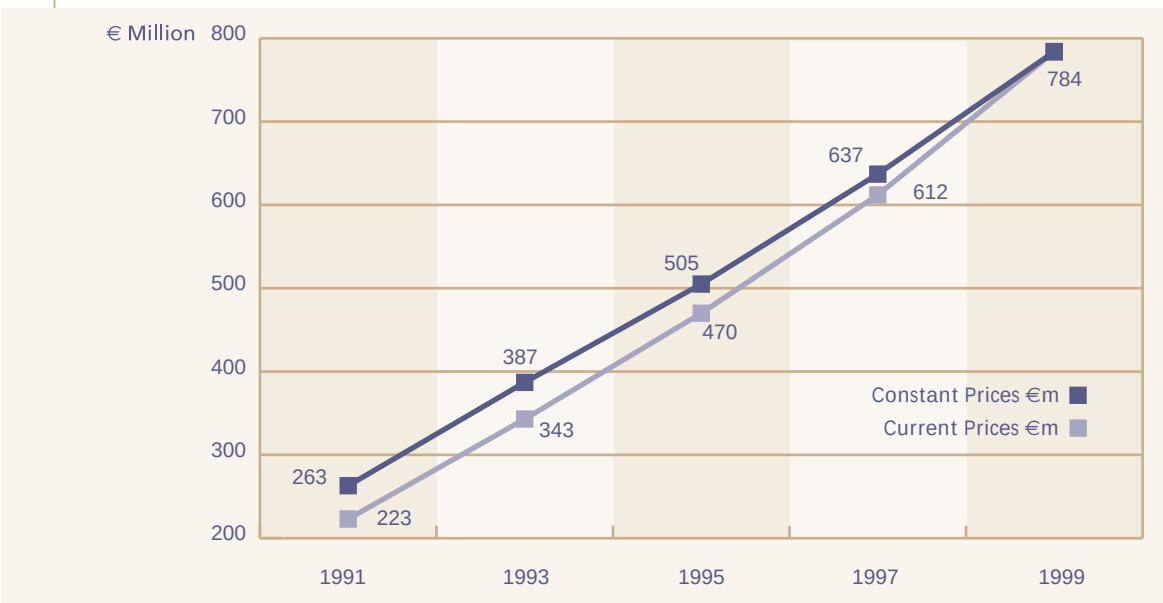
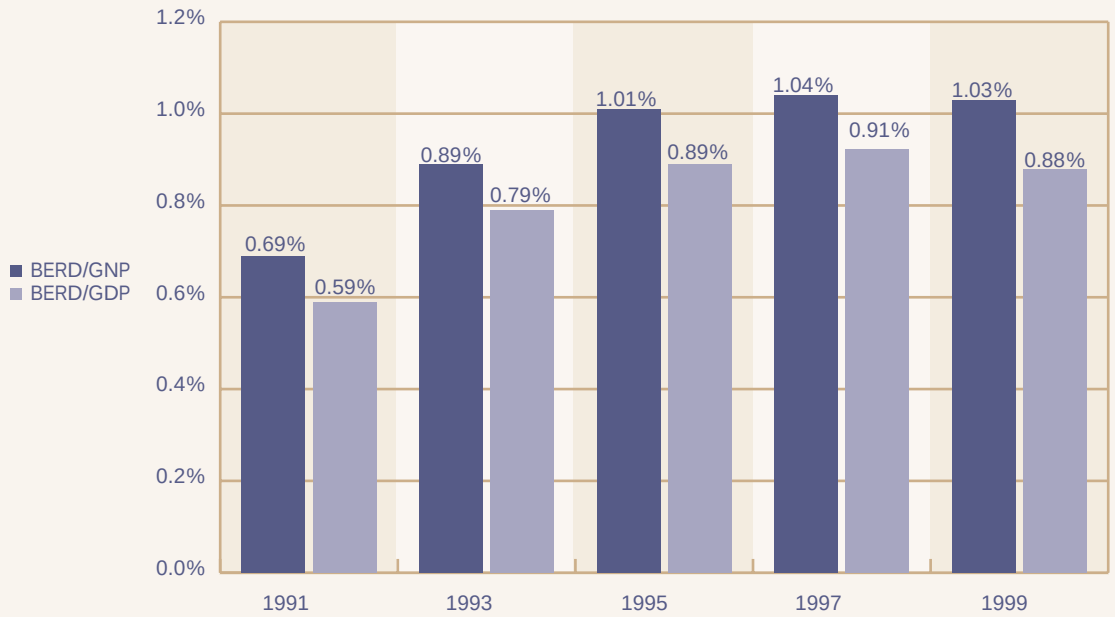


Table 1: *BERD 1991 - 1999*

| | Current Prices | | |
|---|---|---|---|
| | €m | % GNP | % GDP |
| 1991 | 223 | 0.69 | 0.59 |
| 1993 | 343 | 0.89 | 0.79 |
| 1995 | 470 | 1.01 | 0.89 |
| 1997 | 612 | 1.04 | 0.91 |
| 1999 | 784 | 1.03 | 0.88 |

Figure 2: *Business Expenditure on Research & Development 1991 - 1999 expressed as a percentage of Gross Domestic Product and Gross National Product.*




## 1.3 INTERNATIONAL RANKING

As indicated in Table 2, Ireland's ranking has moved from 15th to 16th place out of 26 OECD countries in the period 1997 - 1999 for the indicator BERD as a percentage of GDP. Ireland was ranked 18th out of 26 OECD countries for this indicator in 1991. On the basis of BERD as a percentage of GNP, Ireland was ranked 14th in 1999.

## Table 2: *International Ranking on Business Sector R&D Aggregates 1991-1999*

| | 1991 | 1993 | 1995 | 1997 | 1999 |
|---|---|---|---|---|---|
| Business Expenditure on R&D (BERD) €m | 223 | 343 | 470 | 612 | 784 |
| BERD as a % of GDP | 0.59 | 0.79 | 0.89 | 0.91 | 0.88 |
| Rank among 26 OECD countries | 18 | 17 | 15 | 15 | 16 |
| BERD as a % of GNP | 0.69 | 0.89 | 1.01 | 1.04 | 1.03 |
| Rank among 26 OECD countries | 15 | 12 | 12 | 13 | 14 |

*See Appendix Table A1.*

The indicator BERD as a percentage of GDP is commonly used to compare the relative level of R&D activity in the business sector across countries. Whilst it is a crude measure, and should be used in conjunction with additional information such as industrial structure, it does demonstrate at a broad level that Ireland lies behind most other OECD countries. As shown in Table 3, Ireland is at 0.9% GDP compared to the EU average of 1.2% and the OECD average of 1.5%. This also points to a need for further policies to promote R&D activities in Ireland.

## Table 3: *Business R&D Expenditure as a percentage of GDP, 1993 - 1999*

| | 1993 | 1995 | 1997 | 1999 |
|---|---|---|---|---|
| OECD Average | 1.44 | 1.42 | 1.49 | 1.54 |
| EU Average | 1.18 | 1.13 | 1.14 | 1.20 |
| Sweden | 2.28 | 2.57 | 2.75 | 2.86 |
| Finland | 1.27 | 1.45 | 1.79 | 2.18 |
| Netherlands | 1.01 | 1.04 | 1.11 | 1.13 |
| Ireland | 0.79 | 0.89 | 0.91 | 0.88 |
| Ireland (% GNP) | 0.89 | 1.01 | 1.04 | 1.03 |

## 1.4 CONCLUSIONS

Advanced economies are no longer competitive in many basic manufacturing activities which can be performed more cheaply in less developed regions. Instead they must compete on the basis of brain-power, using knowledge and skills to develop products, processes and services which contain high value components and command relatively high prices. This new paradigm is often referred to as the "knowledge-based economy". A high level of research and development is needed to generate and diffuse the knowledge and know-how essential for such an economy to function successfully. IDA Ireland is endeavouring to attract the sort of investment which will position Ireland at the forefront of some of the key sectors of global businesses into the future. Past investment based on branch plant manufacturing has served Ireland's development well and generated significant job creation, wealth and growth in the economy. The investment that the IDA now wants to attract is based more on innovation and research, from business projects that are knowledge intensive and based on high skills and expertise. Indigenous industry is still dominated by the food sector, which accounts for nearly 50% of its output, but technology is important in many of the new growth sectors such as software, instrumentation and electronics.

# 2 ANALYSIS BY INDUSTRY SECTORS

## 2.1 ANALYSIS BY INDUSTRY SECTORS

The collected data were classified by industrial sector. Table 4 shows the expenditure on R&D in 1999 for each sector.

Table 4: *Expenditures on R&D, R&D intensities (% of industry output) and OECD average R&D intensities classified according to Industry Sector for 1999.*

| Sector | R&D €m | % of output | OECD average (estimate) |
|---|---|---|---|
| Electrical and Electronic Equipment | 316.0 | 1.4% | 5.6% |
| Pharmaceuticals | 82.5 | 2.7% | 11.5% |
| Food, Drink, Tobacco | 44.1 | 0.2% | 0.3% |
| Instruments | 38.9 | 1.5% | 7.0% |
| Chemicals less pharmaceuticals | 24.1 | 0.2% | 3.2% |
| Machinery & Equipment | 22.5 | 1.0% | 2.1% |
| Transport Equipment | 12.6 | 1.2% | 4.5% |
| Rubber & Plastic Products | 11.9 | 0.8% | 1.2% |
| Basic & Fabricated Metals | 9.0 | 0.5% | 0.7% |
| Non-metallic Minerals | 7.0 | 0.6% | 0.8% |
| Wood Products | 5.7 | 1.0% | 0.2% |
| Textiles, Clothing, Leather | 4.2 | 0.3% | 0.3% |
| Other Manufacturing | 4.9 | 0.3% | 1.0% |
| Paper, Print & Publishing | 3.8 | 0.1% | 0.4% |
| Total Manufacturing | 587.3 | 0.8% | 2.4% |
| Software and Computer Related Activities | 162.6 | N/A | N/A |
| Other Services | 30.4 | N/A | N/A |
| Total Business Sector | 783.6 | N/A | N/A |

From Table 4 it is evident that four key sectors dominate BERD - *Electrical and electronic equipment* (40% of BERD), *Software and other computer related activities* (21% of BERD), *Pharmaceuticals* (11% of BERD) and *Food, drink and tobacco* (6% of BERD). These four sectors accounted for almost 80% of total expenditure on R&D in the business sector in 1999.

The data show that Ireland's R&D expenditure across all manufacturing sectors is 0.8% of total manufacturing turnover, which is one-third of the OECD average (2.4%). The research intensity for the *Electrical and electronic equipment* sector at 1.4% is well below the OECD average of 5.6%. The *Pharmaceuticals* sector in Ireland has a research intensity of 2.7% compared to the OECD average for which *Pharmaceuticals* is the most research intensive sector at 11.5%. The *Pharmaceuticals* sector is key to Irish economy performance. The industry is dominated by multinationals and nine of the top ten multinationals have major manufacturing operations in Ireland. ICSTI have recently identified this sector as a priority area and will bring forward proposals during 2002 for embedding these firms more deeply in the Irish economy. Their level of R&D performed here is one issue to be addressed.

The R&D intensity of 0.2% for the *Food, drink and tobacco* sector lies close to the 0.3% OECD average. There are no comparative OECD data for the *Software and related computer activities* sector.

Table 5 provides a comparison of R&D intensities for the major industrial sectors in Ireland against the lead country for the appropriate sector. It provides data for the percentage point deficit between Ireland and the OECD average and Ireland and the lead country. The deficit for the *Pharmaceutical* sector indicates that Ireland at 2.7% is 20 points behind the lead OECD country (Sweden). In the *Electrical and electronic equipment* sector Ireland's research intensity at 1.4% is 8.4 points behind the lead country (Finland). The research intensity for Ireland across the manufacturing sector at 0.8% is 2.9 points behind the lead country (Sweden).

Table 5: *R&D expenditures as a percentage of gross outputs (R&D intensities) - Ireland compared with OECD averages and lead countries according to main R&D performing industry sectors.*

| | Ireland R&D as % output | OECD average (e) R&D as % output | Lead country R&D as % output | Percentage point gap - Ireland Vs. OECD average | Percentage point gap - Ireland Vs. Lead country |
|---|---|---|---|---|---|
| Pharmaceuticals | 2.7 | 11.5 | 22.6 | 8.8 | 19.9 |
| Instruments | 1.5 | 7.0 | N/A | 5.5 | N/A |
| Electrical and Electronic Equipment | 1.4 | 5.6 | 9.8 | 4.2 | 8.4 |
| Machinery & Equipment | 1.0 | 2.1 | 4.3 | 1.1 | 3.2 |
| Food, Drink, Tobacco | 0.2 | 0.3 | 0.7 | 0.1 | 0.5 |
| Total Manufacturing | 0.8 | 2.4 | 3.7 | 1.6 | 2.9 |

Figure 3: *Irish R&D intensity in manufacturing compared to OECD average 1999.*

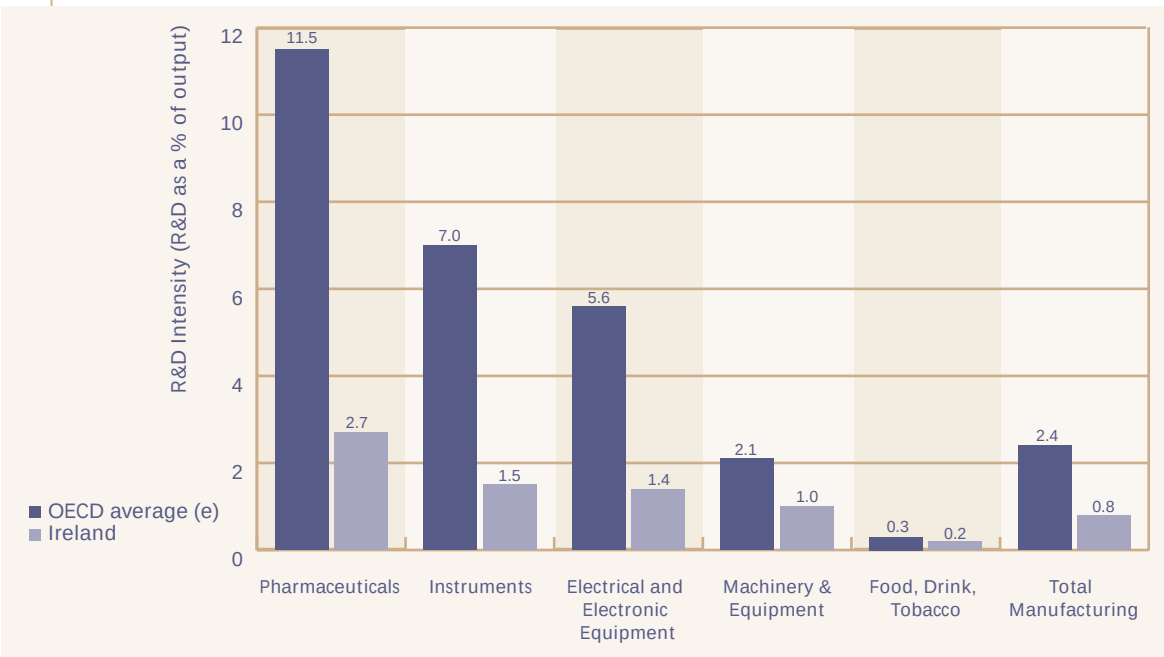


Table 6 shows the trend in share of BERD in Ireland by the main R&D performing industry sectors for the period 1991 - 1999. The main increase in the share of BERD is in the *Software and other computer related activities* sector, which moved from 15% in 1997 to 21% of BERD in 1999. The Information Communication Technologies (ICT) sector plays a particularly important role in Ireland, accounting for 35% of manufacturing trade.

Table 6: *Business expenditure on Research & Development by Industry Sector 1991-1999.*

| | 1991 | 1993 | 1995 | 1997 | 1999 |
|---|---|---|---|---|---|
| Business Expenditure on R&D (BERD) €m | 223 | 343 | 470 | 612 | 784 |
| Electrical and electronic equipment | 34% | 34% | 34% | 41% | 40% |
| Pharmaceuticals | 13% | 18% | 16% | 12% | 11% |
| Food, drink and tobacco | 12% | 12% | 10% | 7% | 6% |
| Software and other computer related activities | 8% | 7% | 8% | 15% | 21% |
| All other sectors | 32% | 29% | 32% | 26% | 23% |

*See Table A2 in the Appendices for detailed sectoral breakdown.*

Ireland's *Electrical and electronic* sector accounted for 40% of all BERD in 1999 which placed Ireland second out of 27 OECD countries for the share of BERD performed in this sector. This lies behind Finland (46%) but is well above the EU average of 17% and all other OECD countries

The *Pharmaceutical* sector accounted for 11% of total BERD in 1999 compared to 12% in 1997. This compares to 22% for the UK, 16.5% in Sweden and is placed sixth out of 19 OECD countries.

The *Food, drink and tobacco* sector accounted for 6% of total BERD in 1999 which represents a slight decrease from 7% in 1997.

## 2.2 CONCLUSIONS

The analysis shows that the level of R&D spending in key industrial sectors in Ireland is below international norms. There are a number of explanations for this. Firstly, almost two-thirds of business sector R&D is performed in the foreign-owned industrial sectors. The majority of these firms in sectors such as pharmaceuticals and electronics are manufacturing branch plants attracted to Ireland in the past by low rates of tax, generous grants and relatively low wage rates. Any R&D performed here is related to manufacturing process improvements and is quite small in scale compared to the gross industry output, which itself will tend to be inflated by transfer pricing policies of the multinational firms. Secondly, a very high proportion (about 50%) of the output of indigenous industry comes from the food sector. This sector has a low R&D intensity internationally (as seen in Table 4) and Irish levels are at about OECD levels. This combination of factors has a marked impact on overall national levels of R&D intensity.

Ireland has the greatest percentage of high technology manufacturing exports of all the OECD countries. Expenditure on R&D is prominent in the knowledge intensive sectors (such as ICT and pharmaceuticals) across all OECD countries, particularly in Ireland. This points to the importance of these industries to our economy. The R&D intensities are generally high in the knowledge intensive sectors such as ICT and pharmaceuticals across the OECD countries. Ireland demonstrates well below average research intensities.

Economic analysis points strongly to the close relation between research and development and economic growth. The pace of technological development and the shortening product life cycles have resulted in an increase in R&D expenditure in the business sector in the developed countries. While R&D investments by business here have continued to grow strongly in 1999, the overall levels remain below international norms in many of the high technology sectors. Increasing these levels remains a key objective for national industrial policy.

# 3 ANALYSIS BY OWNERSHIP

## 3.1 ANALYSIS BY OWNERSHIP

Indigenous owned industry accounts for €284m (36.2%) of BERD (Business Expenditure on R&D) compared to €500m (63.8%) spent on R&D in Ireland by foreign-owned companies in 1999 as indicated in Table 7. This pattern where foreign-owned industry accounts for approximately two-thirds of BERD is consistent with BERD data collected for 1993, 1995 and 1997.

Table 7 also gives an overview of the R&D in the two ownership categories by industrial sector.

Table 7: *R&D expenditures and research intensities of Irish–owned & Foreign–owned Industry in 1999.*

| | Irish Owned | | Foreign Owned | |
|---|---|---|---|---|
| | €m | R&D as a % of gross output | €m | R&D as a % of gross output |
| Electrical and Electronic Equipment | 58.2 | 6.7% | 257.9 | 1.2% |
| Pharmaceuticals | 5.0 | 4.6% | 77.5 | 2.6% |
| Food, Drink, Tobacco | 26.8 | 0.3% | 17.3 | 0.2% |
| Instruments | 13.7 | 9.0% | 25.2 | 1.0% |
| Chemicals less pharmaceuticals | 3.8 | 0.5% | 20.2 | 0.2% |
| Machinery & Equipment | 15.4 | 2.3% | 7.2 | 0.5% |
| Transport Equipment | 7.2 | 1.3% | 5.4 | 1.1% |
| Rubber & Plastic Products | 8.3 | 1.5% | 3.6 | 0.4% |
| Basic & Fabricated Metals | 7.1 | 0.7% | 1.9 | 0.2% |
| Non-metallic Minerals | 4.9 | 0.5% | 2.1 | 0.8% |
| Wood Products | 4.2 | 1.1% | 1.5 | 0.7% |
| Textiles, Clothing, Leather | 3.6 | 0.7% | 0.6 | 0.1% |
| Other Manufacturing | 3.5 | 0.4% | 1.4 | 0.2% |
| Paper, Print & Publishing | 3.2 | 0.2% | 0.5 | 0.0% |
| Total Manufacturing | 164.9 | 0.9% | 422.3 | 0.8% |
| Software and Computer Related Activities | 92.3 | N/A | 70.3 | N/A |
| Other Services | 23.4 | N/A | 7.1 | N/A |
| Total Business Sector | 283.9 | N/A | 499.7 | N/A |

The number of firms spending significant amounts of money (more than €1.3m) on R&D increased from 75 in 1997 to 98 in 1999. The number of foreign-owned firms increased from 50 to 55, while 43 indigenous firms spent more than this amount compared to 25 in 1997.

## Table 8: *R&D Expenditures and Numbers of Irish-owned and Foreign-owned Firms with Expenditure Greater than €1.3m*

| | 1997 | 1999 |
|---|---|---|
| BERD: | | |
| Foreign-owned firms | €400m | €500m |
| Irish-owned firms | €212m | €284m |
| TOTAL | €612m | €784m |
| Number of firms spending > €1.3m: | | |
| Foreign-owned | 50 | 55 |
| Irish-owned | 25 | 43 |
| TOTAL | 75 | 98 |

### Irish-Owned Industries

Table 9 shows the profile of Irish-owned firms characterised by industrial sector with respect to expenditure on R&D and R&D Intensity.

## Table 9: *R&D Expenditure by Sector - Irish owned Firms, 1993 - 1999*

| | 1993 | | 1995 | | 1997 | | 1999 | |
|---|---|---|---|---|---|---|---|---|
| | €m | % of output | €m | % of output | €m | % of output | €m | % of output |
| Electrical and Electronic Equipment | 15.4 | 3.7% | 27.8 | 5.0% | 44.1 | 5.1% | 58.2 | 6.7% |
| Food, Drink, Tobacco | 33.8 | 0.5% | 27.5 | 0.3% | 26.8 | 0.3% | 26.8 | 0.3% |
| Machinery & Equipment | 6.6 | 1.9% | 12.3 | 2.7% | 11.5 | 1.9% | 15.4 | 2.3% |
| Instruments | 1.8 | 2.4% | 4.2 | 4.4% | 4.9 | 3.3% | 13.7 | 9.0% |
| Rubber & Plastic Products | 2.6 | 0.9% | 8.1 | 2.0% | 7.7 | 1.5% | 8.3 | 1.5% |
| Transport Equipment | 3.1 | 0.9% | 3.4 | 0.8% | 5.1 | 1.0% | 7.2 | 1.3% |
| Basic & Fabricated Metals | 5.4 | 0.9% | 10.3 | 1.4% | 8.6 | 0.9% | 7.1 | 0.7% |
| Pharmaceuticals | 4.4 | 6.5% | 3.9 | 4.8% | 4.8 | 4.8% | 5.0 | 4.6% |
| Non-metallic Minerals | 4.4 | 0.7% | 7.7 | 1.0% | 7.1 | 0.8% | 4.9 | 0.5% |
| Wood Products | 0.3 | 0.2% | 1.3 | 0.4% | 2.8 | 0.8% | 4.2 | 1.1% |
| Chemicals less pharmaceuticals | 2.3 | 0.5% | 2.9 | 0.5% | 3.5 | 0.5% | 3.8 | 0.5% |
| Textiles, Clothing, Leather | 3.2 | 0.8% | 8.4 | 1.9% | 7.9 | 1.7% | 3.6 | 0.7% |
| Other Manufacturing | 1.4 | 0.2% | 5.2 | 0.7% | 2.5 | 0.3% | 3.5 | 0.4% |
| Paper, Print & Publishing | 3.0 | 0.2% | 4.5 | 0.3% | 4.9 | 0.3% | 3.2 | 0.2% |
| Total Manufacturing | 87.9 | 0.7% | 127.6 | 0.9% | 142.1 | 0.9% | 164.9 | 0.9% |
| Software and Computer Related Activities | 11.3 | N/A | 18.9 | N/A | 53.4 | N/A | 92.3 | N/A |
| Other Services | 12.7 | N/A | 9.2 | N/A | 13.6 | N/A | 23.4 | N/A |
| Total Business Sector | 114.9 | | 158.8 | | 212.3 | | 283.9 | |

In 1999 there were three dominant industrial sectors which accounted for over 60% of all Irish-owned BERD. These are *Software and computer related activities* at €92.3m which has increased its share dramatically to a level of 32% from 12% in 1995. *Electrical and electronic equipment* at €58.2m remained at a share of 20% of Irish-owned BERD in 1999. The third important sector is *Food, drink and tobacco* at €26.8m accounting for 9% of Irish-owned BERD in 1999 which continues a downward trend from a level of almost 30% in 1993. The industry sectors *Machinery and Equipment* (€15.3m) and *Instruments* (€13.7m) each accounted for circa 5% of Irish-owned BERD in 1999.

The R&D intensity by industrial sector for Irish-owned industries is also provided in Table 9. The *Electrical and electronic equipment* sector had a research intensity of 6.7% in 1999 which has improved from 5.1% in 1997. This lies above the OECD average research intensity of 5.6% for this sector. Also encouraging is the increased spending and research intensity in the *Instrumentation* industry, where expenditure more than doubled between 1997 and 1999. *The Food, drink and tobacco* research intensity for Irish-owned companies remains at the OECD average of 0.3% for this sector. There are no available OECD data for the *Software and computer related activities* industry. Overall, the R&D intensity for Irish-owned manufacturing industry lies at 0.9% in 1999 behind the OECD average of 2.4%; however, the preponderance of the low R&D spending food sector in total output of Irish-owned industry tends to bring down the average intensity.

## Foreign-Owned Industries

A similar analysis of foreign-owned industry provided several insights. Table 10 indicates that three principal industries account for over 80% of foreign-owned BERD. These are *Electrical and electronic equipment* at €257.8 million, which accounts for 52% of foreign-owned BERD, a rise of 10 percentage points over the 1995 data; *Pharmaceuticals* at €77.5 million accounted for 16% of foreign owned BERD in 1999 which continues a downward trend since 1993. In contrast, the share of *Software and computer related activities* continues to increase from 5% in 1993 to 14% or €70.3 million in 1999. *Instruments* at €25.2 million represents 5% of total foreign owned BERD in 1999.

Table 10: *R&D Expenditure by Sector - Foreign-owned Firms, 1993 - 1999*

| | 1993 | | 1995 | | 1997 | | 1999 | |
|---|---|---|---|---|---|---|---|---|
| | €m | % of output | €m | % of output | €m | % of output | €m | % of output |
| Electrical and Electronic Equipment | 102.1 | 1.6% | 132.2 | 1.2% | 206.1 | 1.5% | 257.9 | 1.2% |
| Pharmaceuticals | 57.8 | 7.6% | 72.2 | 4.6% | 70.1 | 3.8% | 77.5 | 2.6% |
| Instruments | 16.9 | 1.7% | 19.9 | 1.7% | 23.4 | 1.5% | 25.2 | 1.0% |
| Chemicals less pharmaceuticals | 14.2 | 0.4% | 16.9 | 0.4% | 15.2 | 0.2% | 20.3 | 0.2% |
| Food, Drink, Tobacco | 7.9 | 0.2% | 18.9 | 0.4% | 14.3 | 0.3% | 17.3 | 0.2% |
| Machinery & Equipment | 3.5 | 0.6% | 9.2 | 1.0% | 8.0 | 0.8% | 7.2 | 0.5% |
| Transport Equipment | 4.8 | 2.7% | 6.8 | 2.7% | 8.9 | 2.9% | 5.4 | 1.1% |
| Rubber & Plastic Products | 1.1 | 0.3% | 4.3 | 0.8% | 3.9 | 0.7% | 3.6 | 0.4% |
| Non-metallic Minerals | 1.9 | 1.4% | 2.8 | 1.9% | 2.9 | 1.8% | 2.1 | 0.8% |
| Basic & Fabricated Metals | 1.2 | 0.3% | 2.1 | 0.4% | 2.9 | 0.5% | 1.9 | 0.2% |
| Wood Products | 0.009 | 0.0% | 1.3 | 1.1% | 1.6 | 1.2% | 1.5 | 0.7% |
| Other Manufacturing | 0.074 | 0.0% | 0.3 | 0.1% | 0.7 | 0.1% | 1.4 | 0.2% |
| Textiles, Clothing, Leather | 3.9 | 0.8% | 6.4 | 1.2% | 2.9 | 0.5% | 0.6 | 0.1% |
| Paper, Print & Publishing | 0.7 | 0.1% | 1.1 | 0.0% | 1.4 | 0.0% | 0.5 | 0.0% |
| Total Manufacturing | 216.2 | 1.2% | 294.5 | 1.1% | 362.2 | 1.0% | 422.3 | 0.8% |
| Software and Computer Related Activities | 11.3 | N/A | 16.8 | N/A | 36.5 | N/A | 70.3 | N/A |
| Other Services | 0 | N/A | 0 | N/A | 1.4 | N/A | 7.1 | N/A |
| Total Business Sector | 228.4 | N/A | 311.3 | N/A | 400.1 | N/A | 499.7 | N/A |

From Table 10, it is evident that the research intensities of foreign-owned industries fall well behind their Irish-owned counterparts, which is to some extent a reflection of their higher turnover figures. The available data show a research intensity of 1.2% for *Electrical and electronic equipment* in 1999, which is consistent with previous years and well below the OECD average of 5.6%. In *Pharmaceuticals* foreign-owned research intensity, at 2.6%, is also well below the OECD average of 11.5% and continues a downward trend from 7.6% in 1993. *Instruments* lies at 1% compared to the OECD average of 7%. Generally the research intensity is lower for all sectors compared to figures for 1993 for foreign-owned BERD.

## 3.2 CONCLUSION

Knowledge-based industries account for a high proportion of industrial R&D internationally, so it is not surprising that both Irish-owned and foreign-owned firms' R&D are concentrated in these industries. R&D intensities are continuing to improve for Irish-owned companies. In contrast, the R&D intensities have fallen for foreign-owned companies. Multinational, particularly US, firms are responsible for a significant proportion of total business expenditure on R&D in Ireland. In general, the huge output increases for high technology foreign firms in Ireland in the period 1993 to 1999 have not been matched by corresponding increases in R&D investment. Their existing operations are largely manufacturing only, and this partly accounts for their low research intensity. Dramatic increases in BERD in future will necessitate a much greater involvement in R&D by high tech multinationals here.

# 4 GOVERNMENT FUNDING OF BERD

## 4.1 ROLE OF GOVERNMENT IN SUPPORTING BUSINESS SECTOR R&D

Government incentive schemes for R&D have played a part in encouraging R&D activity in the business sector.

Table 11: *Government financing of R&D in industry 1991 - 1999.*

| | 1991 | 1993 | 1995 | 1997 | 1999 |
|---|---|---|---|---|---|
| BERD (€m) | 223 | 343 | 470 | 612 | 784 |
| Government Grants for Industry R&D (€m) | 11.6 | 41.3 | 30.1 | 36.7 | 39.8 |
| Government Grants for Industry R&D as a % of BERD | 5.2% | 12.0% | 6.4% | 6.0% | 5.1% |
| Ranking among 25 OECD countries | 21 | 8 | 16 | 16 | 17 |

Table 11 shows the expenditure on business R&D funded by government for the period 1991 - 1999.

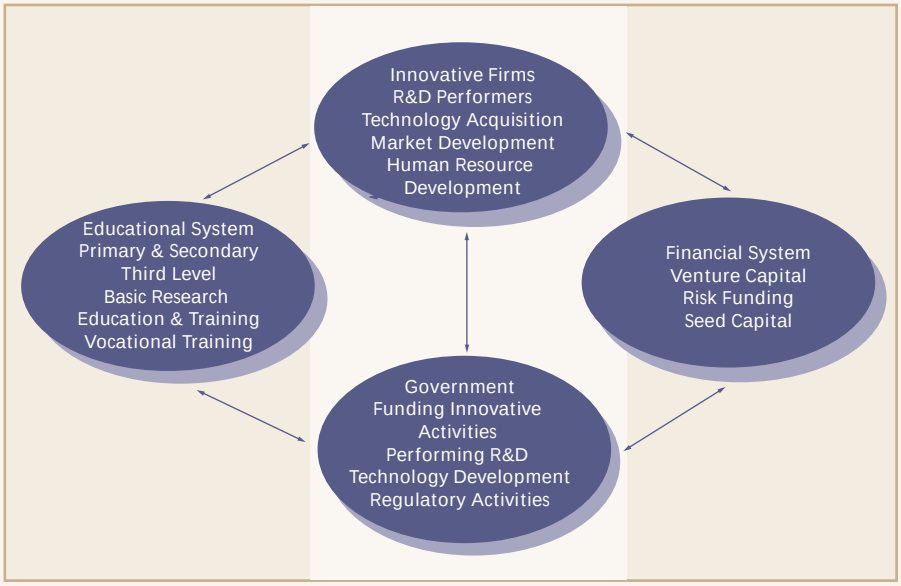
€39.8m was funded by government in 1999 which represents 5.1% of total BERD. Government financing of business R&D from 1991-1999 has been in the region of 5-6% except for 1993 when the EU supported Measure 6 initiative was launched. The OECD average for 1999 government financed R&D in the business sector as a percentage of BERD was 9.6% and the EU average was 8.9%. Ireland ranks 17th out of 25 OECD countries on this indicator. The latest National Development Plan 2000-2006 has allocated extra resources to fund business R&D and this funding is implemented by Enterprise Ireland. The up-take by industry is currently low and it should remain a priority to ensure this funding is fully dispersed to industry.

There are a number of areas which merit consideration by government for grants to industry in order to encourage and promote R&D. Future investments by government should address the rapid technological changes in the knowledge-based industries and the increasing globalisation of industries. Research does not seem to feature very highly on firms' priorities, particularly in periods of economic boom when the emphasis is on meeting high existing demand. The need to plan for new products or processes in the medium term is not seen as urgent. Of course, when the economic downturn arrives, expenditure on R&D will not be increased and may actually be cut. More imaginative ways must be found to encourage companies to spend more on R&D. Support grants are needed to offset the cost of training new staff in R&D skills, tools and methodologies. There may be benefit in increasing the availability and levels of support for feasibility studies. With regard to multinational companies here, it would be worthwhile to revisit the recommendations in the 1998 Forfás report on *'Encouraging R&D by Multinational Enterprises in Ireland'.*

Furthermore, any initiatives which strengthen the linkages between the various actors across the R&D sector as a whole (i.e. business, government and Higher Education sectors) are of crucial importance. The innovation process is now viewed as a highly interactive one, with activities and developments in one sector impinging on innovation capabilities and performance in other sectors. Linkage between the business sector and academic research is increasingly important for high technology industries, to generate the knowledge flows needed for firms to keep on terms with a rapidly changing research environment.

Figure 4 shows in diagrammatic form the elements of the 'national system of innovation' and the linkages between them.

Figure 4 : *National Innovation System - Ireland*



# 5 HUMAN RESOURCES

The numbers of people employed in research activities in industry continued to increase. In 1999 the number of research personnel in industry rose to 8,231 which represents almost 5 people for every 1,000 of the Irish labour force. This is an increase of 1,350 from 6,790 in 1997 (estimated 8% increase per annum). Of those employed in research activities 5,291 are employed as researchers, which has increased from 4,320 in 1997 (an estimated 9% increase per annum). In 1999, 492 of the researchers employed were qualified to PhD level.

Table 13 shows Ireland as employing 4.9 R&D personnel in the business sector per 1000 labour force. The EU average is 5.2 per 1000 labour force and Ireland is ranked 13th out of 25 OECD countries. The figure has risen in Ireland from 4.5 in 1997. This indicator includes technicians and supporting staff.

The number of business sector researchers per 1000 labour force places Ireland at 3.1 researchers in 1999. This has risen from 1.6 in 1991 and ranks Ireland 10th out of 25 OECD countries. Ireland is above the EU average of 2.5 for this indicator which measures the number of research scientists and engineers. The fact that Irish firms are above the EU average in relation to the number of researchers but slightly below in relation to total R&D personnel may indicate that researchers here have less support personnel, such as laboratory technicians, than their counterparts in other EU countries.

Table 13: *International Ranking on Business Sector R&D Personnel 1991-1999.*

| | 1991 | 1993 | 1995 (e) | 1997 (e) | 1999 |
|---|---|---|---|---|---|
| Total R&D Personnel in industry | 3,970 | 4,500 | 5,680 | 6,970 | 8,321 |
| Total R&D Personnel per 1000 labour force | 2.9 | 3.2 | 3.9 | 4.5 | 4.9 |
| Rank among 25 OECD countries | 15 | 15 | 14 | 14 | 13 |
| Total researchers in industry | 2,128 | 2,576 | 3,400 | 4,320 | 5,291 |
| Researchers per 1000 labour force | 1.6 | 1.8 | 2.3 | 2.8 | 3.1 |
| Rank among 25 OECD countries | 15 | 14 | 14 | 11 | 10 |

*See Tables A5 and A6 in the Appendices for detailed international comparisons (e refers to estimated data).*

There is a need to upskill the existing workforce in industry in Ireland in order to keep pace with today's increasingly knowledge-based economy. Initiatives to train existing staff should be further developed by industry in co-operation with the Government and Third Level sector. For instance, flexible support structures by Government could provide support grants to offset the training costs of staff in R&D skills, tools and methodologies. In addition, there is a clear need to train and hire more researchers as noted by several sources including the Expert Group on Future Skills Needs. This requires anticipating demand by industrial sectors for researchers and ensuring third level courses exist to fulfil these needs. The numbers of school leavers in Ireland will fall significantly over the next two decades. In addition the numbers opting for Physics and Chemistry in the Leaving Certificate have declined steadily since the 1980's. This points to a need to address this issue and increase participation and to look at other options such as attracting more mature students into full-time education and attracting qualified researchers from abroad into Ireland. Finally, the perception by industry of the research base in Ireland is an important factor in their decision to undertake research. With the step change in Government investment in research as set out in the National Development Plan this perception is expected to improve dramatically and result in further demand for researchers.

However, all of these plans and aspirations will come to naught if business sector R&D does not increase substantially. There is already anecdotal evidence that highly trained young researchers are experiencing difficulties in obtaining jobs in industry which they had been led to believe would be available. Should this scenario persist it will negate efforts to encourage more students to take science and engineering degrees, particularly to PhD level.

# 6 SOURCES OF R&D FUNDING

Overall, as shown in Table 14, about 82% of funding for R&D in 1999 came from the companies' own resources. This is broadly the case for both Irish owned and foreign owned firms. State grants for R&D were a higher proportion (7.4%) for Irish owned enterprises than for foreign owned (2.1%). Both sectors reported significant support from other foreign sources (i.e. non-EU sources) - 12.2% for foreign firms and 7% for Irish owned; it is not clear how to interpret these data and it is possible that at least some companies reported support from their overseas parent under this heading, although they were not meant to do so.

Table 14: *Source of funds for In-house R&D undertaken in 1999 broken down by ownership*

| Source of Funds | Ownership | | Total |
|---|---|---|---|
| | Irish | Foreign | |
| Own company/internal funds €'000 | 229,198 | 416,851 | 646,048 |
| Payments from other companies in Ireland €'000 | 5,980 | 1,513 | 7,493 |
| Government Grants €'000 | 20,917 | 10,643 | 31,560 |
| Other Irish sources €'000 | 3,474 | 8,301 | 11,775 |
| Direct funding from EU €'000 | 4,700 | 1,223 | 5,923 |
| Other foreign sources €'000 | 19,700 | 61,105 | 80,805 |
| Total €'000 | 283,969 | 499,637 | 783,606 |

# 7 CO-OPERATIVE R&D

Survey respondents were asked about their involvement in joint research activities with other bodies both within and outside Ireland. This would mainly involve other firms as well as higher education or other research institutes.

Table 15 summarises the findings. There is a significant level of co-operative activity, particularly with firms outside Ireland (which may well be linked in some way to the firm in Ireland) and with research centres in Ireland. A low response rate to this question, unfortunately, places some query over the reliability of the data.

## Table 15: *Research Partnerships*

| Partners | Percentage of Firms Involved in Research Partnerships | | |
|---|---|---|---|
| | Ownership | | Total |
| | Irish | Foreign | |
| Firms in Ireland | 14% | 17% | 15% |
| Firms outside Ireland | 25% | 41% | 28% |
| HE / Research Institute in Ireland | 16% | 37% | 20% |
| HE / Research Institute outside Ireland | 9% | 13% | 10% |

(HE - higher education)

# APPENDIX A

## DETAILED TABULAR DATA

### Table A1: *Business Expenditure on Research & Development as a percentage of GDP*

| | 1991 | | 1993 | | 1995 | | 1997 | | 1999 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Value | Rank | Value | Rank | Value | Rank | Value | Rank | Value | Rank |
| No. of countries | 26 | | 26 | | 26 | | 26 | | 26 | |
| Australia | 0.58 | 19 | 0.69 | 18 | 0.86 | 16 | 0.74 | 18 | 0.67 | 18 |
| Belgium | 1.08 | 12 | 1.23 | 10 | 1.23 | 10 | 1.31 | 9 | 1.33 | 9 |
| Canada | 0.80 | 16 | 0.90 | 15 | 1.01 | 13 | 1.01 | 13 | 0.99 | 14 |
| Czech Republic | 1.40 | 9 | 0.88 | 16 | 0.66 | 17 | 0.73 | 19 | 0.81 | 17 |
| Denmark | 0.96 | 14 | 1.02 | 12 | 1.05 | 11 | 1.19 | 11 | 1.25 | 11 |
| Finland | 1.16 | 11 | 1.27 | 9 | 1.45 | 7 | 1.79 | 6 | 2.18 | 2 |
| France | 1.46 | 8 | 1.48 | 7 | 1.41 | 8 | 1.39 | 8 | 1.37 | 8 |
| Germany | 1.76 | 6 | 1.58 | 6 | 1.50 | 6 | 1.54 | 7 | 1.69 | 7 |
| Greece | 0.09 | 26 | 0.13 | 25 | 0.14 | 25 | 0.13 | 26 | 0.13 | 26 |
| Hungary | 0.44 | 21 | 0.31 | 23 | 0.32 | 22 | 0.30 | 23 | 0.28 | 24 |
| Iceland | 0.25 | 24 | 0.42 | 20 | 0.49 | 20 | 0.75 | 17 | 1.08 | 13 |
| Ireland | 0.59 | 18 | 0.79 | 17 | 0.89 | 15 | 0.91 | 15 | 0.88 | 16 |
| Italy | 0.68 | 17 | 0.60 | 19 | 0.53 | 18 | 0.52 | 20 | 0.56 | 19 |
| Japan | 2.13 | 1 | 1.90 | 2 | 1.94 | 2 | 2.09 | 2 | 2.15 | 3 |
| Korea | 1.84 | 5 | 1.84 | 4 | 1.84 | 4 | 1.95 | 3 | 1.76 | 6 |
| Netherlands | 0.98 | 13 | 0.95 | 13 | 1.04 | 12 | 1.11 | 12 | 1.13 | 12 |
| New Zealand | 0.27 | 23 | 0.31 | 23 | 0.26 | 24 | 0.32 | 22 | 0.32 | 22 |
| Norway | 0.90 | 15 | 0.93 | 14 | 0.97 | 14 | 0.94 | 14 | 0.95 | 15 |
| Poland | 0.32 | 22 | 0.32 | 22 | 0.27 | 23 | 0.28 | 24 | 0.31 | 23 |
| Portugal | 0.13 | 25 | 0.13 | 25 | 0.12 | 26 | 0.14 | 25 | 0.17 | 25 |
| Slovak Republic | 1.68 | 7 | 1.04 | 11 | 0.53 | 18 | 0.85 | 16 | 0.43 | 21 |
| Spain | 0.47 | 20 | 0.42 | 20 | 0.39 | 21 | 0.40 | 21 | 0.46 | 20 |
| Sweden | 1.91 | 3 | 2.28 | 1 | 2.57 | 1 | 2.75 | 1 | 2.86 | 1 |
| Switzerland | 1.86 | 4 | 1.86 | 3 | 1.86 | 3 | 1.93 | 4 | 1.93 | 5 |
| United Kingdom | 1.39 | 10 | 1.42 | 8 | 1.30 | 9 | 1.20 | 10 | 1.27 | 10 |
| United States | 1.97 | 2 | 1.78 | 5 | 1.80 | 5 | 1.91 | 5 | 2.00 | 4 |
| Total OECD | 1.54 | | 1.44 | | 1.42 | | 1.49 | | 1.54 | |
| European Union | 1.21 | | 1.18 | | 1.13 | | 1.14 | | 1.20 | |
| Nordic countries | 1.33 | | 1.49 | | 1.64 | | 1.78 | | 1.91 | |

*Source: OECD - Main Science & Technology Indicators (Nearest year used if data not available for a particular year)*

Note: For Ireland figures for 95, 97 and 99 have been updated

## Table A2: *Distribution of R&D Expenditure by Sector - All Firms 1993-1999*

| | 1993 | | 1995 | | 1997 | | 1999 | |
|---|---|---|---|---|---|---|---|---|
| | €'000 | Share of Output | €'000 | Share of Output | €'000 | Share of Output | €'000 | Share of Output |
| Food, Drink, Tobacco | 41,729 | 12% | 46,372 | 10% | 41,149 | 7% | 44,086 | 6% |
| Textiles, Clothing, Leather | 7,168 | 2% | 14,805 | 3% | 10,888 | 2% | 4,240 | 1% |
| Wood Products | 365 | 0% | 2,617 | 1% | 4,352 | 1% | 5,689 | 1% |
| Paper, Print & Publishing | 3,748 | 1% | 5,553 | 1% | 6,225 | 1% | 3,774 | 0% |
| Chemicals less pharmaceuticals | 16,472 | 5% | 19,939 | 4% | 18,646 | 3% | 24,107 | 3% |
| Pharmaceuticals | 62,164 | 18% | 76,098 | 16% | 74,840 | 12% | 82,452 | 11% |
| Rubber & Plastic Products | 3,762 | 1% | 12,424 | 3% | 11,572 | 2% | 11,920 | 2% |
| Non-metallic Minerals | 6,242 | 2% | 10,450 | 2% | 10,044 | 2% | 7,053 | 1% |
| Basic & Fabricated Metals | 6,593 | 2% | 12,442 | 3% | 11,483 | 2% | 8,988 | 1% |
| Machinery & Equipment | 10,128 | 3% | 21,454 | 5% | 19,469 | 3% | 22,529 | 3% |
| Electrical and Electronic Equipment | 117,533 | 34% | 160,053 | 34% | 250,141 | 41% | 316,027 | 40% |
| Instruments | 18,769 | 5% | 24,201 | 5% | 28,272 | 5% | 38,880 | 5% |
| Transport Equipment | 7,895 | 2% | 10,181 | 2% | 14,066 | 2% | 12,618 | 2% |
| Other Manufacturing | 1,500 | 0% | 5,464 | 1% | 3,150 | 1% | 4,948 | 1% |
| Total Manufacturing | 304,068 | 89% | 422,052 | 90% | 504,296 | 82% | 587,311 | 75% |
| Software and Computer Related Activities | 22,613 | 7% | 35,617 | 8% | 89,854 | 15% | 162,551 | 21% |
| Other Services | 12,674 | 4% | 9,175 | 2% | 14,981 | 2% | 30,409 | 4% |
| Total Business Sector | 343,371 | 100% | 470,082 | 100% | 612,350 | 100% | 783,636 | 100% |

## Table A3: *R&D Expenditure in Manufacturing to Gross Output in Selected Countries*

| | Irl | Can | Den | Ger | Fin | Fra | Jap | Nth | Nor | Esp | Swe | UK | USA | OECD average (e) | Lead country |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Manufacturing | 0.8 | 1.2 | 2.0 | 2.3 | 2.2 | 2.5 | 2.9 | 1.7 | 1.3 | 0.6 | 3.7 | 1.9 | 3.2 | 2.4 | 3.7 |
| Food, Drink, Tobacco | 0.2 | 0.2 | 0.5 | 0.1 | 0.5 | 0.3 | 0.7 | 0.6 | 0.4 | 0.1 | 0.5 | 0.4 | 0.3 | 0.3 | 0.7 |
| Textiles, Clothing, Leather | 0.3 | 0.4 | 0.1 | 0.4 | 0.6 | 0.4 | 0.7 | 0.3 | 0.8 | 0.2 | 0.7 | 0.1 | 0.3 | 0.3 | 0.8 |
| Wood Products | 1.0 | 0.1 | 0.1 | 0.2 | 0.4 | 0.4 | 0.4 | 0.3 | 0.2 | 0.1 | 0.2 | 0.1 | 0.5 | 0.2 | 1.0 |
| Paper, Print & Publishing | 0.1 | 0.3 | 0.1 | 0.1 | 0.5 | 0.1 | 0.4 | 0.1 | 0.4 | 0.1 | 0.8 | 0.1 | 0.6 | 0.4 | 0.8 |
| Pharmaceuticals | 2.7 | 7.9 | 17.0 | 8.9 | 15.5 | 9.0 | 12.9 | 6.6 | 10.4 | 2.6 | 22.6 | 17.3 | 11.9 | 11.5 | 22.6 |
| Rubber & Plastic Products | 0.8 | 0.3 | 1.3 | 0.8 | 3.6 | 1.8 | 2.1 | 0.6 | 0.6 | 0.4 | 2.4 | 0.4 | 1.0 | 1.2 | 3.6 |
| Non-metallic Minerals | 0.6 | 0.1 | 0.4 | 0.6 | 1.4 | 1.1 | 2.2 | 0.3 | 0.5 | 0.3 | 1.2 | 0.4 | 0.6 | 0.8 | 2.2 |
| Machinery & Equipment | 1.0 | 1.0 | 3.4 | 2.6 | 2.7 | 2.0 | 3.1 | 1.0 | 1.1 | 1.1 | 4.3 | 2.2 | 2.2 | 2.1 | 4.3 |
| Electrical and Electronic Equipment | 1.4 | 8.1 | 4.7 | 5.1 | 9.8 | 7.6 | 4.9 | 7.4 | 8.6 | 2.7 | 9.2 | 4.2 | 7.2 | 5.6 | 9.8 |
| Instruments | 1.5 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 7.0 | N/A |
| Transport Equipment | 1.2 | 1.1 | 1.6 | 4.5 | 1.4 | 5.2 | 3.4 | 2.9 | 1.0 | 1.1 | 6.2 | 3.5 | 7.1 | 4.5 | 7.1 |
| Other Manufacturing | 0.3 | 1.4 | 9.2 | 0.7 | 1.8 | 0.6 | 0.5 | 0.3 | 0.6 | 0.4 | 0.4 | 0.6 | 1.0 | 1.0 | 9.2 |

*Source: OECD scoreboard (data relate to 1996 in most cases)*

## Table A4: *R&D Expenditure in Manufacturing to Gross Output - All Firms*

| | 1993 | | 1995 | | 1997 | | 1999 | |
|---|---|---|---|---|---|---|---|---|
| | €'000 | Share of Output | €'000 | Share of Output | €'000 | Share of Output | €'000 | Share of Output |
| Food, Drink, Tobacco | 41,729 | 0.4% | 46,372 | 0.4% | 41,149 | 0.3% | 44,086 | 0.2% |
| Textiles, Clothing, Leather | 7,168 | 0.8% | 14,805 | 1.5% | 10,888 | 1.0% | 4,240 | 0.3% |
| Wood Products | 365 | 0.1% | 2,617 | 0.6% | 4,352 | 0.9% | 5,689 | 1.0% |
| Paper, Print & Publishing | 3,748 | 0.1% | 5,553 | 0.1% | 6,225 | 0.1% | 3,774 | 0.1% |
| Chemicals less pharmaceuticals | 16,472 | 0.4% | 19,939 | 0.4% | 18,646 | 0.3% | 24,107 | 0.2% |
| Pharmaceuticals | 62,164 | 7.5% | 76,098 | 4.6% | 74,840 | 3.9% | 82,452 | 2.7% |
| Rubber & Plastic Products | 3,762 | 0.5% | 12,424 | 1.3% | 11,572 | 1.1% | 11,920 | 0.8% |
| Non-metallic Minerals | 6,242 | 0.8% | 10,450 | 1.1% | 10,044 | 1.0% | 7,053 | 0.6% |
| Basic & Fabricated Metals | 6,593 | 0.6% | 12,442 | 1.0% | 11,483 | 0.8% | 8,988 | 0.5% |
| Machinery & Equipment | 10,128 | 1.0% | 21,454 | 1.6% | 19,469 | 1.2% | 22,529 | 1.0% |
| Electrical and Electronic Equipment | 117,533 | 1.7% | 160,053 | 1.4% | 250,141 | 1.7% | 316,027 | 1.4% |
| Instruments | 18,769 | 1.8% | 24,201 | 1.9% | 28,272 | 1.6% | 38,880 | 1.5% |
| Transport Equipment | 7,895 | 1.5% | 10,181 | 1.5% | 14,066 | 1.8% | 12,618 | 1.2% |
| Other Manufacturing | 1,500 | 0.1% | 5,464 | 0.5% | 3,150 | 0.2% | 4,948 | 0.3% |
| Total Manufacturing | 304,068 | 1.0% | 422,052 | 1.0% | 504,296 | 1.0% | 587,311 | 0.8% |

## Table A5: *Total Business Sector R&D Personnel per 1000 Labour Force*

| | 1991 | | 1993 | | 1995 | | 1997 | | 1999 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Value | Rank | Value | Rank | Value | Rank | Value | Rank | Value | Rank |
| No. of countries | 25 | | 25 | | 25 | | 25 | | 25 | |
| Australia | 2.5 | 18 | 2.8 | 16 | 3.0 | 16 | 2.7 | 17 | 2.6 | 17 |
| Belgium | 5.3 | 9 | 5.1 | 10 | 5.3 | 10 | 5.3 | 12 | 5.3 | 11 |
| Canada | 3.8 | 14 | 4.2 | 14 | 5.6 | 8 | 5.4 | 11 | 4.9 | 14 |
| Czech Republic | 10.8 | 1 | 5.4 | 9 | 2.2 | 18 | 2.2 | 19 | 2.4 | 18 |
| Denmark | 5.2 | 10 | 5.5 | 8 | 6.1 | 7 | 7.0 | 6 | 7.4 | 5 |
| Finland | 5.8 | 7 | 6.1 | 6 | 7.1 | 5 | 8.9 | 2 | 10.8 | 1 |
| France | 6.2 | 6 | 6.5 | 5 | 6.4 | 6 | 6.5 | 7 | 6.4 | 7 |
| Germany | 8.1 | 4 | 7.4 | 4 | 7.2 | 4 | 7.2 | 5 | 7.3 | 6 |
| Greece | 0.6 | 24 | 0.7 | 24 | 0.7 | 24 | 0.8 | 24 | 0.8 | 24 |
| Hungary | 2.9 | 16 | 1.8 | 20 | 1.7 | 21 | 1.6 | 21 | 1.4 | 22 |
| Iceland | 2.0 | 20 | 2.8 | 17 | 3.7 | 15 | 5.6 | 9 | 6.3 | 8 |
| Ireland | 2.9 | 15 | 3.2 | 15 | 3.9 | 14 | 4.5 | 14 | 4.9 | 13 |
| Italy | 2.7 | 17 | 2.7 | 18 | 2.6 | 17 | 2.7 | 18 | 2.6 | 16 |
| Japan | 8.7 | 2 | 8.8 | 1 | 8.6 | 3 | 8.6 | 4 | 8.9 | 3 |
| Korea | 5.1 | 11 | 4.9 | 12 | 4.6 | 13 | 4.2 | 15 | 3.9 | 15 |
| Netherlands | 4.3 | 13 | 4.4 | 13 | 5.1 | 12 | 5.5 | 10 | 5.7 | 9 |
| New Zealand | 1.5 | 22 | 1.7 | 22 | 1.6 | 22 | 1.6 | 22 | 1.6 | 21 |
| Norway | 4.7 | 12 | 5.0 | 11 | 5.5 | 9 | 5.7 | 8 | 5.7 | 10 |
| Poland | 1.5 | 23 | 1.5 | 23 | 1.5 | 23 | 1.3 | 23 | 1.2 | 23 |
| Portugal | 0.4 | 25 | 0.4 | 25 | 0.4 | 25 | 0.4 | 25 | 0.7 | 25 |
| Slovak Republic | 2.2 | 19 | 2.2 | 19 | 2.0 | 19 | 2.9 | 16 | 2.2 | 20 |
| Spain | 1.9 | 21 | 1.8 | 21 | 1.7 | 20 | 1.8 | 20 | 2.3 | 19 |
| Sweden | 7.5 | 5 | 8.1 | 3 | 9.5 | 1 | 10.0 | 1 | 10.1 | 2 |
| Switzerland | 8.5 | 3 | 8.6 | 2 | 8.6 | 2 | 8.7 | 3 | 8.6 | 4 |
| United Kingdom | 5.5 | 8 | 5.8 | 7 | 5.1 | 11 | 4.8 | 13 | 5.2 | 12 |
| European Union | 5.2 | | 5.1 | | 5.0 | | 5.1 | | 5.2 | |
| Nordic countries | 6.0 | | 6.5 | | 7.4 | | 8.2 | | 8.7 | |

*Source: OECD - Main Science & Technology Indicators (Nearest year used if data not available for a particular year)*

Note: For Ireland figures for 95, 97 and 99 have been updated

## Table A6: *Business Sector Researchers per 1000 Labour Force*

| | 1991 | | 1993 | | 1995 | | 1997 | | 1999 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Value | Rank | Value | Rank | Value | Rank | Value | Rank | Value | Rank |
| No. of countries | 25 | | 25 | | 25 | | 25 | | 25 | |
| Australia | 1.5 | 16 | 1.6 | 15 | 1.7 | 16 | 1.6 | 16 | 1.5 | 16 |
| Belgium | 2.1 | 11 | 2.7 | 7 | 2.7 | 8 | 2.7 | 13 | 2.7 | 14 |
| Canada | 2.1 | 9 | 2.5 | 9 | 3.3 | 4 | 3.4 | 5 | 3.1 | 8 |
| Czech Republic | 2.1 | 10 | 1.5 | 17 | 1.0 | 18 | 1.0 | 19 | 1.1 | 18 |
| Denmark | 1.8 | 13 | 2.0 | 12 | 2.4 | 13 | 2.6 | 14 | 2.8 | 12 |
| Finland | 2.0 | 12 | 2.2 | 11 | 2.7 | 9 | 3.5 | 4 | 4.1 | 5 |
| France | 2.4 | 8 | 2.6 | 8 | 2.6 | 10 | 2.8 | 12 | 2.8 | 13 |
| Germany | 3.6 | 2 | 3.3 | 5 | 3.3 | 5 | 3.3 | 6 | 3.4 | 6 |
| Greece | 0.3 | 24 | 0.3 | 24 | 0.4 | 24 | 0.4 | 24 | 0.4 | 24 |
| Hungary | 1.2 | 19 | 0.8 | 21 | 0.7 | 21 | 0.8 | 21 | 0.8 | 22 |
| Iceland | 1.2 | 18 | 1.9 | 13 | 2.4 | 12 | 3.2 | 8 | 4.1 | 4 |
| Ireland | 1.6 | 15 | 1.8 | 14 | 2.3 | 14 | 2.8 | 11 | 3.1 | 10 |
| Italy | 1.2 | 17 | 1.2 | 18 | 1.2 | 17 | 1.2 | 18 | 1.2 | 17 |
| Japan | 5.2 | 1 | 5.6 | 1 | 5.8 | 1 | 6.0 | 1 | 6.4 | 1 |
| Korea | 3.5 | 3 | 3.4 | 3 | 3.2 | 6 | 3.2 | 7 | 3.0 | 11 |
| Netherlands | 1.6 | 14 | 1.6 | 16 | 1.8 | 15 | 2.3 | 15 | 2.3 | 15 |
| New Zealand | 0.8 | 21 | 0.9 | 20 | 0.9 | 19 | 0.9 | 20 | 0.9 | 21 |
| Norway | 3.2 | 4 | 3.4 | 4 | 3.6 | 3 | 4.1 | 3 | 4.2 | 3 |
| Poland | 0.6 | 23 | 0.6 | 23 | 0.6 | 23 | 0.6 | 23 | 0.6 | 23 |
| Portugal | 0.1 | 25 | 0.2 | 25 | 0.2 | 25 | 0.2 | 25 | 0.4 | 25 |
| Slovak Republic | 1.0 | 20 | 1.0 | 19 | 0.9 | 20 | 1.3 | 17 | 1.0 | 19 |
| Spain | 0.8 | 22 | 0.7 | 22 | 0.7 | 22 | 0.7 | 22 | 0.9 | 20 |
| Sweden | 2.9 | 5 | 3.5 | 2 | 4.3 | 2 | 4.8 | 2 | 5.2 | 2 |
| Switzerland | 2.5 | 7 | 2.5 | 10 | 2.5 | 11 | 3.1 | 9 | 3.1 | 9 |
| United Kingdom | 2.8 | 6 | 3.0 | 6 | 2.9 | 7 | 2.9 | 10 | 3.2 | 7 |
| European Union | 2.2 | | 2.3 | | 2.3 | | 2.4 | | 2.5 | |
| Nordic countries | 2.5 | | 2.9 | | 3.4 | | 3.9 | | 4.2 | |

*Source: OECD - Main Science & Technology Indicators (Nearest year used if data not available for a particular year)*

Note: For Ireland figures for 95, 97 and 99 have been updated

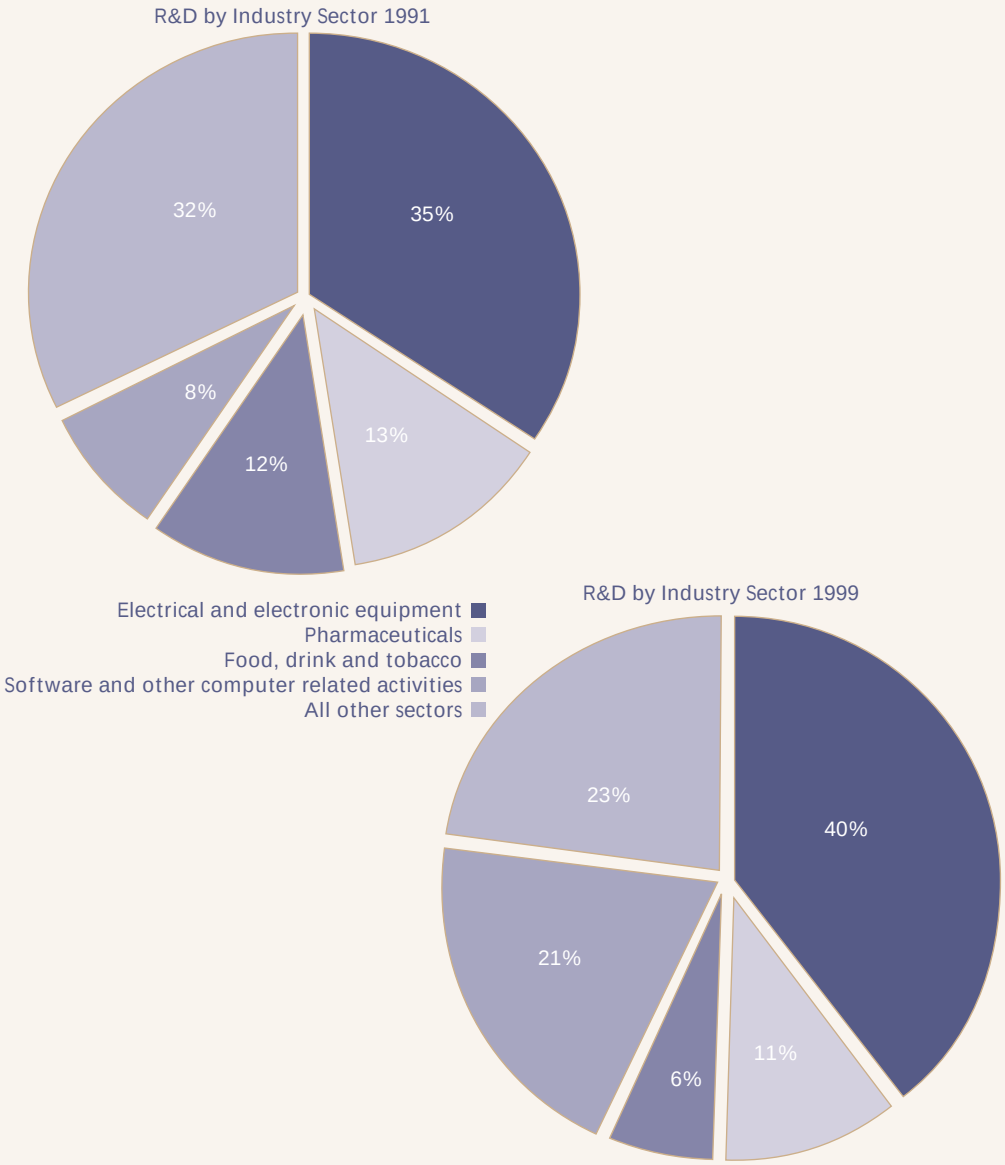
## Table A7: *Proportion of Business Sector R&D Financed by Government*

| | 1991 | | 1993 | | 1995 | | 1997 | | 1999 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Value | Rank | Value | Rank | Value | Rank | Value | Rank | Value | Rank |
| No. of countries | 25 | | 25 | | 25 | | 25 | | 25 | |
| Australia | 3.0 | 23 | 2.4 | 23 | 2.4 | 23 | 2.3 | 24 | 3.1 | 22 |
| Belgium | 7.8 | 15 | 7.7 | 17 | 7.7 | 12 | 7.6 | 14 | 7.6 | 13 |
| Canada | 9.9 | 11 | 9.9 | 13 | 6.5 | 15 | 5.7 | 17 | 3.6 | 21 |
| Czech Republic | 6.6 | 18 | 4.1 | 21 | 4.5 | 20 | 7.9 | 13 | 14.1 | 3 |
| Denmark | 7.9 | 14 | 5.8 | 20 | 6.1 | 17 | 5.3 | 19 | 4.2 | 19 |
| Finland | 5.4 | 20 | 6.1 | 19 | 5.6 | 18 | 4.1 | 22 | 4.2 | 19 |
| France | 22.3 | 3 | 15.3 | 4 | 12.7 | 5 | 10.4 | 7 | 9.0 | 8 |
| Germany | 10.0 | 10 | 9.0 | 15 | 8.8 | 11 | 9.2 | 10 | 7.6 | 13 |
| Hungary | 8.2 | 13 | 11.4 | 9 | 16.2 | 4 | 14.6 | 4 | 5.7 | 16 |
| Iceland | 9.6 | 12 | 14.4 | 5 | 3.3 | 22 | 5.0 | 20 | 2.4 | 23 |
| Ireland | 5.2 | 21 | 12.0 | 8 | 6.4 | 16 | 6.0 | 16 | 5.1 | 17 |
| Italy | 13.2 | 6 | 13.4 | 6 | 16.7 | 3 | 13.5 | 5 | 13.3 | 5 |
| Japan | 1.4 | 25 | 1.4 | 25 | 1.6 | 25 | 1.3 | 25 | 1.8 | 25 |
| Korea | 3.6 | 22 | 3.6 | 22 | 3.6 | 21 | 4.8 | 21 | 5.8 | 15 |
| Netherlands | 7.5 | 16 | 7.8 | 16 | 6.6 | 14 | 5.4 | 18 | 4.4 | 18 |
| New Zealand | 7.2 | 17 | 6.9 | 18 | 6.9 | 13 | 8.7 | 11 | 8.7 | 9 |
| Norway | 15.9 | 4 | 16.0 | 3 | 11.9 | 6 | 11.0 | 6 | 9.7 | 7 |
| Poland | 33.9 | 1 | 33.9 | 1 | 33.8 | 1 | 29.2 | 1 | 26.5 | 1 |
| Portugal | 6.5 | 19 | 9.1 | 14 | 5.1 | 19 | 9.4 | 9 | 8.1 | 11 |
| Slovak Republic | 11.4 | 7 | 10.8 | 10 | 10.8 | 8 | 16.5 | 2 | 24.4 | 2 |
| Spain | 11.3 | 8 | 10.6 | 12 | 9.2 | 10 | 8.7 | 11 | 8.6 | 10 |
| Sweden | 10.3 | 9 | 10.8 | 10 | 9.5 | 9 | 7.6 | 14 | 7.8 | 12 |
| Switzerland | 1.7 | 24 | 1.7 | 24 | 1.7 | 24 | 2.4 | 23 | 2.4 | 23 |
| United Kingdom | 14.6 | 5 | 12.4 | 7 | 11.3 | 7 | 10.4 | 7 | 10.2 | 6 |
| United States | 22.5 | 2 | 19.4 | 2 | 17.8 | 2 | 15.2 | 3 | 13.6 | 4 |
| Total OECD | 14.8 | | 12.6 | | 11.5 | | 10.2 | | 9.6 | |
| European Union | 13.5 | | 11.3 | | 10.4 | | 9.3 | | 8.9 | |
| Nordic countries | 9.8 | | 9.9 | | 8.6 | | 6.9 | | 6.6 | |

*Source: OECD - Main Science & Technology Indicators (Nearest year used if data not available for a particular year)*

Note: For Ireland figures for 91 - 99 have been updated (current prices)

## A8: *Comparison of breakdown of R&D by Industry Sector for 1991 and 1999*



## A9: *Nature of R&D Activity in Irish-owned and Foreign-owned Firms 1999*

| | Irish-owned | Foreign-owned |
|---|---|---|
| Expenditure on R&D £m (€m) | £224m (€284m) | £394m (€500m) |
| Nature of R&D Activity: | | |
| Basic and applied research | 40% | 28% |
| Experimental Development | 60% | 72% |
| Orientation of R&D work: | | |
| Developing new products | 53% | 37% |
| Improving existing products | 29% | 32% |
| Developing new processes | 9% | 16% |
| Improving existing processes | 7% | 14% |
| Other | 2% | 0% |

# APPENDIX B

QUESTIONNAIRE

Survey of Research and Development in Industry 1999/2000

Please check the following details and amend if necessary

Respondent: _____

Respondent Title: _____

- *This survey is concerned with measuring the research and development (R&D) activity of companies in the Republic of Ireland in 1999. The R&D activities of related companies operating outside the Republic of Ireland should be ignored.*
- *The questionnaire should be completed by companies either engaging in R&D or having R&D performed on their behalf by other parties.*
- *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. You will be asked at the end of the questionnaire to confirm the names of all plants which have been included.*
- *The information you provide will be treated in strict confidence and will be used for statistical purposes only. Data will not be published in an identifiable form.*

Please answer the following questions to describe your company's involvement in Research and Development (R&D).

Definition of Research and Development (R&D)

Research and Development (R&D) in industry is defined as creative work which is 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 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.

## General description of R&D activity

Q.1 Given the above definition, did your company perform any in-house R&D in 1999?

Yes ☐

No ☐

Q.2 Was any R&D performed on your behalf by other parties in 1999? (i.e. sub-contracted R&D performed by other companies/institutes)

Yes ☐

No ☐

Q.3 Does your company have a formal R&D department? (i.e. R&D as a separate cost centre with its own dedicated personnel)

Yes ☐

No ☐

Q.4a In what year did your company commence R&D in Ireland? _____

Q.4b In what year did your company first establish a formal R&D department? _____

# Resources allocated to in-house performed R&D

This section of the questionnaire aims to measure the human and financial resources allocated by your company to in-house performed R&D. Please use the following general rules to decide on what should be included as R&D and what should be excluded from 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 implies full-scale testing and subsequent further design and engineering)*

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*

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 no longer R&D.

# In-house R&D personnel

Q.5a Please specify the number of staff (male and female) in each category involved in in-house R&D over the course of 1999.

Q.5b As staff may share their time between R&D and non-R&D activities, please specify also the average percentage of time spent on R&D for each of these categories of staff.

| | Q.5a Number of staff | | | Q.5b Average % of time spent on R&D |
|---|---|---|---|---|
| | Male | Female | Total | |
| PhD researchers<br>Scientists and engineers with a PhD qualification | | | | |
| Non-PhD researchers<br>Scientists and engineers with other degree level qualifications | | | | |
| Technicians<br>Technically qualified personnel (laboratory technicians, draftspeople) | | | | |
| Support Staff<br>All Other R&D Supporting Staff (Including R&D managers, administrators and clerical staff) | | | | |
| Total R&D Staff | | | | |

# Expenditure on in-house R&D

Q.6 Please specify your expenditure in 1999 and an estimate of your expenditure on in-house R&D for the year 2000 under each of the following headings:

Note: Include only actual expenditure and exclude depreciation charges. R&D performed outside the company should not be included here as this is covered in a later question.

| Current Expenditure on R&D: | 1999 000's | 2000 est. 000's |
|---|---|---|
| Labour costs<br>Wages, salaries and all associated costs of personnel directly associated with R&D | £ | £ |
| Other current expenditure<br>Materials, supplies and equipment, literature and subscriptions, overheads associated with R&D | £ | £ |

Capital Expenditure directly linked to R&D:

| | | |
|---|---|---|
| Land and buildings<br>Sites for laboratories and pilot plants, buildings purchased, constructed and repaired directly for R&D | £ | £ |
| Instruments and equipment<br>Major instruments and other capital equipment acquired wholly for R&D purposes | £ | £ |
| Total expenditure on in-house R&D | £ | £ |
| Estimated Total Sales Turnover<br>(used to compute R&D as a percentage of sales) | £ | £ |

# Sources of funds for in-house R&D in 1999

Q.7 Please specify the source of funds for the in-house R&D undertaken in 1999:

| | 000s |
|---|---|
| Own company/internal funds | £ |
| Payments from 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 1999 - to equate to the 1999 total given in Q.6 above | £ |

# Nature of R&D activity

Q.8 Please indicate the breakdown of total R&D expenditure in terms of the following categories as defined below:

| | |
|---|---|
| Basic Research | % |
| Applied Research | % |
| Experimental Development | % |
| | 100% |

Basic Research: Experimental or theoretical work undertaken primarily to acquire new knowledge, without any particular application or use in view.

Applied Research: Original investigation undertaken in order 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.

Q.9 Please describe the orientation of your R&D activities by estimating the proportion of expenditure given over to each of the following categories.

| Activity | % |
|---|---|
| Health and Life Sciences | |
| Food and Beverages | |
| Computing (hardware and/or software) | |
| Telecommunications (hardware and/or software) | |
| Other electronics | |
| Materials | |
| Chemical Processes | |
| Other (Please Specify): | |
| | 100% |

Q.10 Please indicate the breakdown of total R&D expenditure in terms of the following aims:

| | |
|---|---|
| Developing new products | % |
| Improving existing products | % |
| Developing new processes | % |
| Improving existing processes | % |
| Other (please specify briefly) | % |
| | 100% |

Q.11 Please estimate how your total sales turnover in 1999 (as recorded at Q.6 above) was distributed across the following types of products:

| | |
|---|---|
| Technologically new products introduced between 1997 and 1999 | % |
| Technologically improved products introduced between 1997 and 1999 | % |
| Products which were technologically unchanged between 1997 and 1999 | % |
| | 100% |

A technologically new product is a product whose technological characteristics or intended uses differ significantly from those of previously produced products.

A technologically improved product is an existing product whose performance has been significantly enhanced or upgraded. Technologically new or improved products include products that are new to your enterprise even if they are not new to the market as a whole.

Q.12 Did your company engage in joint research projects with any of the following parties in 1999?

| | Tick the appropriate box for each category (√) | |
|---|---|---|
| | Yes | No |
| Firms in Ireland | | |
| Other firms outside Ireland | | |
| Higher education or other institutes in Ireland | | |
| Higher education or other institutes outside Ireland | | |

Q.13 Please specify how much, if anything, you paid to the following parties for R&D performed on your behalf outside the company in 1999. This expenditure is *in addition* to the in-house expenditure recorded at Q.6 above.

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

Q.14 Please state the number of patents applied for and granted to your company (if any) in 1999 in the appropriate box.

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

# Classification Details

Q.15 Number of permanent full-time employees at the end of 1999 _____

Q.16 Please describe the nature of your business including all products and services provided.

_____

_____

Q.17 Are most of the shares in your company Irish-owned?

Yes - 50% or more Irish-owned

No - Less than 50% Irish-owned

Q.18 Is your company an independent enterprise or part of a wider enterprise group?

Independent Enterprise

Part of a wider group

Q.19 If your company is part of a wider group please state in which country is your group headquarters located?

_____

Q.20 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. | | |
| 5. | | |
| 6. | | |
| 7. | | |
| 8. | | |
| 9. | | |
| 10. | | |

| Please use the space below to provide any additional comments on R&D activity within your company or to express your views on the environment for undertaking R&D in Ireland. |
|---|
| |

THANK YOU VERY MUCH FOR YOUR CO-OPERATION

Please return the questionnaire in the reply paid envelope provided. If you have any queries in relation to the survey, please contact either James Williams or Nicola Hughes at the ESRI (Ph.01-6671525) or Rhona Dempsey at Forfás (Ph 01-6073052)

# METHODOLOGY

The survey is based on a questionnaire which was sent to all known R&D performing enterprises in Ireland. An initial total of 2615 enterprises were contacted and it was established that 1163 of these claimed to undertake R&D. This was therefore the population of R&D active firms for the survey.

The fieldwork extended from late August 2000 to February 2001 and repeated contact was made to try to improve the response rate. Particular attention was paid to about 350 of the larger firms, which were known to include the major R&D performers. A total of 604 responses were ultimately obtained, a response rate of 52%. A higher response rate was obtained for the priority group of larger firms.

In grossing up the data, individual estimates were made for the non-respondents based on calculating a value from respondents within the same industrial sector weighted according to number of employees. The value was controlled for ownership (foreign or Irish owned) and size of firm.

# Reports Published by Forfás 2000 - 2001

| | |
|---|---|
| Survey of Research in the Higher Education Sector | May 1994 |
| Submission to the Science, Technology and Innovation Advisory Council<br>Irish Council for Science, Technology & Innovation in Ireland | June 1994 |
| Technological Innovation in Irish Manufacturing Industry<br>Preliminary findings from the Irish Innovation Survey | November 1994 |
| Telecommunications in Ireland<br>A Report on Infrastructure and Services Available, Planned and Required by Irish Industry in the period 1994-1999 | November 1994 |
| Evaluation of Bio-Research Ireland<br>Findings from the Review of Bio-Research Ireland | November 1994 |
| State Investment in Science & Technology, 1993<br>Final Allocations by Government for the year 1993 to Institutions Engaged in any Activity Related to Science and Technology – the Science Budget for 1993 | December 1994 |
| Transport Needs of Irish Manufacturing Sectors<br>Analysis of the Critical Role of Transport Services and Infrastructure in Securing Competitive Advantage for Companies in the New Global Order | June 1995 |
| 1994 Employment Survey<br>Review of Employment Trends in Manufacturing and Internationally Traded Service Sectors | July 1995 |
| Guide to RTD Measures and Actions in the Community Support Framework for Ireland, 1994-1999 | August 1995 |
| Research and Development in the Business Sector<br>Findings from the 1993 Census of R&D Performing Enterprises in Ireland | September 1995 |
| Annual Survey of Irish Economy Expenditures<br>Results for 1993 | October 1995 |
| Ireland's Cost and Competitiveness Environment<br>Analysis of Those Factors Both Directly and Indirectly Influencing Competitiveness of the Enterprise Sectors | October 1995 |
| Forfás Annual Report, 1994 | November 1995 |
| State Investment in Science & Technology, 1995<br>Financial Allocations by Government for 1995 to Institutions Engaged in Any Activity Related to Science and Technology – the Science Budget for 1995 | December 1995 |
| Evaluation of Applied Research Programme<br>Findings from the Review of the Applied Research Programme in the Regional Technical Colleges | December 1995 |
| Evaluation of the AMT Ireland<br>Findings from the Review of Advanced Manufacturing Programme | December 1995 |
| World Class to Serve the World<br>Report of the Forfás Transport & Logistics Group | March 1996 |

| | |
|---|---|
| Evaluation of Technology Centres Programme | July 1996 |
| "Shaping Our Future"<br>A Strategy for Enterprise in Ireland in the 21st Century | May 1996 |
| Funding for Research and Technology Development in SMEs | August 1996 |
| 1995 Employment Survey | August 1996 |
| Forfás Annual Report 1995 | August 1996 |
| Telecommunications and Enterprise<br>Building and Investing for our Future | September 1996 |
| Review of the Property Function for Industrial Development Purposes | October 1996 |
| Innovation Ireland | November 1996 |
| Annual Survey of Irish Economy Expenditures<br>Results for 1994 | December 1996 |
| State Investment in Science and Technology 1996 | December 1996 |
| Teltec Ireland – An Evaluation | February 1997 |
| Irish S&T Indicators – An Update<br>The 1996 Annual Report of FIOS. The Advisory Committee on S&T Indicators. | March 1997 |
| Information Society Ireland - A Strategy for Action | March 1997 |
| Where the jobs are and how to get them | May 1997 |
| Forfás Annual Report 1996 | July 1997 |
| Survey of Process and Product Innovation in Irish Industry 1993 - 1995 | August 1997 |
| 1996 Employment Survey | August 1997 |
| Annual Survey of Irish Economy Expenditures<br>Results for 1995 | October 1997 |
| State Expenditure Priorities for 1998<br>Statement of the Irish Council for Science, Technology & Innovation (ICSTI) | September 1997 |
| State Investment in Science & Technology, 1997 | December 1997 |
| £250 Million Scientific and Technological Education (Investment) Fund<br>Statement of the Irish Council for Science, Technology & Innovation (ICSTI) | January 1998 |
| Annual Competitiveness Report 1998 &<br>The Competitiveness Challenge Summary Statement | February 1998 |
| Broadband Telecommunications Investment in Ireland | March 1998 |
| Annual Survey of Irish Economy Expenditures<br>Results for 1996 | April 1998 |
| A Partnership Approach to Research Funding – The Need for a National Science and Engineering Research Fund<br>Statement of the Irish Council for Science, Technology & Innovation (ICSTI) | May 1998 |
| 1997 Employment Survey | June 1998 |

| | |
|---|---|
| Statement of the 3rd National Innovation Conference<br>Partnership for Success: Collaboration for Innovation and Competitiveness | June 1998 |
| Forfás Annual Report 1997 | July 1998 |
| Basic Research Support in Ireland<br>An evaluation of the Basic Research Grants Scheme operated by Forbairt | August 1998 |
| Science in Primary Schools<br>Statement of the Irish Council for Science, Technology & Innovation (ICSTI) | September 1998 |
| Innovation in Enterprises in Ireland<br>Statement of the Irish Council for Science, Technology & Innovation (ICSTI) | November 1998 |
| Mechanisms for Prioritisation of State Expenditures on Science and Technology<br>Statement of the Irish Council for Science, Technology & Innovation (ICSTI) | November 1998 |
| Statement on Telecommunications:<br>A Key Factor in Electronic Commerce and Competitiveness<br>National Competitiveness Council (NCC) | November 1998 |
| The First Report of the Expert Group on Future Skills Needs<br>Responding to Ireland's growing skill needs | December 1998 |
| Statement on Skills<br>National Competitiveness Council (NCC) | December 1998 |
| State Expenditure Priorities for 1999<br>Statement of the Irish Council for Science, Technology & Innovation (ICSTI) | January 1999 |
| Business Education & Training Partnership<br>Report on the Inaugural Forum, Royal Hospital Kilmainham | March 1999 |
| Investing in Research, Technology and Innovation (RTI) in the Period 2000 to 2006<br>Statement of the Irish Council for Science, Technology & Innovation (ICSTI) | March 1999 |
| State Investment in Science & Technology, 1998<br>Financial allocations by Government for 1998 to institutions engaged in any activity related to science and technology – the Science and Technology Budget for 1998 | March 1999 |
| Forfás/IBEC: Telecommunications for Business: A User's Guide | April 1999 |
| Technology Foresight Ireland<br>Irish Council for Science, Technology & Innovation (ICSTI) | April 1999 |
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State Bodies Working Together

Forfás Mission Statement

Forfás 5th Framework Brochure

Network Magazine
(Ongoing)

EMU - The Business Awareness Campaign
and Eurochange Magazine
(Ongoing)

Forfás Clients' Charter

Forfás, Wilton Park House, Wilton Place, Dublin 2. Tel: 01-607 3000, Fax: 01-607 3030,Website: www.forfas.ie