Forfás

Survey of Research and Development in the Higher Education Sector 2002

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

Survey of Research and Development in the Higher Education Sector 2002

November 2004

Foreword

This report was prepared by the Science and Technolgoy Indicators unit of Forfás.

Andrew Stockman
Michelle Finlay
Helena Connellan

Forfás acknowledges with gratitude the information supplied by those in the finance and personnel offices of third level institutions on which analysis was based.

If you require further information about this survey please contact:

Science and Technology Indicators Unit,
Science and Technology Division,
Forfás,
Wilton Park House,
Wilton Place,
Dublin 2,
Ireland

Tel: 01 607 3154
www.forfas.ie

Contents

Executive Summary

This paper presents the results from the survey of research and development performed in the higher education sector (HERD) in Ireland in 2002. The higher education (HE) sector includes universities and institutes of technology, the programmes in advanced technologies (PATs) and the technology centres.

Despite being below the average EU performance, Ireland is making strong efforts to close the gap between domestic R&D performance and that of major competitors on the international stage. Ireland's R&D vision states that *"by 2010 Ireland will be internationally renowned for the excellence of its research and be at the forefront in generating and using new knowledge for economic and social progress, within an innovation driven culture".*

It is clear that the Irish research sector is being truly transformed. Total expenditure on R&D in the higher education sector increased by 23% in real terms between 2000 and 2002. This increase will have been driven further in the period 2003-2004 as a result of additional R&D expenditure from the Programme for Research in Third-Level Institutions (PRTLI) and Science Foundation Ireland (SFI).

The key findings of this survey are as follows:

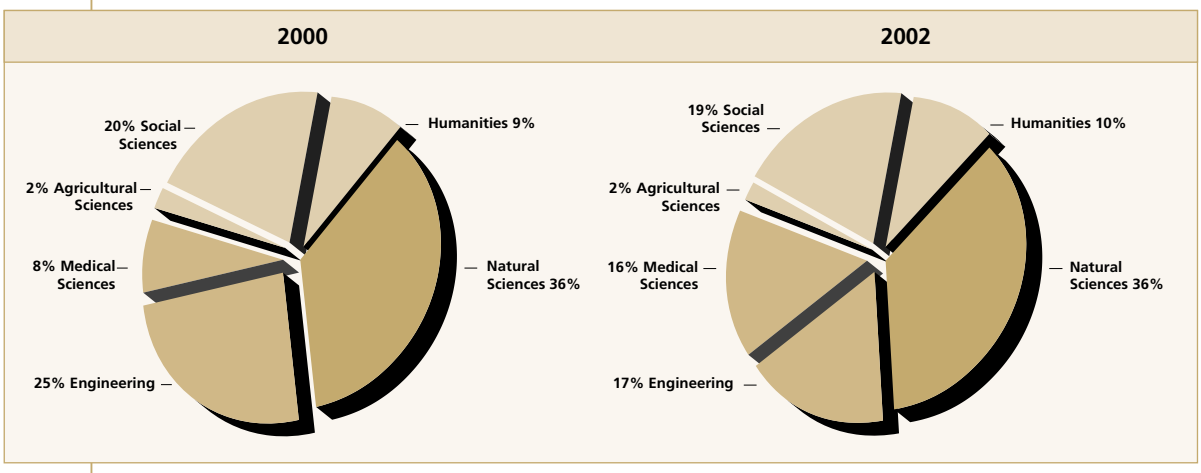
- The total expenditure on R&D in the Higher Education sector (HERD) reached over €322m in 2002, up from €238m in 2000.

Research Expenditure in the HE sector 1996 – 2002 (€m), current and constant prices

	1996	1998	2000	2002
	€m	€m	€m	€m
HERD (current prices)	153.1	203.7	238.1	322.3
HERD (constant prices)	187.3	239.9	261.2	322.3

- Almost all Fields of Science (FOS) experienced a real increase in expenditure over a six year period to 2002. Natural Sciences have the higher R&D expenditure with an increase of almost 24% during that period. Medical Sciences experienced an increase in excess of 150% during the period 2000-2002, rising by €31.5m to €52.4m in 2002. Expenditure in Engineering fell from €66.3m in 2000 to €53.5m in 2002; this includes a worrying decrease in the fields of electrical/electronic engineering.

Share of total R&D expenditure by Field of Science, 2000 and 2002.



- The most significant increase occurred in Medical Sciences which has increased its relative share of total R&D expenditure to 16% in 2002.
- The relative share of **Engineering** decreased from 25% to 17% in the same period.
- The share of R&D expenditure for the rest of the fields of academic activity remained relatively stable.

- Research income in the higher education sector is provided by a number of different sources: direct government funding, indirect government funding, and other sources.

Sources of Research Funds 2002 (€m)

	Direct Sources of Funds						
	Direct Gov't	Other	EU	Irish Business	Foreign	Indirect Gov't	Total
Total	129.8	27.5	23.5	11.9	6.6	122.9	**322.3**
% of Total	40%	9%	7%	4%	2%	38%	**100%**
% Real change 2000 – 2002	108%	-18%	-25%	-14%	-30%	16%	**25%**
% Real change 1996 – 2002	236%	170%	11%	0%	42%	52%	**78%**

- Total Government funding (including from direct and indirect sources) accounted for 79% of all research income in the higher education sector in 2002, increasing its funding share from the 66% recorded in 2000.

- As well as gathering data on expenditure and costs associated with R&D, the 2002 survey also collected data on numbers of personnel involved in R&D activities.

Total Research Personnel by Status of Employment, 2002, Full Time Equivalent

	Academic Staff	Contract Lecturers	Post-doctoral Fellows	Research Assistants	Total Researchers	Technicians	Admin Staff	Other Staff	Total Research Personnel
	A	B	C	D	E (A+B+C+D)	F	G	H	E+F+G+H
Total	1547	150	310	790	2797	240	72	70	**3179**
% Total	49%	5%	10%	25%	88%	8%	2%	2%	**100%**

- The total number of Researchers has increased from 2,148 to 2,797 during the period 2000 to 2002. Post-doctoral fellows accounted for 10% of all personnel classified as researchers in the HE sector. The majority of these post-doctoral fellows were classified in the areas of Natural Sciences (71.9%) and Medical Sciences (15.8%). Academic staff accounted for 49% of the total HE research personnel. Research Assistants made up 25% of total HE research.

- Information on gender was collected for the 2002 survey for the first time. Below is a breakdown of researchers and research personnel by gender.

Total Research Personnel by Gender Proportion in HE sector, 2002

	Academic Staff	Contract Lecturers	Post-doctoral Fellows	Research Assistants	Total Researchers	Technicians	Admin Staff	Other Staff Personnel	Total Research
% Male	71%	53%	42%	44%	62%	67%	12%	55%	**55%**
% Female	29%	47%	58%	56%	38%	33%	88%	45%	**45%**

- The proportion of male researchers at 62% is higher than that of females measured at 38%.
- Contract Lecturers and Post-Doctoral Fellow are fairly evenly divided between male and females. Female Post-Doctoral Fellows and Research Assistants outnumber their male counterparts.
- The proportion of total research personnel is more evenly divided (55% male, 45% female).

In order to assess Ireland's relative performance and progress toward meeting the objectives set out in the Lisbon Agenda and in Ireland's "Action Plan for the Promotion of R&D to 2010", it is essential to benchmark Ireland's position compared to other OECD countries.

International Ranking of Higher Education Sector R&D 1998 – 2002, €m

	1998	2000	2002	2000-2
Higher Education Exp on R&D *(HERD)*	203.7	238.1	322.3	↑
HERD as a % of GDP *(GNP used for Ireland)*	0.30% (18th)	0.27% (22nd)	0.31% (19th)	↑
Total researchers in HE sector	2,425	2,148	2,797	↑
HE Researchers per 1000 labour force	1.5 (21st)	1.2 (22nd)	1.5 (20th)	↑

- HERD has risen from 0.27% of GNP in 2000 to 0.31% in 2002.
- HERD spending of 0.31% of GNP in Ireland compares with an EU HERD average of 0.41% of GDP within that period. This indicates a closing gap between Ireland and other EU countries within this period.
- Ireland's position in 2002 at 0.31% of GNP is 19th out of 26 OECD countries.
- The numbers of researchers in the third level sector increased greatly in the 2000 to 2002 period. Ireland is ranked in the lower third of OECD countries, with 1.5 researchers per thousand labour force. The average EU level is 1.8 researchers per thousand labour force.

1 Introduction

It is now widely accepted that economic productivity and international competitiveness are contingent on the effective production, use and application of knowledge. The Higher Education sector catalyses both the production and application of new knowledge through the R&D it performs, and through the skilled people it produces.

European countries, including Ireland, are committed through the Lisbon 2010 Strategy to significantly increasing and improving the quality of R&D investments over the next decade, in an effort to improve economic potential and to maximise productivity gains. The EU is currently lagging behind the R&D performances of the United States, Japan and other key competitors regarding research and innovation performance.

Despite being below the average EU performance, Ireland is making strong efforts to close the gap between domestic R&D performance and that of major competitors on the international stage. Ireland's R&D vision states that *"by 2010 Ireland will be internationally renowned for the excellence of its research and be at the forefront in generating and using new knowledge for economic and social progress, within an innovation driven culture".*

The Higher Education sector, alongside the business sector and other public sector organisations, is a key component of the national R&D effort and the drive to become a knowledge-based society.

- It provides a national base of skills and knowledge through the more fundamental nature of its R&D.
- It complements the research in business sector firms and public sector institutes which are usually more applied and developmental in their focus than academic research.

It is clear that the Irish research sector is being truly transformed. Total expenditure on R&D in the Higher Education sector increased by 23% in real terms between 2000 and 2002. This increase will have been driven further in the period 2003-2004 as a result of additional R&D expenditure from the Programme for Research in Third-Level Institutions (PRTLI) and Science Foundation Ireland (SFI).

Forfás monitors state, business, and higher education expenditure on R&D in Ireland on a regular basis. This biennial survey is part of that effort and relates to R&D performed in the Higher Education Sector in 2002. The population for this survey includes all universities and institutes of technology, the programmes in advanced technologies (PATS) and the technology centres located in colleges. The survey covers all fields of knowledge, not just science and technology. These data feed into wider OECD and Eurostat work as well as informing policy-makers and practitioners of the state-of-play at a given point in time. The methodology and procedures followed in this survey are those recommended by the OECD.

2 General Trends in Expenditure

The total expenditure on R&D in the Higher Education sector (HERD) reached over €322m in 2002, up from €238m in 2000. Figure 1 shows this expenditure (in nominal and real terms) and illustrates the trend since 1992. The increase in expenditure represents a real increase of 23.3% over the period 2000 to 2002, or an 11% real annual increase. This compares with a real increase of 72% over the period 1996 (HERD was €153m) to 2002, or an annual growth rate of 9.5%.

Figure 1: *Trend in HERD expenditure, 1992-2002, in constant and current prices*

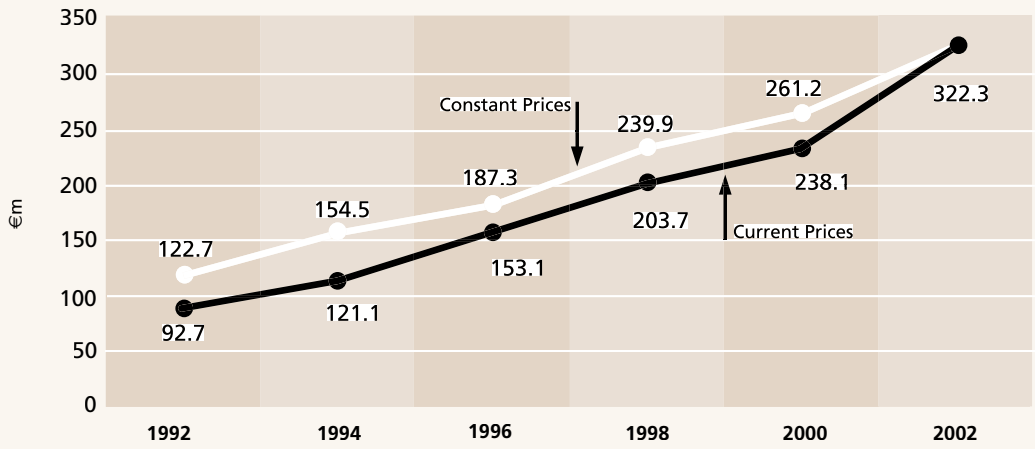


Table 1 shows expenditure on R&D across the higher education sector broken down between the main performers across the period 1996 to 2002. The universities are the dominant performers of R&D across the higher education sector, and continue to account for the majority of HERD. A 36.4% real increase in R&D expenditure by Universities between 2000 and 2002 pushed spending up to €286.7m, and increased their relative share of total HERD expenditure from 81% in 2000 to 89% in 2002. PATs (Programs in Advanced Technology) showed a decline in spending. In terms of relative share of HERD, PATs now account for only 3%. The relative share of HERD performed by the institutes of technology has decreased from 10% in 2000 to a level of 8% in 2002.

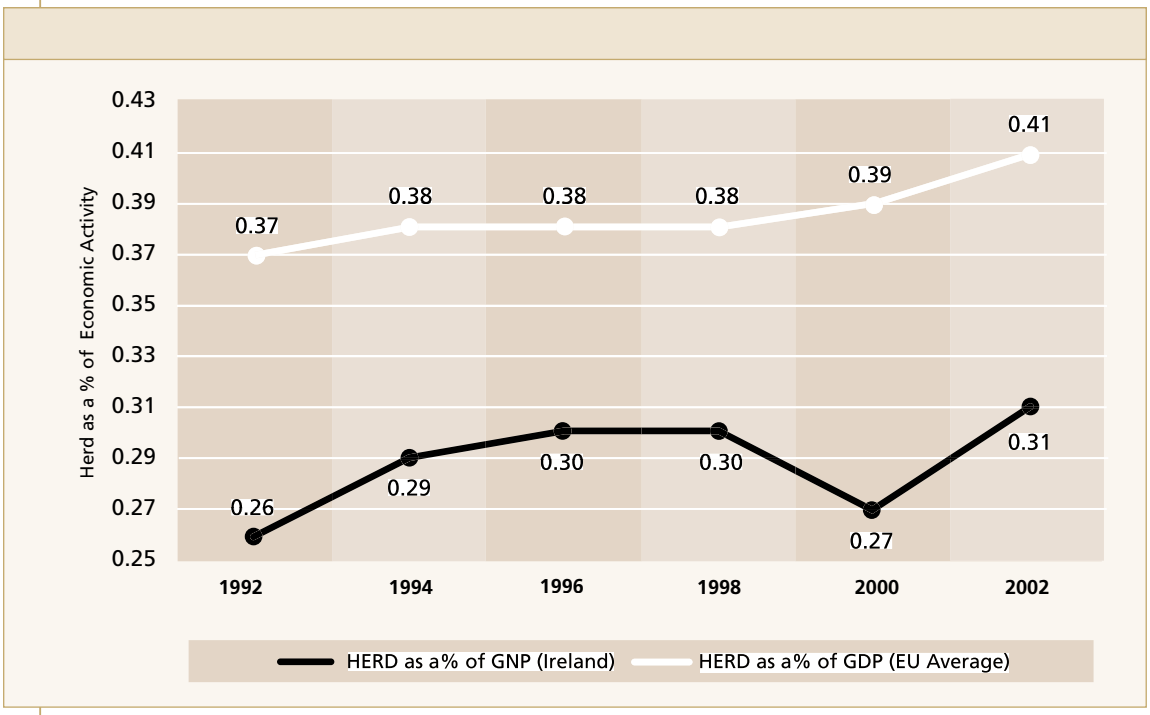
Table 1: *Research Expenditure analysed by performer, 1996 – 2002 (€m), current prices.*

	1996		1998		2000		2002	
	€m	%	€m	%	€m	%	€m	%
University	129.8	85%	169.2	83%	191.6	81%	286.7	89%
Institutes of Technology	6.4	4%	13.5	7%	24.0	10%	25.3	8%
PATS	16.9	11%	21.0	10%	22.4	9%	10.3	3%
Herd (Current Prices)	153.1	100%	203.7	100%	238.1	100%	322.3	100%
Herd (Constant Prices)	187.3		239.9		261.2		322.3	

The ratio of HERD to Gross Domestic Product (GDP) is a key indicator for international comparisons of higher education research activity relative to overall economic activity. In Ireland though, GDP is greatly inflated because of transfer payments made by large foreign-owned firms here, and so the economic activity measure of Gross National Product (GNP) which excludes net factor flows is preferred when benchmarking international performance.

Figure 2 charts HERD as a percentage of GNP. It shows an increase in HERD performance across Ireland from 0.27% of GNP in 2000 to 0.31% in 2002. This was facilitated by a 35.4% nominal rise in HERD spending between 2000 and 2002, outstripping the 18.8% rise in nominal GNP. In HERD spending of 0.31% in Ireland compares with an EU HERD average of 0.41% of GDP within that period. This indicates a closing gap between Ireland and other EU countries within this period.

Figure 2: *HERD as a percentage of Economic Activity, 1992-2002, Ireland V's EU*



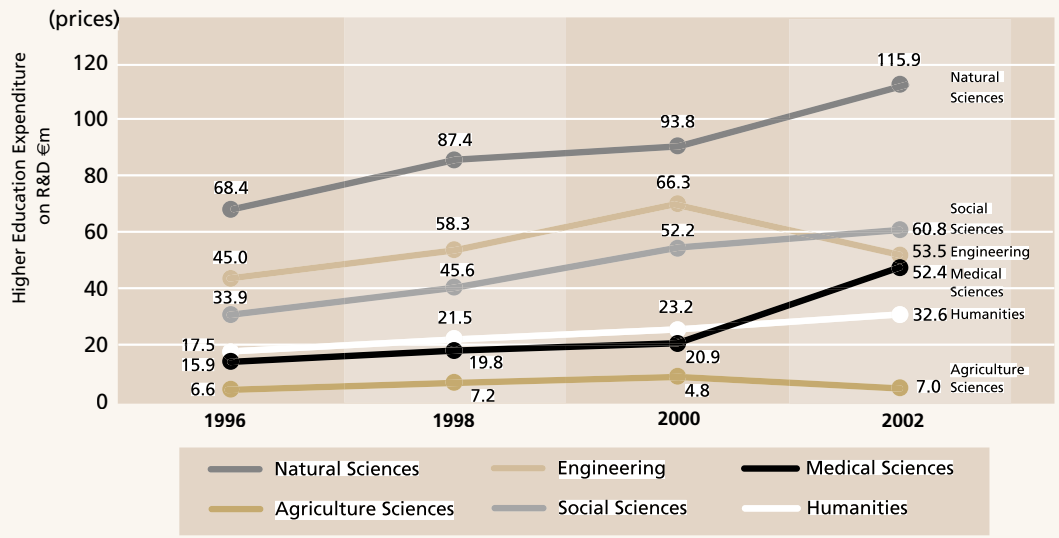
This survey captures data from a 2002 survey of R&D across the higher education sector. It therefore does not yet fully capture the significant recent rises in investment expected across the higher education research sector as a result of increased research funding from the PRTLI and SFI. These programmes will see an additional €1,251m allocated to the higher education sector over the period 2000-2006. By 2004 and projecting forward to 2006 the ratio of HERD to GNP is expected to have risen further from its current level of 0.31% of GNP, further closing the gap in relative HERD spending with EU neighbours.

3 Fields of Science

As well as measuring overall levels of Higher Education spending, it is useful to examine various research areas amongst which funds are divided. Dividing overall spending into different areas allows closer examination of key areas of research and their relevance to overall economic performance. In order to maintain comparability across member countries, the OECD have developed a classification structure for all HE research. There are six broad fields described as 'Fields of Science'. They are Natural Sciences, Engineering, Social Sciences, Humanities, Medical Sciences and Agricultural Sciences.

Expenditure is collected by sub-fields within these Fields of Science categories. A more detailed breakdown of the expenditure by Fields of Science is available in Appendix 4. Almost all broad fields of academic activity experienced real increases in expenditure over the six-year period to 2002. (Figure 3)

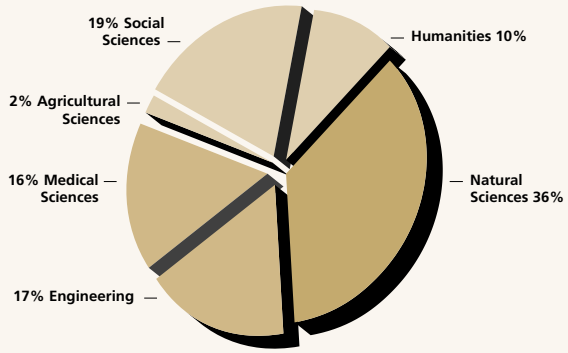
Figure 3: *Expenditure by Field of Science 1996 – 2002; (constant 2002 prices)*



- Natural Sciences remain with the higher R&D expenditure. There has been an increase in this field of €98.8m in 2000 to €115.9m in 2002. This represents an increase of almost 24% during that period.
- Medical Sciences experienced an increase in excess of 150% during the period 2000-2002, increasing by €31.5m to €52.4m in 2002.
- Expenditure in Engineering fell from €66.3m in 2000 to €53.5m in 2002. This represents a decrease of 19%.

In addition to examining the overall changes in expenditure, and the expenditure in different fields of science, it is interesting to look at how these increases and decreases affect the share of total R&D expenditure for each area of research.

Figure 4: *Share of total R&D expenditure by Field of Science, 2002*



- The most significant **increase occurred in Medical Sciences** which has increased its relative share of total R&D expenditure from 8% in 2000 to 16% in 2002.
- The relative share of **Engineering** decreased from 25% to 17% in the same period.
- The share of R&D expenditure for the rest of the fields of academic activity remained relatively stable, with Natural Sciences maintaining the largest share.
- Each Field of Science is divided into up to five sub-fields. Examining these classifications can give further insight into the changes in HERD expenditure.

Natural Sciences:

- Biological Sciences accounted for 14% of HERD in 2002, a slight decrease in relative share but a real increase of 15% over 2000 figures.
- Environmental Science (€6.3m in 2002) increased by €1.5m over 2000.
- Both Chemical and Physical Sciences also showed significant increases of €6.1m and €9.7m respectively increasing their share of total R&D expenditure to 7.6% and 6.8%.

Engineering:

- R&D Expenditure on Civil Engineering remained relatively stable during the 2000-2002 period.
- Expenditure on R&D in Electrical and Electronic Engineering fell by €13.6m between 2000 and 2002. This decreased its share of total R&D spending from 13.8% in 2000 to 6.9% in 2002.

Medical Sciences:

- The major R&D expenditure was on basic medicine, which increased substantially by €25.9m over 2000 levels to reach €40.3m in 2002.

4 Sources of Funds

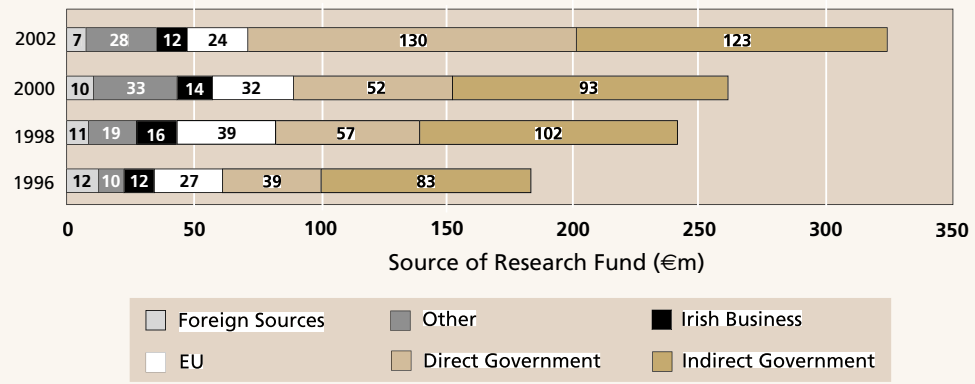
Research income in the higher education (HE) sector is provided by a number of different sources. These sources fall under three main headings – Direct government funding, indirect government funding and other sources. Figure 4 shows the trends in sources of research income from 1996 to 2002. Total Government funding (including direct and indirect sources) accounted for 79% of all research income in the higher education sector in 2002, increasing its funding share from the 66% recorded in 2000.

Direct Government funding of individual projects comes through various departments and their agencies. The HEA (PRTLI) and SFI were the main state agencies involved in providing direct research funds in 2002.

Indirect sources are derived from the annual 'block grant' from the HEA. The HEA allocates funds, to the universities, on behalf of the Department of Education and Science. The amount of this allocation is attributable to R&D and is determined using estimates of the time spent on research by academic staff. This is standard OECD practice in all countries operating a dual system of HE funding. These funds do not provide for incremental costs associated with individual projects.

Other sources of research income for the HE sector include funding from the European Union, Irish Businesses, Other Foreign sources and Other National funding (including internal funds).

Figure 4: *Sources of Research Funds, 1996-2002, in constant 2002 prices*



- Direct Government funding has more than tripled in real terms over the six-year period 1996-2002, and in doing so has become the largest funder of research in higher education. Direct funding from government departments and agencies rose to €131m in 2002, more than doubling from the figure recorded in 2000. This mainly reflects the impact of PRTLI and SFI.
- Indirect Government funding of research income from the HEA increased by 15.6% between 2000 and 2002 to €123m.
- Other funding has risen markedly in real terms from 1996 to 2002 and now represents the next major source of funding after Direct and Indirect Government funds. Following a rapid increase from 1996 to 2000 it fell somewhat from €33m in 2000 to €28m in 2002. The share of total HE research funding from Other sources rose from 5.4% in 1996 to 8.5% in 2002.

- European funding of HE research has fallen significantly in real terms from 1998-2002. In 2002, EU funding contributed €24m to total HE funding, or a share of 7.3% of total funds and below the peak share of 16.1% funding posted in 1998.
- Funding from Irish businesses accounted for a 3.7% share of all funding in 2002 at €11.9m indicating a real decrease of 15% from 2000 (€14m) to 2002. Weakening economic activity in the period might account for some of the fall-off in business funding for HE research. The fall also suggests a need to strengthen the research links between firms in Ireland and the Higher Education sector.
- Foreign sources decreased its relative share of total HE funding to 2.1% in 2002 from 4% in 2000, as a result of a 30% real fall in funding from this source.

The overall research funding provided by each source can be further broken down by Field of Science. Table 2 charts this breakdown.

Table 2: *Sources of Research Funding by Fields, 2002 (€m)*

	Direct Sources of Funds						
	Direct Gov't	**Other**	**EU**	**Irish Business**	**Foreign**	**Indirect Gov't**	**Total**
Natural Sciences	61.6	5.4	12.1	3.7	3.3	29.7	**115.9**
Social Sciences	5.8	8.3	3.6	2.1	0.4	40.6	**60.8**
Engineering	21.9	3.4	5.7	4.6	1.1	16.8	**53.5**
Medical Sciences	32.9	5.7	1.2	1.4	1.8	9.6	**52.4**
Humanities	5.2	3.3	0.8	0.1	0.1	23.1	**32.6**
Agricultural Sciences	2.3	1.3	0.2	0.1	0.1	3.0	**7.0**
Total	**129.8**	**27.5**	**23.6**	**12.0**	**6.7**	**122.8**	**322.3**
% of Total	41%	8%	7%	4%	2%	38%	**100%**
% Real change 2000 – 2002	108%	-18%	-25%	-14%	-30%	16%	**25%**
% Real change 1996 – 2002	236%	170%	11%	0%	42%	52%	**78%**

The areas of Natural Sciences and Medical Sciences received 53% and 63% of their respective funding from the Direct Government funds. Medical Sciences are least dependent on indirect Government funds receiving 18% of their total funding from this source. It is interesting to note the changing capacity of the Higher Education sector to source funds independently of the usual sources, as is evident by noting the funding classified under the category Other in Table 2. Social Sciences attributes almost 14% of its total funding to this category followed by Medical Sciences (11%). All other fields received around between 5% and 10% of total funds through this funding source.

5 Types of Research

In addition to knowing where HE funding is sourced it is also important for policymakers to understand what types of research are being carried out across the economy in order to benchmark performance toward achieving key research goals. All research, including that across the Higher Education sector, can be classified further into three key areas. The following categories and definitions of research types are standardised across the OECD.

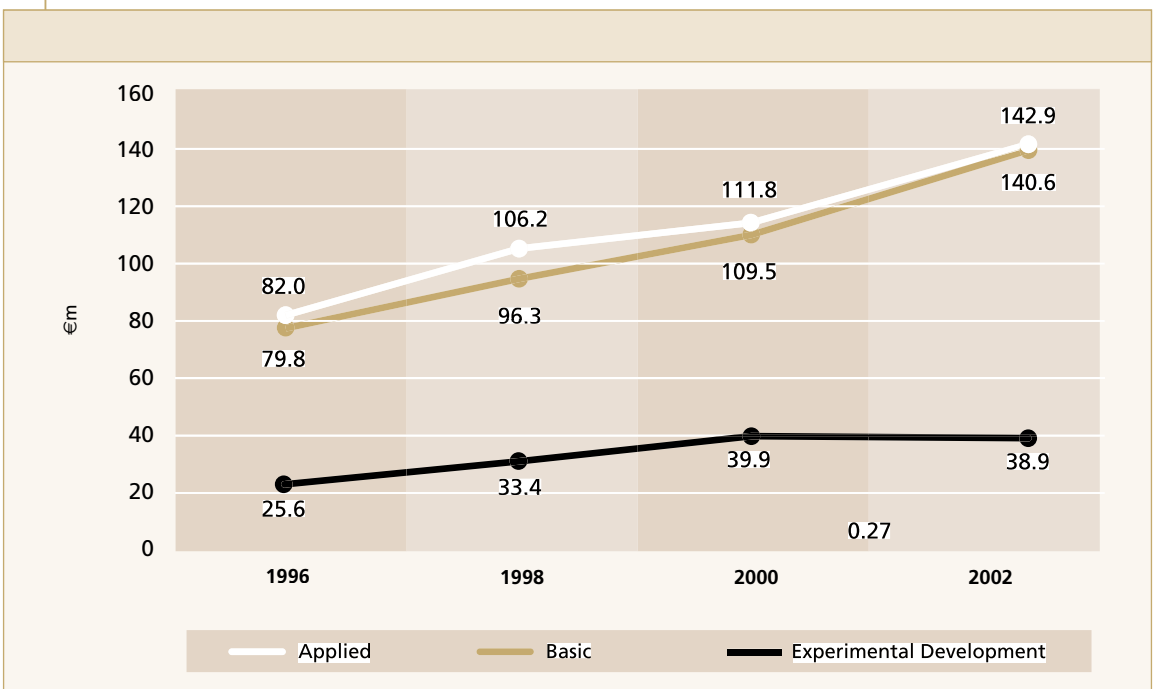
Basic Research: "Experimental or theoretical work undertaken primarily to acquire new knowledge without any particular application or end-use in view".

Applied Research: "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 devises, to installing new processes, systems and services, or to improving substantially those already produced or installed".

Figure 5 indicates spending by the type of research – basic, applied or experimental development – conducted by the HE sector over the six year period to 2002.

Figure 5: *Types of Research, 1996-2002, in constant 2002 prices (€m)*



- 'Applied Research' in the Higher education sector increased by 27.8% in real terms between 2000 and 2002 to total €142.9m. This acceleration in applied research spending growth has pushed up its share of total HE research expenditure from 42.8% in 2000 to 44.3% in 2002.
- 'Basic Research' accounted for €140.6m of the total research carried out across the HE sector in 2002. It increased by 28.3% in real terms between 2000 and 2002, increasing its share of total expenditure marginally from 42% to 43.6% over the period. Natural Sciences and Social Sciences/Humanities contributed almost 75% of the basic research effort in terms of expenditure.
- 'Experimental Development' research in the HE sector fell by 2% in real terms between 2000 and 2002. Its share of total HE research expenditure therefore fell from 15% in 2000 to 12% in 2002. Engineering Sciences are the major performers within this category.

Table 3 breaks down research expenditure across the Higher Education sector according to Research Type and also Field of Science (FOS).

Table 3: *Research Expenditure distributed across Types of Research in 2002.*

FOS	Basic		Applied		Experimental		Total	
	€m	%	€m	%	€m	%	€m	%
Natural Sciences	59.1	51.0%	43.2	37.3%	13.6	11.7%	115.9	100%
Engineering	12.0	22.5%	26.4	49.3%	15.1	28.2%	53.5	100%
Medical sciences	17.3	33.6%	29.6	57.6%	4.5	8.8%	51.5	100%
Agri Sciences	1.6	19.9%	5.6	70.6%	0.8	9.6%	7.9	100%
Social Sciences	26.2	43.1%	30.7	50.6%	3.8	6.2%	60.7	100%
Humanities	24.3	74.3%	7.3	22.4%	1.1	3.2%	32.7	100%
Total	**140.6**	**43.6%**	**142.9**	**44.3%**	**38.9**	**12.1%**	**322.3**	**100%**

- Engineering Sciences spent over 77% of their budget on either applied or experimental development in 2002.
- Natural Sciences spent over half of their budget on basic research, and accounted for 42% of the basic research expenditure.

6 Types of Cost

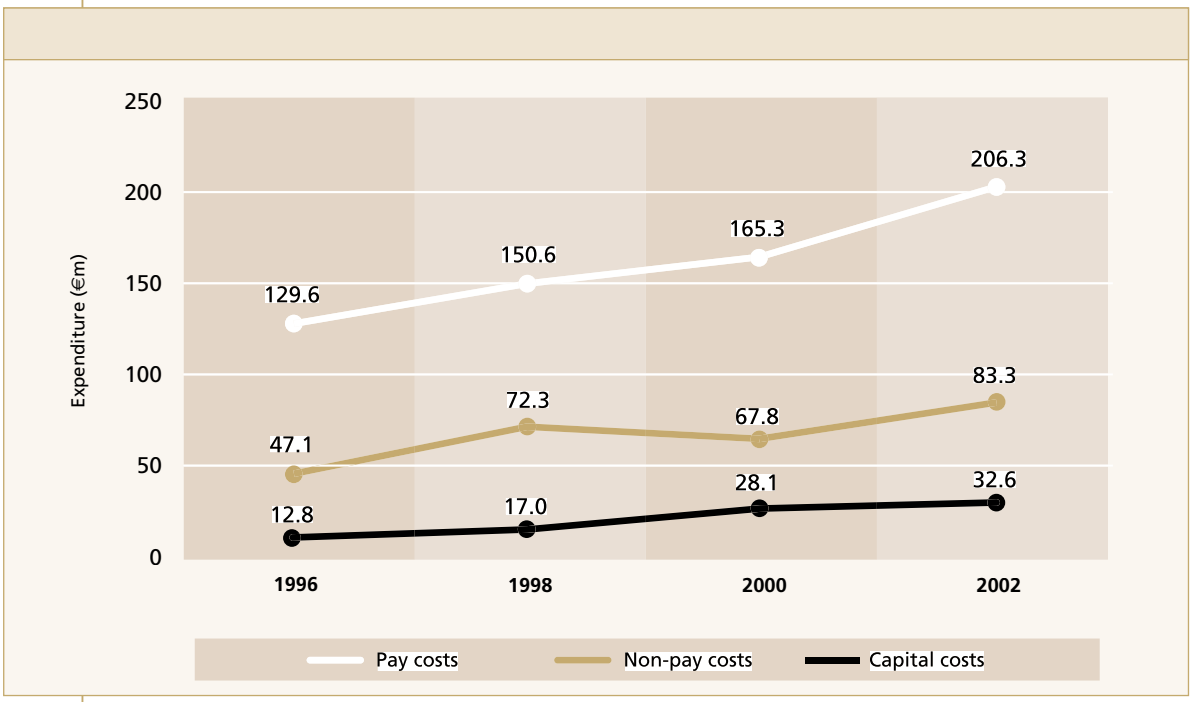
The 2002 survey of Higher Education Research and Development asks for respondents to detail a breakdown on spending on R&D distributed by type of cost. Policymakers are then able to analyse and evaluate in which areas spending of research funding is taking place across the HE sector.

Three types of research costs in the HE sector are identified within the survey, namely:

- Pay costs
- Capital costs and
- Non-pay costs.

Figure 6 illustrates the trend in each cost-type identified by the survey of R&D across the Higher Education sector from 1996 to 2002.

Figure 6: *Distribution of types of costs, 1996-2002 in constant 2002 prices*



- Pay costs represented 64% of all costs in 2002, compared to 68% in 1996. Pay costs continued on a strong upward trend accounting for €206.3m of total Research and Development funding and rising by 24.8% in real terms in the two year period between 2000 and 2000. This reflects an increase in the numbers of research personnel of 22% in that period, pushing up the overall research personnel wage bill (chapter 7).
- Total capital costs across the HE research sector increased by 15.6% in real terms to €32.6m during the period 2000 to 2002. Capital costs have increased steadily since 1996, the main increase happening post-1998. This reflects the establishment of the PRTLI (Programme for Research in Third Level Institutions) and the associated rise in targeted capital spending. This figure should continue to increase steadily over the coming years, as a result of this programme.

- Having suffered a decline between 1998 and 2000, non-pay costs increased significantly for HE research institutes from over the 2000 to 2002 period from €67.8m to €83.4m, an increase of 23% in real terms over the two years. Table 4 details the types of costs broken down further according to Field of Science

Table 4: *Type of Costs by Field of Science, 2002 (€m)*

	Pay costs	Non-pay costs	Capital costs	Total
Natural sciences	70.0	31.5	14.4	**115.9**
Social Sciences	43.9	14.4	2.4	**60.7**
Engineering	32.1	15.7	5.8	**53.6**
Medical sciences	28.2	13.9	9.5	**51.6**
Humanities	26.8	5.5	0.3	**32.6**
Agricultural sciences	5.3	2.3	0.3	**7.9**
Total	**206.3**	**83.3**	**32.6**	**322.3**
% Total	64%	26%	10%	**100%**
% Real change 2000 - 2002	25%	23%	16%	**23%**
% Real change 1996 - 2002	59%	77%	154%	**70%**

- In all Fields of Science, pay costs accounted for the majority of HE research institute funds, generally between 60% (Natural Sciences and Engineering) and 72% (Social Sciences). Pay costs in the Medical Sciences area though accounted for just 54.7% of total research costs.
- Capital costs accounted for 10% of all spending by HE research institutes. Across the Fields of Science though there was a wide range in the proportion of total costs dedicated to capital costs. Whilst capital costs for research in Agricultural and Social sciences accounted for just 4% of the total, capital costs for Medical science activities accounted for 18.3% of total costs incurred by those HE institutes.
- Natural Sciences, Social Sciences and Engineering were the key fields in monetary terms associated with Non-pay costs. The ratio of non-pay to overall costs in the HE research sector generally ranged from 24% (Social Sciences) to 29% (Engineering).

7 Human Resources

Efforts to build a knowledge economy in Ireland will depend heavily on the ability to attract increasing numbers of high quality researchers and research personnel. The Irish R&D action plan estimated that an additional 8,000 researchers will be required over the period to 2010 if efforts to reach the higher education and public sector expenditure targets of the plan are to be realised. The HE Sector will play a key role in efforts to reach this target, by increased research personnel in the sector, improved linkages with enterprise and by providing a strong pipeline of future research graduates. As well as gathering data on expenditure and costs associated with R&D, the 2002 survey also collected data on numbers of personnel involved in R&D activities.

Human resources data in this chapter includes all associated support staff in addition to researchers and technical staff. The time spent on research is taken into consideration and personnel data are supplied as full-time equivalents for this survey (where 1 FTE works 40 hours per week on Research & Development). Table 5a shows a breakdown of Researchers (academic staff, contract lecturers, post-doctoral fellows and research assistants) by each Field of Science.

Table 5a: *Researchers by Occupation and Field of Science in HE sector, 2002, Full Time Equivalents.*

Academic	Academic Staff	Contract Lecturers	Post-doctoral Fellows	Research Assistants	Total Researchers
	A	B	C	D	(A+B+C+D)
Natural Sciences	395	78	223	380	1076
Social Sciences	517	20	17	64	618
Engineering	211	15	12	250	488
Humanities	322	6	5	21	354
Medical Sciences	81	26	49	61	217
Agricultural Sciences	21	5	4	14	44
Total	**1547**	**150**	**310**	**790**	**2797**
% Total	**55%**	**5%**	**11 %**	**29%**	**100%**

- Making comparisons between 2002 and 2000 figures is difficult as much of the personnel data in 2000 was estimated as a result of poor response rates to that survey. The 2002 survey achieved a 100% response rate across the HE sector.
- The number of total researchers has increased from 2,148 to 2,797 during the period 2000 to 2002. Post-doctoral fellows accounted for 11% of all researchers in the HE sector. The majority of these post-doctoral fellows were classified in the areas of Natural Sciences (71.9%) and Medical Sciences (15.8%).
- Academic staff accounted for 55% of the HE researchers.
- Research Assistants made up 29% of total HE researchers.

Table 5b: *Total Research Personnel by Occupation and Field of Science, 2002, FTE*

Total	Total Researchers	Technicians	Admin Staff	Other Staff	Total Research Personnel
	E	F	G	H	(E+F+G+H)
Natural Sciences	1076	89	16	43	1224
Social Sciences	618	4	21	0	643
Engineering	488	65	7	27	586
Humanities	354	2	6	0	362
Medical Sciences	217	49	14	0	280
Agricultural Sciences	44	31	8	0	83
Total	**2797**	**240**	**72**	**70**	**3178**
% Total	**88%**	**8%**	**2%**	**2%**	**100%**

- Within the period 2000-2002, total research personnel (total researchers plus technicians, administrative staff and others) rose by 22.1% from 2,602 to 3,179.
- Almost 39% of research personnel were accounted for in the Natural Sciences area, with social sciences and engineering accounting for large proportions also. Agricultural sciences accounted for less than 3% of all research personnel.

Tables 6a and 6b show a breakdown of researchers and research personnel by Gender.

Table 6a: *Researchers by Gender in HE sector, 2002.*

	Academic Staff	Contract Lecturers	Post-doctoral Fellows	Research Assistants	Total Researchers
% Male	71%	53%	42%	44%	**62%**
% Female	29%	47%	58%	56%	**38%**

Overall, the proportion of male researchers at 62% is higher than that of females measured at 38%. This difference arises mainly because of the large difference in the proportion of male and female full time academic staff (71% male and 29% female). Total numbers of research personnel between males and females are fairly evenly divided over the Contract Lecturers and Post-Doctoral Fellow categories. Female Research Assistants out number males.

Table 6b: *Total Research Personnel by Gender in HE sector, 2002*

	Total Researchers	Technicians	Administrative Staff	Other Staff	Total Research Personnel
% Male	62%	67%	12%	55%	**55%**
% Female	38%	33%	88%	45%	**45%**

The proportion on total research personnel is more evenly divided (55% male, 45% female). This is mainly due to the high proportion of female administrative staff (88%).

8 International Comparisons

In order to assess Ireland's relative performance and progress toward meeting the objectives set out in the Lisbon Agenda and in Ireland's "Action Plan for the Promotion of R&D to 2010", it is essential to benchmark Ireland's position compared to other OECD countries. The appropriate indicators are a useful tool when used in conjunction with a detailed knowledge of the underlying research system. This chapter benchmarks Ireland's R&D performance in the Higher Education sector on the international stage. The following international statistics are analysed:

- Higher Education R&D expenditure (HERD) as a % of economic activity.
- Researchers per thousand people in labour force.
- Scientific publications per million inhabitants.

Table 6 provides details a summary of these traditionally used international indicators for the HE sector. Irish ranking among 26 OECD countries are highlighted in brackets. See tables A5.1 and A5.2 in the appendices for detailed international comparisons

Table 6: *International Ranking of Higher Education Sector R&D 1998 – 2002, €m*

	1998	2000	2002	2000-2
Higher Education Exp on R&D *(HERD)*	203.7	238.1	322.3	↑
HERD as a % of GDP *(GNP used for Ireland)*	0.30% (18th)	0.27% (22nd)	0.31% (19th)	↑
Total researchers in HE sector	2,425	2,148	2,797	↑
HE Researchers per 1000 labour force	1.5 (21st)	1.2 (22nd)	1.5 (20th)	↑
Scientific Publications per million population	527	580	647	↑

- Ireland's position in 2002 at 0.31% of GNP is 19th out of 26 OECD countries and has slipped from 18th position in 1998. The average OECD level of HERD is 0.41% of GDP, with an EU average of 0.39% of GDP. In Ireland the higher education sector accounts for 22% of all Research and Development performed across the National Innovation System.
- The numbers of researchers in the third level sector increased greatly in the 2000 to 2002 period. Ireland is ranked in the lower third of OECD countries, with 1.5 researchers per thousand labour force (Figure 8). The average EU level is 1.8 researchers per thousand labour force.
- Despite relatively low funding levels Ireland's performance in terms of scientific output (publications per million population) is around EU average levels.

Figure 7: *HERD as a % of GDP, 2002*

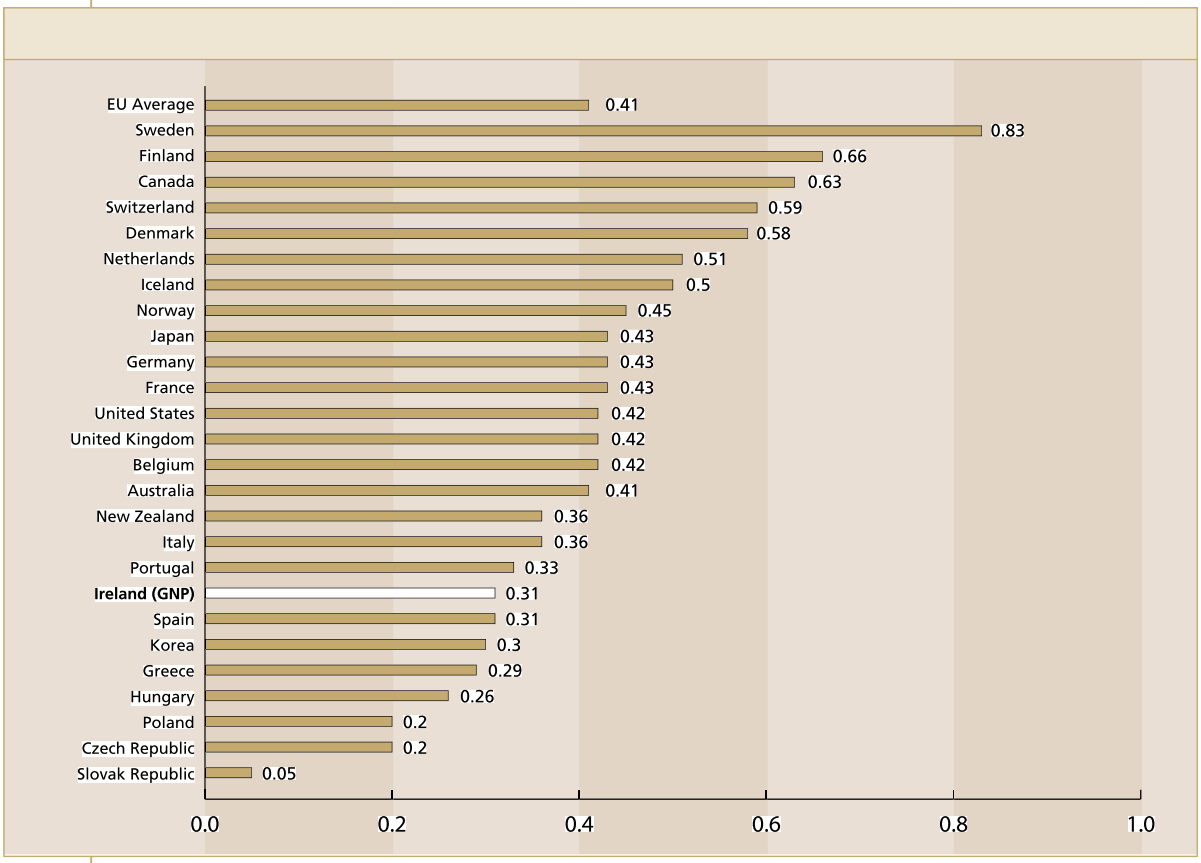
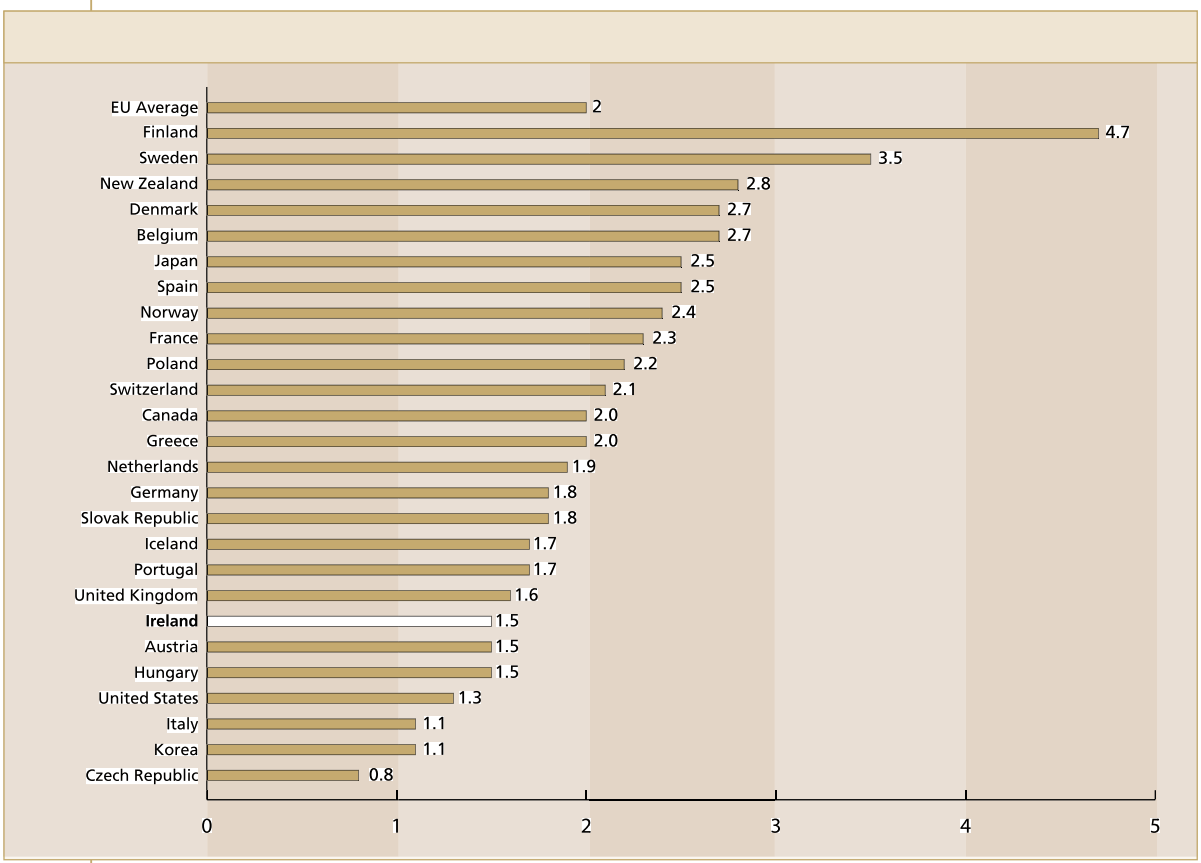
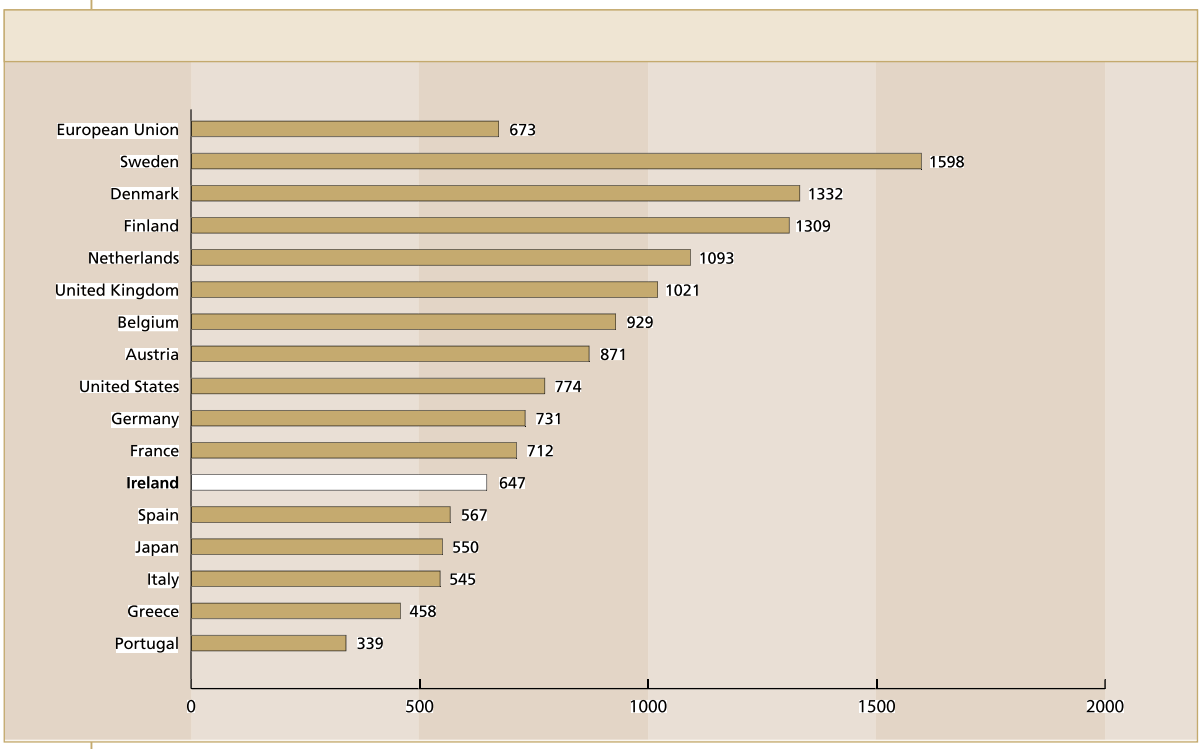


Figure 8: *HE Researchers per Thousand Labour Force, 2002*



As noted, HERD in Ireland is below the EU average and this is reflected in the number of scientific publications per million inhabitants (Figure 9). This indicator provides an insufficient picture, as countries invest differently in scientific production and these differences should be taken into account. More appropriate indicators would relate the number of papers to the number of researchers or to the expenditure on research in the higher education sector (HERD), which is a good proxy because the overwhelming majority of scientific publications stem from this sector. In Europe, the UK, Finland, Denmark, Spain and Ireland had the highest ratings in 2002 in terms of total scientific publications per million HERD. Thus, despite relatively low funding in this period, the academic research community performed quite well in terms of research outputs.

Figure 9: *Scientific Publications per Million Inhabitants*[1]



1. *Source: European Commission, Key Figures 2003-2004*

Appendix 1 Methodology

Introduction

The survey was carried out following OECD/Frascati Manual (1993, 2002) guidelines for estimating levels of research and development in the higher education sector and the results for Ireland are comparable to those from other OECD countries.

There were two elements to this survey of research and development in higher education colleges:

- An analysis of financial data received from each institution;
- An analysis of personnel data received from each institution.

Coverage

The coverage included all academic departments, in the seven universities*, eleven institutes of technology**, as well as the Dublin Institute of Technology, Royal College of Surgeons, St. Patrick's College Drumcondra and Mary Immaculate College.

* Universities: NUI Dublin, NUI Cork, NUI Galway, NUI Maynooth, University of Dublin (Trinity College), University of Limerick and Dublin City University.

** Institutes of Technology (IT): Athlone IT, Carlow IT, Cork IT, Dundalk IT, Galway-Mayo IT, Letterkenny IT, Limerick IT, Sligo IT, Tallaght IT, Tralee IT and Waterford IT.

Timing of survey and subsequent follow-up

Questionnaires were sent out in mid November 2003 to the various colleges. There was intensive follow-up of non-respondents by telephone from January 2004 until the end of July 2004. Final outstanding information was received in August 2004.

Financial Data

Detailed departmental income and expenditure was obtained from the finance office in each university. Industrial liaison offices provided similar information for the Institutes of Technology.

This information comprised total capital and current expenditure from the colleges' block grant for all departments, from which a research proportion was derived, based on the amount of research-time reported by respondents in the 1996 Higher Education census survey.

Research income for each department was provided by source of funds and types of costs.

Personnel Data

Detailed departmental headcounts were obtained from the personnel offices, categorised by academic staff, post-doctoral fellows, research assistants, technicians, administrative and other staff. In order to calculate full-time equivalent totals for each category, the co-efficients of total research time derived from the 1996 survey were applied accordingly.

Appendix 2 Definitions of Fields of Activity and of Types of Research

Fields of Research Activity

Natural Sciences

1.1 Mathematics and computer sciences
(Mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified with the engineering fields)

1.2 Physical Sciences
(Astronomy and space sciences, physics, other allied subjects)

1.3 Chemical Sciences
(Chemistry, other allied subjects)

1.4 Earth and related environmental sciences
(Geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanaology, palaeoecology, other allied sciences)

1.5 Biological sciences
(Biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences excluding clinical and veterinary sciences)

Engineering and Technology

2.1 Civil Engineering
(Architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical Engineering and Electronics
(Electrical engineering and electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects)

2.3 Other Engineering Sciences
(Such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other allied subjects)

Medical Sciences

3.1 Basic medicine
(Anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine
(Anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences
(Public health services, social medicine, hygiene, nursing, epidemiology)

Agricultural Sciences

4.1 Agriculture, forestry, fisheries and allied sciences
(Agronomy, animal husbandry, fisheries forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

Social Sciences

5.1 Psychology

5.2 Economics

5.3 Educational sciences
(Education and training and other allied subjects)

5.4 Other social sciences
(Anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary, methodological and historical S&T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences)

Humanities

6.1 History
(History, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and Literature
(Ancient and modern)

6.3 Other humanities
(Philosophy (including the history of science and technology), arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S&T activities relating to the subjects in this group)

Source: Proposed Standard Practice for Surveys on Research and Experimental Development, OECD (Frascati Manual1993, 2002)

Appendix 3 - Acronyms

ACRONYMS

EU	European Union
FTE	Full-time equivalent (1 FTE = R&D 40 hours per week)
GDP	Gross Domestic Product
GNP	Gross National Product
HE	Higher Education
HEA	Higher Education Authority
HERD	Higher Education Expenditure on R&D
OECD	Organisation for Economic Co-operation and Development
PAT	Programme in Advanced Technology
R&D	Research and Development

Appendix 4
Detailed Irish Tables

Table A4.1: *Expenditure by Field of Science, Current Prices*

Field of Science	1992 €'000	1994 €'000	1996 €'000	1998 €'000	2000 €'000	2002 €'000
Natural sciences	39.1	52.8	55.9	74.2	85.5	115.9
Engineering	22.3	26.8	36.8	49.5	60.4	53.6
Medical sciences	9.0	12.7	13.0	16.8	19.1	51.6
Agricultural sciences	2.6	2.9	5.4	6.1	4.4	7.9
Social	11.2	16.0	27.7	38.7	47.6	60.7
Humanities	8.5	9.8	14.3	18.3	21.1	32.6
Total	**92.7**	**121.1**	**153.1**	**203.7**	**238.1**	**322.3**

Table A4.2 *Expenditure by Areas of R&D Activity by Field of Science (Excluding Arts/Humanities) 2002*

Field of Science	ICT	Electronics	Production Engineering	Materials	Instrumentation	Biotechnology	Food	Marine	Natural Resources	Environment	Energy	Medical Sciences	Economic & Social Sciences	Other	Total
	€'000	€'000	€'000	€'000	€'000	€'000	€'000	€'000	€'000	€'000	€'000	€'000	€'000	€'000	€'000
Agriculture, Forestry and Food	84.6	0.0	0.0	0.0	64.2	345.4	51.8	0.0	2433.3	197.0	0.0	0.0	786.7	277.6	4,241
Basic Medicine	2484.1	364.2	435.1	206.5	933.6	1243.0	11.1	6.6	204.2	109.4	0.0	31539.0	1667.2	1087.8	40,292
Biological Sciences	1298.7	275.8	322.3	379.8	215.8	13976.9	1557.9	2251.4	3624.3	3903.9	58.9	10969.0	362.5	5433.5	44,631
Chemical Sciences	1057.6	309.3	313.8	3197.1	941.5	1145.1	815.4	181.8	726.4	2315.2	482.5	3015.3	398.6	8738.4	23,638
Civil Engineering	611.1	55.7	342.7	332.5	1082.1	21.4	0.0	21.9	127.9	1553.5	322.5	7.0	1062.2	1789.9	7,331
Clinical Medicine	85.9	9.8	9.8	2.3	109.7	441.4	638.6	0.0	0.0	0.0	0.0	5922.3	254.0	212.8	7,687
Environmental Sciences	41.3	41.1	18.8	56.6	51.2	120.6	0.0	693.6	1762.4	1850.7	64.1	11.9	45.6	1535.5	6,293
Economics	73.0	2.6	3.1	4.2	0.0	3.3	324.3	10.6	117.2	35.3	0.0	1.3	6223.3	41.4	6,840
Educational Sciences	181.8	0.0	0.0	0.0	9.6	0.0	63.5	0.0	0.0	84.6	0.0	547.9	4865.7	2447.1	8,200
Electrical Engineering and Electronics	6761.9	10424.8	442.1	1326.4	1105.4	16.7	142.1	16.7	37.6	69.6	548.5	361.8	16.7	1119.9	22,390
Health Sciences	125.0	8.9	9.5	5.1	17.3	31.3	91.4	0.2	2.2	45.0	0.0	3532.6	265.2	276.8	4,411
Mathematics and Computer Sciences	11864.2	87.6	431.4	90.9	46.4	76.5	97.8	45.3	45.9	294.0	184.3	195.6	484.1	4596.5	18,541
Natural Sciences	91.4	45.7	0.0	182.8	0.0	457.0	0.0	0.0	0.0	91.4	0.0	0.0	45.7	32.4	946
Other Engineering Sciences	1537.6	239.7	2001.6	4880.1	1084.3	363.7	4166.6	21.1	596.4	664.6	1811.0	1786.2	134.6	4524.8	23,812
Other Social Sciences	2608.5	22.4	294.9	33.9	0.0	85.2	73.4	135.8	791.2	1873.0	60.7	562.2	24944.8	9588.2	41,074
Physical Sciences	858.3	641.6	457.2	7609.7	3663.9	303.1	17.9	81.7	161.4	962.6	561.9	789.2	204.8	5570.8	21,884
Psychology	436.2	9.0	20.1	5.1	143.0	15.8	0.0	0.2	2.2	17.3	17.3	1074.6	2547.8	459.1	4,748
Veterinary Medicine	133.9	3.1	3.8	6.7	10.3	230.0	186.2	0.2	692.2	50.8	0.0	670.2	1.1	1159.1	3,147
Total	**30335**	**12541**	**5106**	**18320**	**9478**	**18876**	**8238**	**3467**	**11325**	**14118**	**4112**	**60986**	**44311**	**48892**	**290,105**

Table A4.3 *Expenditure by Source of Funds and Field of Science, 2002*

	HEA Indirect Funds €'000	Direct Gov't Sources €'000	Irish Business Sector €'000	EU €'000	Foreign Sources €'000	Other €'000	Total €'000
Mathematics & Computer Science	7,956	6,227	1193.3	1,611	354	1,200	18,541
Physical Science	3,838	13,812	294	3,468	187	286	21,885
Chemical Science	6,942	13,742	493	1,474	79	1,854	24,584
Environmental Science	1,593	2,712	254	1,072	425	237	6,293
Biological Science	9,403	25,139	1,468	4,523	2,255	1,843	44,631
Civil Engineering	3,841	906	433	635	15	1,501	7,331
Electrical Engineering & Electronics	4,275	12,005	2,105	2,443	631	931	22,390
Other Engineering Sciences	8,711	9,033	2,013	2,621	453	981	23,812
Basic Medicine	7,108	26,566	828	542	870	4,379	40,292
Clinical Medicine	1,264	3,637	518	435	825	1,007	7,686
Health Science	1,229	2,650	5	181	58	288	4,411
Agricultural Science	1,922	1,160	-64	109	2	1,113	4,241
Veterinary Medicine	1,099	1,143	112	56	112	249	2,770
Psychology	2,593	1,100	15	470	109	461	4,748
Economics	5,705	549	92	265	0	229	6,840
Educational Science	4,985	1,565	39	194	0	1,418	8,201
Other Social Science	27,285	2,627	1,999	2,672	242	6,219	41,044
History	5,661	1,736	15	6	0	289	7,707
Languages & Literature	13,774	1,851	5	50	0	1,601	17,281
Other Humanities	3,664	1,659	56	750	67	1,458	7,655
TOTAL	**122,847**	**129,820**	**11,873**	**23,574**	**6,685**	**27,544**	**322,342**
% TOTAL	**38%**	**40%**	**4%**	**7%**	**2%**	**9%**	**100%**

Table A4.4 - Expenditure by Types of R&D Activity by Field of Science, 2002

Field of Science	Basic Research		Applied Research		Experimental Research		Total	
	€'000	% Total	€'000	% Total	€'000	% Total	€'000	% Total
Mathematics & Computer Science	7,670	41%	7,215	39%	3,655	20%	18,541	100%
Physical Science	11,415	52%	7,789	36%	2,681	12%	21,885	100%
Chemical Science	12,124	49%	10,286	42%	2,174	9%	24,584	100%
Environmental Science	3,642	58%	2,174	35%	478	8%	6,293	100%
Biological Science	24,276	54%	15,745	35%	4,610	10%	44,631	100%
Civil Engineering	1,095	15%	2,789	38%	3,447	47%	7,331	100%
Electrical Engineering & Electronics	4,831	22%	11,657	52%	5,902	26%	22,390	100%
Other Engineering Sciences	6,183	26%	11,907	50%	5,723	24%	23,812	100%
Basic Medicine	14,307	36%	22,775	57%	3,209	8%	40,292	100%
Clinical Medicine	2,713	35%	3,492	45%	1,482	19%	7,686	100%
Health Science	680	15%	3,621	82%	110	2%	4,411	100%
Agricultural Science	418	10%	3,481	82%	342	8%	4,241	100%
Veterinary Medicine	740	27%	1,823	66%	206	7%	2,770	100%
Psychology	1,627	34%	2,490	52%	631	13%	4,748	100%
Economics	1,772	26%	4,913	72%	155	2%	6,840	100%
Educational Science	2,856	35%	4,343	53%	1,002	12%	8,201	100%
Other Social Science	20,021	49%	19,013	46%	2,009	5%	41,044	100%
History	6,699	87%	999	13%	10	0%	7,707	100%
Languages & Literature	12,100	70%	4,890	28%	291	2%	17,281	100%
Other Humanities	5,440	71%	1,469	19%	746	10%	7,655	100%
TOTAL	**140,608**	**44%**	**142,870**	**44%**	**38,864**	**12%**	**322,342**	**100%**

Table A4.5 - Expenditure by Type of Cost and Field of Science 2002

Field of Science	Labour	Other Current	Total Current	Capital	Total
	€'000	€'000	€'000	€'000	€'000
Mathematics & Computer Science	12,538	4,799	17,337	1,204	18,541
Physical Science	10,685	4,818	15,503	6,382	21,885
Chemical Science	14,877	5,745	20,622	3,962	24,584
Environmental Science	4,025	2,118	6,143	150	6,293
Biological Science	27,888	14,036	41,924	2,707	44,631
Civil Engineering	4,709	2,070	6,779	552	7,331
Electrical Engineering & Electronics	12,480	6,485	18,965	3,425	22,390
Other Engineering Sciences	14,882	7,145	22,027	1,785	23,812
Basic Medicine	20,365	10,875	31,240	9,052	40,292
Clinical Medicine	5,203	2,321	7,524	162	7,686
Health Science	3,214	1,040	4,254	157	4,411
Agricultural Science	3,090	1,054	4,144	97	4,241
Veterinary Medicine	1,661	946	2,607	163	2,770
Psychology	3,694	917	4,610	137	4,747
Economics	5,602	1,152	6,754	86	6,840
Educational Science	5,891	2,127	8,018	183	8,201
Other Social Science	28,796	10,297	39,093	1,951	41,044
History	6,639	1,045	7,684	23	7,707
Languages & Literature	14,880	2,171	17,161	120	17,281
Other Humanities	5,135	2,187	7,332	323	7,655
TOTAL	**206,254**	**83,348**	**289,721**	**32,621**	**322,342**

Table A4.6 - R&D Personnel (Full-Time Equivalent) by Field of Science 2002

Field of Science	Full Time Academic Staff FTE	Contract Lecturers FTE	Post Doctoral Fellows FTE	Research Assistants FTE	Technicians FTE	Admin FTE	Other Staff FTE	Total FTE
Mathematics & Computer Science	124	16	21	70	10	2	37	280
Physical Science	66	12	25	50	10	4	0	167
Chemical Science	83	3	24	31	6	1	0	148
Environmental Science	27	3	30	27	19	3	0	109
Biological Science	101	14	61	170	45	4	11	406
Civil Engineering	47	0	0	12	5	4	0	68
Electrical Engineering & Electronics	75	9	7	43	36	1	11	182
Other Engineering Sciences	113	6	1	46	7	3	3	179
Basic Medicine	57	10	8	24	42	7	0	148
Clinical Medicine	34	18	68	24	12	7	0	163
Health Science	21	1	6	33	2	3	0	66
Agricultural Science	14	1	2	0	11	1	0	29
Veterinary Medicine	6	3	0	13	18	6	0	46
Psychology	22	0	1	0	1	0	0	24
Economics	65	0	0	9	0	0	0	74
Educational Science	70	2	0	0	0	2	0	74
Other Social Science	305	19	10	44	5	16	0	399
History	61	4	6	15	1	1	0	88
Languages & Literature	155	15	22	32	4	4	6	238
Other Humanities	101	14	18	147	6	3	2	291
TOTAL	**1547**	**150**	**310**	**790**	**240**	**72**	**70**	**3179**

Appendix 5 Detailed International Tables

Table A5.1: *HERD as a percentage of GDP, 2002*

	1996		1998		2000		2002	
	Value (%)	Rank	Value (%)	Rank	Value (%)	Rank	Value (%)	Rank
Australia	0.44	7	0.43	10	0.41	11	0.41	15
Belgium	0.43	8	0.46	7	0.47	6	0.42	12
Canada	0.45	5	0.49	6	0.56	5	0.63	3
Czech Republic	0.09	25	0.12	25	0.19	24	0.20	24
Denmark	0.4	12	0.41	11	0.44	8	0.58	5
Finland	0.46	4	0.57	3	0.6	2	0.66	2
France	0.39	13	0.38	14	0.41	11	0.43	9
Germany	0.42	9	0.4	12	0.4	13	0.43	10
Greece	0.22	21	0.26	21	0.33	17	0.29	22
Hungary	0.16	24	0.17	24	0.19	24	0.26	23
Iceland	0.42	9	0.51	5	0.44	8	0.50	7
Ireland (GNP)	**0.3**	**16**	**0.3**	**18**	**0.27**	**22**	**0.31**	**19**
Italy	0.27	18	0.34	17	0.33	17	0.36	16
Japan	0.41	11	0.44	8	0.43	10	0.43	11
Korea	0.24	20	0.28	19	0.3	19	0.30	21
Netherlands	0.58	3	0.53	4	0.57	4	0.51	6
New Zealand	0.3	16	0.4	12	0.35	16	0.36	17
Norway	0.45	5	0.44	8	0.47	6	0.45	8
Poland	0.2	23	0.2	23	0.22	23	0.20	25
Portugal	0.21	22	0.25	22	0.29	20	0.33	18
Slovak Republic	0.05	26	0.07	26	0.06	26	0.05	26
Spain	0.27	18	0.27	20	0.28	21	0.31	20
Sweden	0.76	1	0.79	1	0.81	1	0.83	1
Switzerland	0.66	2	0.63	2	0.6	2	0.59	4
United Kingdom	0.37	15	0.35	16	0.38	14	0.42	13
United States	0.38	14	0.36	15	0.38	14	0.42	14
EU Average	**0.38**	**-**	**0.39**	**-**	**0.4**	**-**	**0.39**	**-**
OECD Average	**0.37**	**-**	**0.37**	**-**	**0.39**	**-**	**0.41**	**-**

Table A5.2: *HE researchers per 1000 population, 2002*

	1996		1998		2000		2002	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
Australia	1.9	1	2	1	2.1	1	0.7	20
Belgium	1	10	1.1	9	1.2	8	1.2	9
Canada	1.2	6	1.1	9	1.1	10	1.1	11
Czech Republic	0.3	26	0.3	26	0.4	25	0.4	26
Denmark	1.1	8	1.2	8	1.1	10	1.5	4
Finland	1.3	4	1.9	2	2.1	1	2.4	1
France	0.9	11	0.9	12	1	13	1.0	12
Germany	0.8	12	0.8	16	0.8	17	0.8	17
Greece	0.6	19	0.7	19	1	13	0.8	19
Hungary	0.4	24	0.4	24	0.6	22	0.6	23
Iceland	1.4	2	1.7	3	1.7	3	1.7	3
Ireland	**0.6**	**19**	**0.7**	**19**	**0.6**	**22**	**0.7**	**21**
Italy	0.6	19	0.4	24	0.4	25	0.5	25
Japan	1.4	2	1.4	5	1.4	5	1.3	6
Korea	0.4	24	0.5	23	0.5	24	0.5	24
Netherlands	0.8	12	0.8	16	0.8	17	1.0	14
New Zealand	0.8	12	1.3	6	1.3	6	1.4	5
Norway	1.1	8	1.1	9	1.2	8	1.2	7
Poland	0.8	12	0.9	12	0.9	15	1.0	13
Portugal	0.6	19	0.7	19	0.8	17	0.9	15
Slovak Republic	0.7	18	0.9	12	0.9	15	0.9	16
Spain	0.8	12	0.9	12	1.1	10	1.1	10
Sweden	1.3	4	1.5	4	1.6	4	1.8	2
Switzerland	1.2	6	1.3	6	1.3	6	1.2	8
United Kingdom	0.8	12	0.8	16	0.8	17	0.8	18
United States	0.5	23	0.8	19	0.7	21	0.6	22
EU Average	**0.8**	**-**	**0.8**	**-**	**0.9**	**-**	**0.9**	**-**
OECD Average	**0.7**	**-**	**0.8**	**-**	**0.8**	**-**	**0.8**	**-**

Recent Publications

Broadband Telecommunications Benchmarking Study	January 2004
Research and Development in Ireland, 2001 – at a glance	January 2004
Competitiveness through Innovation *National Competitiveness Council (NCC)*	February 2004
International Trade & Investment Report, 2003	March 2004
Wireless Communications: An Area of Opportunity for Ireland	April 2004
National Code of Practice for Managing Intellectual Property from Publicly Funded Research *Irish Council for Science, Technology & Innovation (ICSTI)*	April 2004
Forfás Annual Report	April 2004
Innovation Networks	June 2004
Enterprise Strategy Group Report *Ahead of the Curve*	July 2004
Export Licensing of Military and Dual-Use Goods in Ireland	July 2004
Statement on Nanotechnology *Irish Council for Science, Technology & Innovation (ICSTI)*	July 2004
Building Ireland's Knowledge Economy **The Irish Action Plan for Increasing Research and Development to 2010**	September 2004
A Model to Predict the Supply and Demand for Researchers	September 2004
Statement on Prices and Costs *National Competitiveness Council (NCC)*	September 2004
State Expenditure Priorities for 2005 *Irish Council for Science, Technology & Innovation (ICSTI)*	September 2004
Sustainable Development in Ireland *Irish Council for Science, Technology & Innovation (ICSTI)*	October 2004
Annual Competitiveness Report 2004 & The Competitiveness Challenge Report *National Competitiveness Council (NCC)*	October 2004

Functions of Forfás

Forfás is the national policy and advisory board for enterprise, trade, science, technology and innovation. It is the body in which the State's legal powers for industrial promotion and technological development have been vested. It is also the body through which powers are delegated to Enterprise Ireland for the promotion of indigenous industry and to IDA Ireland for the promotion of inward investment. Science Foundation Ireland was established as a third agency of Forfás in July 2003. The broad functions of Forfás are to:

- advise the Minister on matters relating to the development of industry in the State
- advise on the development and co-ordination of policy for Enterprise Ireland, IDA Ireland, Science Foundation Ireland and such other bodies (established or under statute) as the Minister may by order designate
- encourage the development of industry, science and technology, innovation, 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, IDA Ireland and Science Foundation Ireland in relation to their functions.

Is é Forfás an bord náisiúnta um polasaí agus comhairle le haghaidh fiontraíochta, trádála, eolaíochta, teicneolaíochta agus nuála. Is é an comhlacht é a bhfuil comhactaí dlíthiúla an stáit maidir le cur-chun cinn tionscail agus forbairt teicneolaíochta dílsithe ann. Is é an comhlacht é freisin trína dciomnaítear cumhachtaí ar Fhiontraíocht Éireann le tionscail dúchais a chur chus cinn agus ar ghníomhaireacht Forbartha Tionscail na hÉireann (GFT Éireann) le hinfheistíocht isteach sa tir a chur chun tosaigh. Bunaiodh Fondúireacht Eolaíochta Éireann mar an treas eagraíocht de chuid i Forfás mí iúil 2003. Is iad feighmeanna Fhorfáis :

- comhairle a chur ar an Aire ó thaobh cúrsaí a bhaineann le forbairt tionscail sa Stát
- comhairle maidir le forbairt agus comhordú polasaithe a chur ar fáil d'Fhiontraíocht Éireann, d'GFT Éireann, Fondúireacht Eolaíochta Éireann agus d'aon fhoras eile dá leithéid (a bunaíodh go reachtúil) a d'fhéadfadh an tAire a ainmniú trí ordú
- forbairt na tionsclaíochta, na teicneolaíochta, na margaíochta agus acmhainní daonna a spreagadh sa Stát
- bunú agus forbairt gnóthas tionsclaíoch ón iasacht a spreagadh sa Stát, agus
- Fiontraíocht Éireann, GFT Éireann agus Fondúireacht Eolaíochta Éireann a chomhairliú agus a chomhordú ó thaobh a gcuid feidhmeanna.

Board Members

Eoin O'Driscoll	*Chairman,* *Managing Director, Aderra*
Martin Cronin	*Chief Executive,* *Forfás*
Sean Dorgan	*Chief Executive,* *IDA Ireland*
Sean Gorman	*Secretary General,* *Department of Enterprise, Trade & Employment*
Dr William Harris	*Director General,* *Science Foundation Ireland*
Prof. Michael Hillery	*Emeritus Professor of Engineering,* *University of Limerick*
Rody Molloy	*Director General,* *FÁS*
William Murphy	*Partner,* *Tynan Dillon and Company*
Feargal O'Rourke	*Partner, Taxation,* *PricewaterhouseCoopers*
Frank Ryan	*Chief Executive Officer,* *Enterprise Ireland*
Dr Don Thornhill	*Chairman,* *Higher Education Authority*
Toni Wall	*Managing Director,* *Wall 2 Wall Limited*
Jane Williams	*Managing Director,* *The Sia Group Limited*

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