Women in Industrial Research

Women in industrial research: an overview

Setting the scene

In the context of international R&D development, this chapter reviews the potential of highly qualified women and female participation in industrial research. The field is very diverse and complex, data are often incomplete, and little analysis is available. The following overview draws on data from different sources, in particular Eurostat[1], DG Research[2], OECD and US databases and publications. The review also includes material from companies, national governments, as well as data, literature and preliminary results from a study[3] on women in research in the private sector commissioned by the European Commission.

The rising proportion of women in higher education and employment in recent decades has been one of the major structural changes affecting labour markets and society. However this phenomenon has not yet been translated into a substantial participation of women in industrial research. There are large national differences in Europe, because of traditions and cultural backgrounds and in framework conditions to support work/life balance.

This chapter concentrates on the 15 EU Member States, but also includes data for other European countries and for the US.

World-wide trends in industrial research

The Capex scoreboard on research and innovation indicates that R&D is dominated by IT hardware (25%) and automotive (17%), closely followed by pharmaceuticals and biotechnology (16%). Five sectors (electronic and electrical, health, IT hardware, pharmaceuticals and biotechnology, software

[1] New Cronos database.
[2] WiS database.
[3] A full report on this study, outlining the methodologies used and a full summary of results and raw /data will be available early 2003 (Meulders et al: in press). It was conducted by DULBEA (the Department of Economic Analysis at the Université Libre de Bruxelles) and by la Fundació CIREM (Centre d'Iniciatives i Recerques Europees a la Mediterrània), Barcelona.

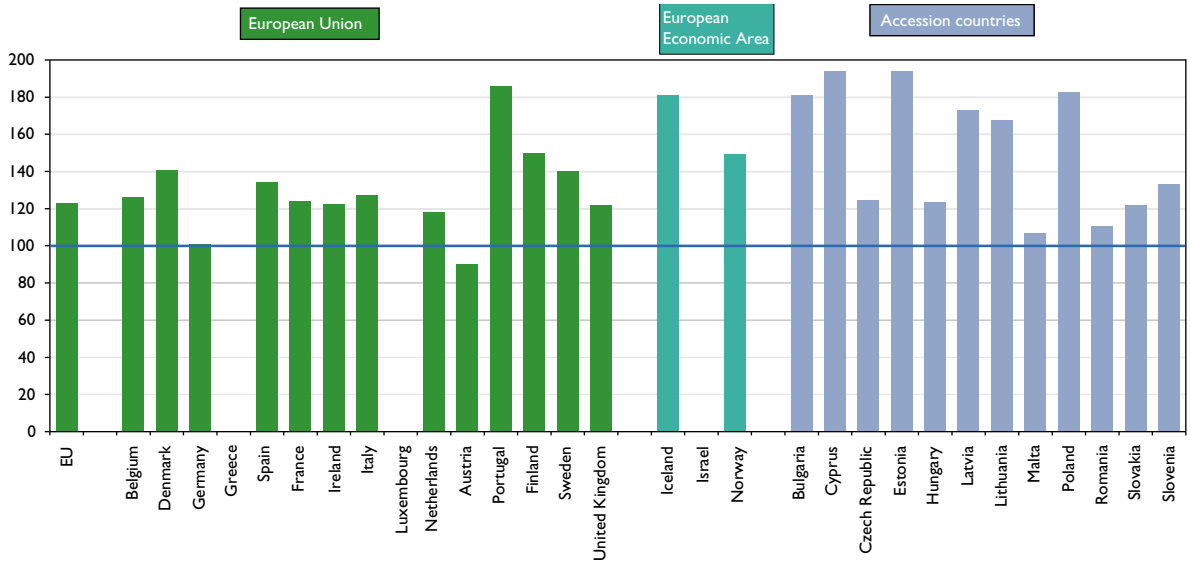
and IT services) have the highest R&D intensity and account for over 60% of all R&D[4]. The Business Enterprise Sector[5] accounts for 56.3%[6] of all European R&D financing and 65.3%[7] of R&D performance.

Major increase in women's qualifications

There has been a spectacular rise in women's educational attainment in the EU Member States over the last 20 years. In the 18-21 age group, women are more likely than men to be enrolled in tertiary education programmes in every EU Member State. For the 22-24 and 25-28 year old age groups, this is already true in the case of 8 countries[8].

In 2000 there were on average more than 120 women graduates for every 100 male graduates in Europe (55% female graduates, see Figure 3.1). Only in Austria did the proportion of women graduates remain below 50%. In Scandinavian countries by contrast, women now constitute about 60% of graduates. In seven of the 12 Accession Countries (right hand side of Figure 3.1) the dominance of women graduates is even higher – more than 150 female per every 100 male graduates.

Figure 3.1: Women graduates in Europe per 100 men graduates (ISCED 5 and 6) (2000)



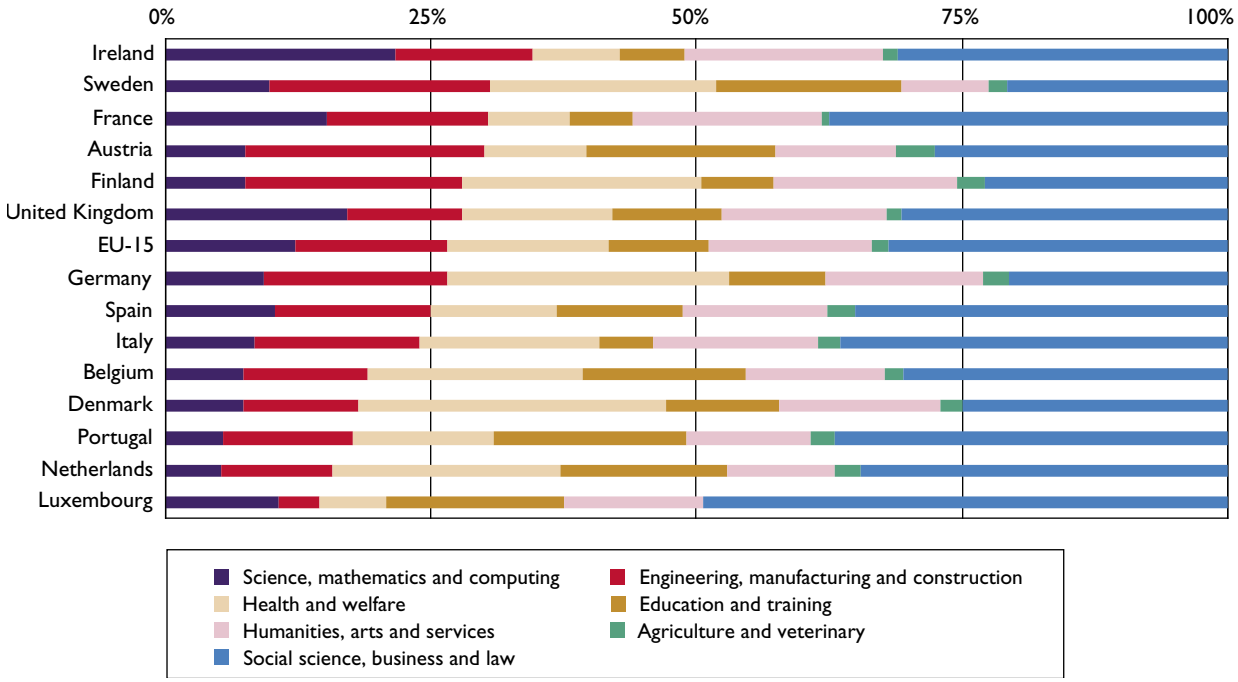
Source: Eurostat
Data: Eurostat, UOE. Includes all first and advanced degree programs in higher education[9].
Exceptions to the reference year: Denmark, France, Italy, Ireland, Finland, and Cyprus (1999).
Netherlands, Poland, and Romania: Excludes ISCED level 6.
Luxembourg does not have a complete university system, most students study abroad, breakdown by sex is not available.
Austria: ISCED level 5B refers to previous year.
Cyprus: Excludes 12,448 tertiary students studying abroad which represents 53% of the total number of Cypriot tertiary students.
Romania: Excludes second qualification.

[4] Capex scoreboard on innovation of the Department on Trade and Industry (DTI), United Kingdom http://www.innovation.gov.uk/projects/capex_scoreboard/capexscoreboard_fr.htm#score2
[5] OECD (1993).
[6] See DG Research, Key Figures 2002, Table 1.1.1
[7] Provisional estimate from OECD data, DG Research, Unit K3
[8] See Table 3.1 in annex. Source: Eurostat (2002) The life of women and men in Europe: A statistical portrait, ISBN 92-894-3569-2, Luxembourg.
[9] The number of female graduates per 100 males is calculated by dividing the total number of female graduates by the total number of male graduates and multiplying the result by 100.

Distribution across fields of study

Regardless of the gender dimension, there are some common patterns in the distributions of all higher education students by field of science in Europe, as Figure 3.2 reveals[10]. Social science, business, and law together tend to attract most students in all countries. By contrast science, mathematics and computing together with engineering, manufacturing and construction only recruit a third or less graduates, ranging from 34.5% of all graduates in Sweden to 16% in the Netherlands and 15% in Luxembourg.

Figure 3.2: Distribution of all graduates (ISCED 5 and 6,male and female), by broad field of study, (2000)



Source: DG Research, Unit C5
Data: Eurostat, New Cronos (see Annex Table 3.2).
Ranked by the summed proportions of graduates in the two main fields of science, mathematics, computing (ISCED 42-48) and engineering (ISCED 52-58).
Missing data: Greece.

However, these figures hide deep disparities in educational subject choices between the sexes (Figure 3.3, Annex Table 3,2).

In the year 2000, in the EU 166,734 women graduated in science, mathematics and computing and engineering as Table 3.1 indicates – about 10% more than the year before. In science, mathematics and computing 41% of all graduates were women in 2000, compared with only 20% of all graduates in the field of engineering, manufacturing and construction.

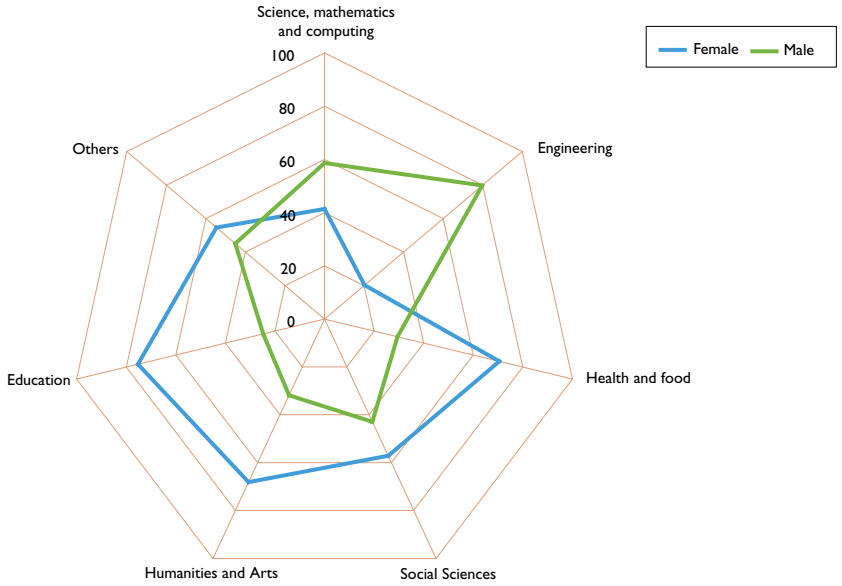
Box 3.1

By 1999 20% of all Masters and 27% of all Doctorates in the US were foreign born. With 52% their percentage was highest in Civil engineering, followed by Mechanical engineering (49.2%), Electrical engineering (47.2%), and Computer sciences (46.4%).

Source: NSB (2002, pp 3-30)

[10] The fields presented are drawn from the ISCED classification of broad groups and fields of education and include broad groups 1-7 only [Education (1); Humanities and Arts (2); Social sciences, business and law (3); Science (4); Engineering, manufacturing and construction (5); Agriculture (6); Health and welfare (7)]. 1997 (ISCED)

Figure 3.3: Proportions of male and female graduates in tertiary education, in selected fields of study 2000, EU-average



Source: DG Research, Unit K3
Data: Eurostat, UOE
Health and Food = Health and Agriculture: ISCED fields 62 (Agriculture, forestry and fishery), 64 (Veterinary)+72 (Health)

Box 3.2

In Israel, women make up 28% of students in engineering studies. A National Institute for Technology and Hi-Tech Training report argues that women will avoid entering domains where they will be in a distinct minority.

There are strong variations in the proportion of women (in % of all graduates) in the different fields of study between the EU Member States. There is no evidence that those countries with a high female proportion of all graduates also have a high proportion of women graduates in science and engineering as Table 3.1 shows. By the same token, a strong position in science does also not necessarily indicate an equally strong position in engineering and vice versa.

In science, mathematics and computing we find the highest proportions of women graduates with 50% and more in Italy and Ireland – and the lowest in the Netherlands, Belgium and Germany with about 30%. In engineering, manufacturing and construction, Portugal has the highest proportion of women graduates with 35% and again the Netherlands the lowest with only 13%.

It seems that in most European countries strategies to encourage women to study engineering have not yet been sufficiently successful. This is also true for computing and physics.

European women are obtaining more than a third of new PhDs

In 2000, 39% (27,027) of all PhDs in the EU were awarded to women. This proportion is slightly higher than the average of 30 OECD countries (38%)[11]

[11] *Source:* OECD, 2002, Education at a Glance. OECD Indicators 2002

Table 3.1: Women graduates in tertiary education (ISCED 5 & 6) in the EU, by all fields, Science and Engineering, (absolute numbers and %) 2000

	Total (all fields)		Science, mathematics and computing		Engineering, manufacturing and construction	
	Number	%	Number	%	Number	%
EU	1,184,530	55.3	105,798	41.4	60,936	20.4
Belgium	38,121	55.9	1,510	30.1	1,716	21.7
Denmark	21,667	56.7	966	32.5	1,337	26.3
Germany	152,064	50.3	8,755	31.4	8,542	16.4
Spain	149,182	57.3	11,267	42.5	9,327	23.9
France	277,082	55.4	31,813	41.8	14,072	18.7
Ireland	23,133	55.1	4,556	50.3	930	17.2
Italy	106,555	56.0	8,718	55.0	8,179	27.5
Netherlands	43,006	54.2	1,162	27.5	1,039	12.6
Austria	11,855	47.5	656	35.2	840	14.9
Portugal	38,017	65.0	1,450	45.7	2,476	34.6
Finland	22,298	61.7	1,265	46.4	1,494	20.3
Sweden	24,739	58.4	1,969	47.5	2,192	24.8
UK	276,801	54.9	31,711	41.5	8,882	18.1

Source: Eurostat, UoE, including ISCED 5 and 6
Missing data: Greece
Not applicable: Luxembourg
France, Italy: 1999 data
Denmark: In 2000 no data for ISCED 6; indicator on basis 1999.

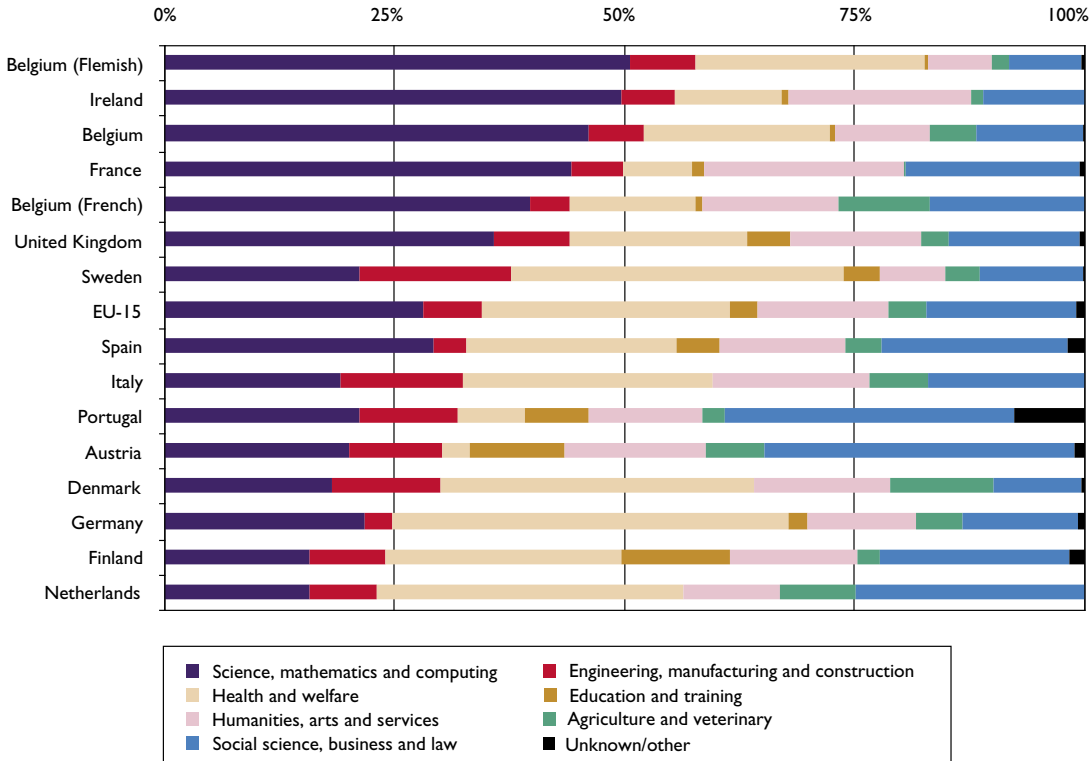
but lower than in the US (44%)[12]. Of these women, 7,593 women earned a PhD in science, mathematics and computing, which equals 34% of all PhD graduates in this field. The share of women PhDs in life sciences is 50%, followed by mathematics (30%), physical sciences (27%) and computing (17%). In engineering, manufacturing and construction women's share of PhDs was 20% (1,744 women PhDs). By comparison, in the OECD countries the share of women PhDs was 47% in life sciences; 30% in mathematics and computing and 23% in engineering in 2000.

There are, distinct national differences. In science, mathematics and computing women PhDs, in % of all PhDs, constituted about 50% in Ireland, Portugal, and Italy and have been lowest in Germany and the Netherlands with less than 30% In engineering, Italy is a little ahead of the other countries with 35% women graduates, followed by Portugal and Ireland with almost 30%. The countries with the lowest proportions of women graduating in engineering are Germany, the Netherlands, and Belgium with only 15% or less).

As Figure 3.4 indicates, more or about 50% of all women PhDs in Ireland, Belgium and France are in science, mathematics, computing and engineering. On the other hand, women doctorates in Netherlands, Finland, and Germany are more likely to have studied health and/or social sciences.

[12] *Source:* National Science Board, 2002, Science and Engineering Indicators 2002

Figure 3.4: Distribution of women PhD graduates (ISCED 6), by broad field of study, 2000



Source: DG Research, UNit C5
Data: Eurostat, New Cronos (See Annex Table 3.3)
EU15: estimated, excludes Greece.
Denmark, France and Italy: 1999 data.
Luxembourg does not have a complete university system. Most students study abroad.
Ranked by the aggregated proportions of graduates in the two main fields of science, mathematics, computing (ISCED 42-48), and engineering (ISCED 52-58).

Box 3.3

"Today just as many women as men graduate from university, so the difference in the number of suitable candidates for (leading) positions is expected to increase quickly."

Source: Klomp, Luuk, Meinen, Gerhard, Meurink, Andre, and Martje Roessingh, 2000, Knowledge-based economy 2000 – R&D and innovation in the Netherlands, Statistics Netherlands

Women in industrial research are still invisible

In 1999, a total of 935,222 researchers were employed in the EU (see Figure 3.2). Forty nine per cent worked in industry (Business Enterprise Sector) and 49% in the public sector (Governmental and Higher Education Sector)[13]. The proportion of researchers, who work in industry was highest in Ireland and Austria (64%), followed by Germany (59%), Sweden (57%), UK (56%), and Belgium (55%). In all other countries less researchers are working in industry than in the public sector: only 13% in Portugal and 16% in Greece.

About two thirds of all researchers in the EU are employed in Germany, France and UK (Table 3.2). The concentration of researchers in these three countries is even more pronounced if one considers only researchers in industry: nearly one third of all EU researchers in industry are working in Germany alone.

There are remarkable differences in the number and proportion of female researchers in the EU. The proportion of women among researchers among

[13] The Governmental Sector includes publicly supported research institutes. The private non-profit sector is not included here.

Table 3.2: Total number of researchers and percentage distribution by sector, EU, US, Japan, 1999

	Total number	Business enterprise %	Governmental %	Higher education %
Germany	255,260	59	15	26
UK	165,105	56	9	30
France	160,424	47	16	35
Italy	76,796	35	16	47
Spain	61,568	25	19	55
Netherlands	40,623	48	20	31
Sweden	39,921	57	6	37
Belgium	30,219	55	4	40
Finland	25,398	42	16	41
Austria	20,222	64	5	31
Denmark	18,438	47	21	31
Portugal	15,752	13	22	52
Greece	14,828	16	13	71
Ireland	10,668	73	3	24
EU15	935,222	49	14	35
US	1,219,407	83	4	11
Japan	658,910	66	5	27

Source: DG Research
Data: Eurostat, Member States, OECD; *Notes:* (1) Researchers in full-time equivalents (FTE) (2) EU-average does not include Luxembourg

all researchers is highest in Portugal (43%) and Greece (41%) and lowest in Austria (19%) and Germany (14%) (Figure 3.5). In all other EU countries women constitute more than 25% of all researchers.

By comparison, in Iceland women have a share of 33%, Norway 28%, Switzerland 21%, and in the US 24%.

Industrial research relies mostly on researchers, who are qualified in the fields of science, mathematics, computing and engineering, where participation of women in higher education, especially in advanced studies, is still lower than that of men. It is not surprising, therefore that the proportion of women among industrial researchers is lower than in other sectors (Table 3.3), which have researchers from a broader spectrum of disciplines. However, this does not explain why the proportion of women in industrial research amounts to only 15% (for 10 EU countries, see Table 3.3).

Indeed, women do not even constitute 30% of industrial researchers in any individual EU Member State. This, despite the fact that their overall participation in R&D thus ranges between 26% and 43% in eight Member States (see Figure 3.6).

Women make up between 18% and 28% of industrial researchers in eight of the 10 countries that provide sex-disaggregated statistics. In the two remaining countries, Germany, and Austria, the share of women among all researchers is even below 10%. Germany with its dominant position in European industrial R&D, lowers the European average to 15%. This average is distinctly lower

Table 3.3: Numbers and proportions of female researchers in industrial research (BES), EU, 1999

Countries	All researchers ranked by total number	Number of women	% of women
Germany*	150,149	14,414	9.6
Denmark	11,292	2,218	19.6
Greece	3,931	940	23.9
Spain	17,310	3,353	19.4
France	86,215	17,787	20.6
Ireland	1,900	536	28.2
Italy	29,706	5,490	18.5
Luxembourg**	1,217	No data	No data
Austria	13,966	1,258	9.0
Portugal	3,328	793	23.8
Finland	22,515	3,999	17.8
Sweden**	39,921	No data	No data
UK**	98,587	No data	No data
EU (10)	340,312[14]	50,789	14.9

Source: DG Research, Unit C5
Data: Eurostat, New Cronos; DG Research, WiS database
Exceptions to the reference year: Austria (1998); France, Italy (2000); Ireland (2001)
* = Full time equivalent; ** = No gender differentiation data available
No data for Belgium and the Netherlands

Box 3.4

A survey of 162 life science researchers who had worked in both academia and industry identified career development opportunities and financial rewards as the key attractions of the latter.

Source: Grimwade, A. (2001) 'Working in academia and industry', *The Scientist*, vol 25, no 8, at http://www.the-scientist.com/Yr2001/apr/prof2_010416.html

than women's share of all graduates in science, mathematics and computing (41%) or than the already low share of women in engineering (20%).

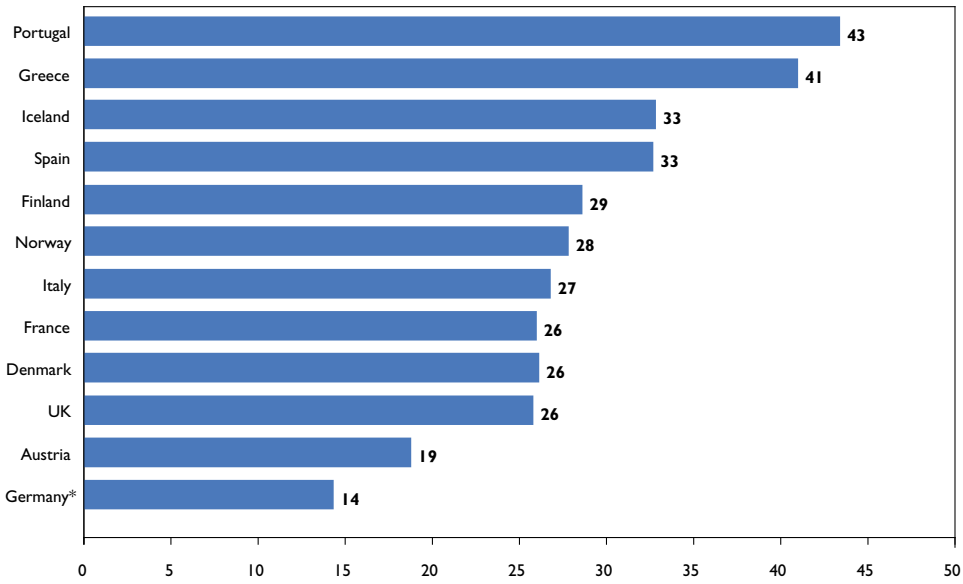
Around three-quarters[15] of all researchers in the business enterprise sector are employed in countries whose main economic activity[16] is in the more R&D intensive manufacturing. The other domain in which both men and women are concentrated is "real estate, renting and business activities", which are especially important areas for Denmark (40%) and Greece (25%). These two domains comprise companies whose main economic activities are in IT or in R&D.

The overall proportion of all researchers in these two domains – manufacturing (D) and "real estate and business activities"(K) - amounts to 76% (70% for women) in Greece and exceeds 84% in all the other countries. Only in Denmark does the proportion of women researchers in manufacturing – 53% – exceed the proportion of men researchers.

Although women researchers are generally distributed across domains in a similar way to men, the only domains where women participate substantially in industrial research are health and social work (N) and financial intermediation (J).

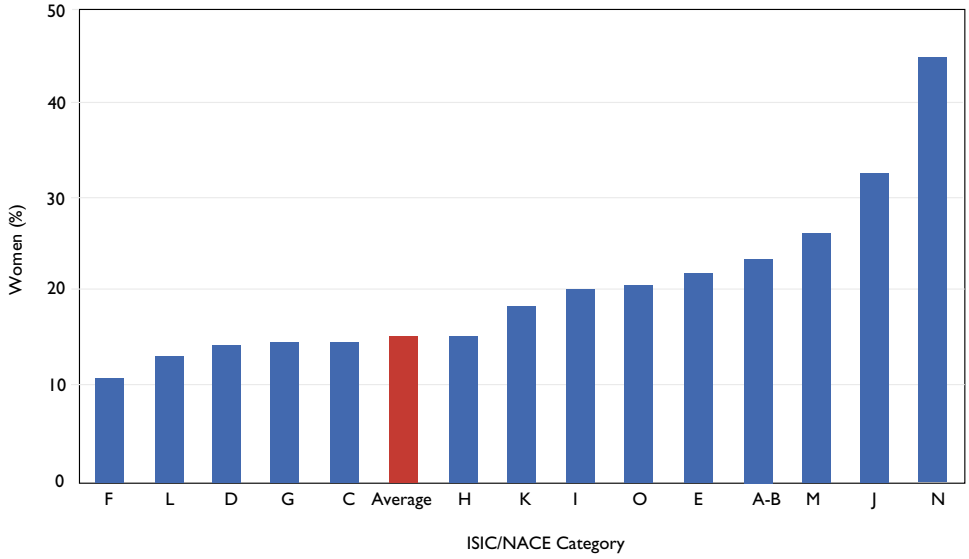
[14] 480,037 if Luxembourg, Sweden and UK are included.
[15] The overall for the 9 countries (A, D, DK, EL, E, FIN, F, I, P), which were able to provide data is 78.6%.
[16] These data have been reported by Member States to DG Research; data are structured by ISIC/NACE classification of main economic activity.

Figure 3.5: Female researchers (head count) as a percentage of all researchers at the national level, 1999



Source: DG Research, Units C5 and K3
Data: Eurostat, Member States
Exceptions to reference year: P: 2000, A: 1998
*= Full time equivalent

Figure 3.6: Percentage of female researchers (head count) among all reserachers by domain of economic activity (ISIC/NACE category)[17], EU, 1999



Missing data: Belgium, Ireland, Luxembourg, Netherlands, Sweden, United Kingdom. Exeptions to the reference year: Austria (1998), France and Finland (2000)

[17] A+B = Agriculture, hunting and forestry + Fishing; C= Mining and quarrying; D= Manufacturing; E= Electricity, gas and water supply; F = Construction; G = Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods; H = Hotels and restaurants; I = Transport, storage and communication; J = Financial intermediation; K= Real estate, renting and business activities; L= Public administration and defence; compulsory social security; M = Education; N= Health and social work; O = Other community, social and personal service activities.

It is of special interest to compare the situation between France and Germany, because they are the countries with the highest numbers of researchers in the EU[18]. In France women researchers in industry play a far more important role than in Germany, their share amounts to 21% of all researchers in industry but only to 10% in Germany. Even though Germany has nearly twice as many industrial researchers as France, France has over 3,000 more female researchers working in industry than Germany (Table 3.3).

The following trends are results of a survey, which was conducted in the public and private research sector in France, and published in March 2002[19]. The survey covered 11,200 companies and 50 research centres.

The trends identified were:

- Female participation is higher in public research than in industrial research,
- There is a remarkable increase in the number of women in all scientific fields – especially in health and also in self-employment.
- The proportion of women is larger in life sciences and chemistry (49%), and lowest in mathematics, physics or engineering (only 8%).

Sex disaggregated data have been available in France since 1993. A slight increase in the share of female researchers in industry has been observed between 1993 and 1999. As in Germany, women tend to be more concentrated in the field of pharmaceuticals, but their representation is significantly better in France (50% compared to 37% in Germany). Even in the fields where participation is lowest, one is about twice as likely to encounter a female researcher in France than in Germany.

The German Faktenbericht 2002[20] presents data on women in industrial research for 1999. The presence of female researchers is relatively higher in the areas of food and tobacco processing, textiles and chemical industry (nearly one-third). Companies whose main economic activity centers around pharmaceuticals employ the highest proportion of women researchers (37%). The proportion of women researchers is particularly low in the areas of vehicle construction (6.5%) – and especially in the sub-groups of other vehicle construction and aerospace vehicle construction (3.8% in each) – and of mechanical engineering (5.4%). The percentage of women was lowest in broadcasting, television and telecommunications technology with 3% only.

A glance at the situation in the associated countries

In the associated countries women participation in industrial research tends to be comparatively higher than in the Member States.

Country differences in this group are however substantial. In Switzerland, Norway, and, to a lesser degree, also in Czechia and Hungary female participation rates in industrial research assemble those in the EU.

[18] Sex-disaggregated data for the UK are not available yet.
[19] French Ministry of Research, 2002, Women in French Research. The White Paper.
[20] Bundesministerium für Bildung und Forschung (BMBF), 2002, Faktenbericht 2002

Table 3.4: Numbers and percentage of female researchers in industrial research (BES), Associated countries, 1999

Countries	Researchers in industrial research*	Women researchers in industrial research	Women researchers in industrial research (%)
Bulgaria	1,435	637	44.4
Switzerland	17,210	2,845	16.5
Cyprus	189	39	20.6
Czech Republic	9,488	1,559	16.4
Estonia	651	232	35.6
Hungary	4,063	948	23.3
Iceland	842	197	23.4
Lithuania	339	153	45.1
Latvia	211	71	33.6
Norway	12,626	2,476	19.6
Slovenia	1,772	506	28.6
Slovakia*	2,552	742	29.4

Source: DG Research, Unit C5
Data: Eurostat, New Cronos; DG Research, WiS database.
Notes: No data for Israel, Malta, Poland and Romainia.
Exceptions to the reference year: Iceland, Lithuania (2000)
* = Full-time equivalent.

In the US, 19% of all researchers in industry are women[21]

Since the National Research Council (NRC) published its first report on women in industrial research, *Why so few?* (NRC, 1993), sex-disaggregated statistics have become much more available in the US[22]. In 1999, about every fourth researcher (scientist or engineer) in the US was a female. Nearly two thirds of them worked in the private sector, mainly in industry/businesses. Others were self-employed, or worked in private-non-profit institutions. Some 38% of all female researchers worked in governmental and educational institutions.

Just over half (52%) of all women scientists and engineers in industry are computer scientists or mathematicians, 23% engineers, 9% life scientists, 8% physical scientists and 7% social scientists[23].

Gender differences in industrial research have decreased in the US (as in Europe). The largest gender differences remain in engineering and in the physical sciences where women are more likely to be found in applied research than in basic research[24].

[21] These data are based on different definitions as for instance the date of the OECD cited above (compare table 3.2). Thus, the different data sets cannot be compared. However, the distributions across the various sectors and female participation rates provide a good indication.
[22] It is worth noting that the US National Science Foundation's biennial Scientists and Engineers Statistical Data System (SESTAT) surveys enable scientists and engineers to be defined in terms of education or occupation or both: it is an extremely rich data set that may serve as a model for Europe.
[23] NSB, 2002, Appendix, Table 3-40, p A3 138-9
[24] National Research Council, 2001, From Scarcity to Visibility. Gender Differences in the Careers of Doctoral Scientist and Engineers, Washington DC.

Box 3.5

Ask any working mother, and chances are, she will say that having to juggle a family and a job is incredibly taxing. Employers are beginning to do their bit, but some are changing more quickly than others. A survey published by *Human Resources* magazine shows that while more than 70% of public sector organisations have formal flexible working policies, less than 25% of private sector organisations do. This figure drops to 14% for FTSE 250 firms.

Source: Maria Scott, *The Observer,* 18 November 2001

Working conditions and trends for female researchers in industry in EU Member States

Based on the European Labour Force Survey (LFS) in 2002 a first analysis has been undertaken to analyse working conditions and situation of female researchers in industry. Preliminary data show the following trends[25]:

- During the last years (1995-2000) in industry (Business Enterprise Sector – BES) employment of highly qualified female scientists and engineers increased faster than that of males.
- At the EU level, nearly 60% (in Spain, more than 80%) of all women scientists and engineers in industry/BES are under 34-years-old, they were significantly younger than their male colleagues and tended to be younger than other female employees (non-researchers) in the same sector.
- Women scientists and engineers are more likely to have a temporary contract than their male colleagues (this is even more pronounced in the public sector). However, there are significant country differences: far more women scientists and engineers have temporary contracts in industry/BES in Belgium, Italy, Luxembourg and Portugal than in other EU countries.
- A higher proportion of female than of male scientists and engineers in industry/BES is employed in small and medium-sized enterprises (SMEs).
- In all EU countries the proportion of women scientists working part-time is clearly smaller than of other female part-time employees in the same sector. Only every sixth female scientist or engineer is working part-time in the business enterprise sector. Country differences are significant: while nearly half of all women scientists and engineers in the Netherlands work part-time, only 4% do so in Denmark.
- Scientists and engineers are four times more likely to work from home than other employees, especially male scientists and engineers. While 12% of women scientists and engineers in enterprises usually or sometimes work from home, the percentage for men is 18%. Again there are distinct country differences. Nearly 50% of all female scientists and engineers in Denmark usually or sometimes work from home , while in Spain and France working from home is almost non-existent.
- In the EU, relatively fewer women (28%), who work as scientists in industry/BES, have one or more children as compared to female non-researchers working in the same sector (34%).

The impact of family

The fact that female researchers tend to be younger probably partly explains the fact that fewer women researchers in industry have children compared with other female employees. Many studies have, however, also shown that highly educated women tend to postpone maternity as the opportunity cost of staying at home to raise children is higher for highly educated women[26]. If women scientists decide to combine a career with children, they are very dependent on childcare infrastructures, whether formal or informal. These infrastructures still vary enormously across Europe, with respect to their availability, flexibility, quality, and cost. An actual analysis on "Women and men

[25] See footnote 3 (Meulders et al: in press) The main sources are the R&D Survey, the European Labour Force Survey (ELFS), and the Structure of Earnings Survey (SES).

[26] This depends in part on the national arrangements for maternity leave, for example, length of leave, whether it is paid or not and whether the woman is eligible for promotion while on leave. In both Norway and Sweden there are examples of women being promoted while on maternity leave or while working part-time.

reconciling work and family life" points out that in more than two thirds (up to 94%) of the households in the EU with children, where the mothers have a university degree, both partners are working[27]. The lack of available childcare provision might explain why some women, especially highly educated ones, decide not to have children (see Gornick et al, 1997; Gustafsson and Meulders, 2000; Gustafsson, 2002).

In Denmark, public childcare is provided for 55% of all children younger than three years, in France childcare facilities are available for 41%, in Finland and Sweden for 34%; on the other side of the spectre, in Germany, UK, Austria, Italy, Spain, and Greece childcare is only available for less than 10% of children younger than three years[28]. Obviously the lack of child care provisions as well as not harmonised regulations for maternity/paternity leave and for elder care in the EU affects career development and mobility of women considerably and puts them at a disadvantage[29]. On the one hand, the decision of a number of highly educated women not to have children because of these circumstances, which is cited above, can clearly not remain an answer to this problem either.

Box 3.6

Childcare: British parents spend more on childcare than anyone else in Europe, because most is provided privately. The cheapest form of childcare – child minders – typically charge £20 per day, or £100 per week, but most will look after children only until 6pm. Lokewise nurseries, which charge about £200 per week, usually close their doors promptly at 6pm. This leaves anyone who works slightly irregular hours facing the cost of a nanny – anything up to £300 per week plus tax and national insurance.

Source: Maria Scott, *The Observer,* 18 November 2001

Box 3.7

Guilt: Many mothers returning to work face considerable emotional costs. Every week some or other claims that children of working mothers do less well at A-levels, or have to eat substandard food because their mothers are too tired to cook. A study last week even claimed that men with working spouses were sadder.

Source: Maria Scott, *The Observer,* 18 November 2001

Career development

International studies on women's careers in industrial research in Europe are not available yet. Based on firm level data members of the expert group and other companies reported in autumn 2002 to the Women and Science Unit of DG Research[30], it can be concluded that more women researchers have been recruited within the last years. But only very few women are occupying leading positions. Exceptions tend to be the few companies with a woman CEO.

There is a high diversity of career paths and patterns, but at all stages of the scientific career, science and research is loosing out on the potential of talented women who are frequently forced out of their professional career by unfavourable circumstances. Frequently women are forced to choose between family and a professional career. Whatever their personal decision is, it always leads to a loss: there are either fewer children or a lack of professional talent[31]. As often, the employer, the firm, will make the choice on the traditional perception of limited performance capabilities of "mothers", instead of the woman herself.

[27] Ana Franco and Karin Winqvist, 2002, Women and men reconciling work and family life, Statistics in focus, Theme 3 – 9/2002.
[28] Council of the European Union, 2000 (12577/00), Review of the implementation by Member States of the European Union an the European institutions of the Beijing Platform for Action: relationship between family life and working life (23 October 2000).
[29] See above.
[30] In order to collect firm level data, a short questionnaire was developed and sent out by members of the expert group and professional organisations. It was also available on the WIR website. Until November 2002 we received first data mainly from international companies, three from German companies, three from French companies, two from companies based in UK, two in Spain, two in Netherlands, one in Belgium and two private research institutions in Denmark and Germany.
[31] The phenomenon of the leaky pipeline has been described above (Osborn et al, 2000).

A German study of physicists

A German study on women and men in physics[32] analysed the career development of women physicists. Some 11% of all women physicists worked as researchers in industry, another 15% were also employed by industry, but worked in other departments. While quite a high number of men aged 36-45 years tend to leave public sector research for a career in industry, women change sectors less frequently. Only 5% of women physicists in this age group are researchers in industry, compared to 14% of men. Women are clearly under-represented in leading positions, and more frequently do not continue their careers in research (43% of women versus 23% of men).

Wage differences

For the US, salary differences for female and male scientists and engineers are analysed in the Science and Engineering Indicators 2002(NSB, 2002). The gender pay gap (without controlling for years since graduating, effects of family and other personal characteristics as well as other factors) is highest for those with Bachelors degrees: women earn 35% less. However, for people with PhDs, the difference still amounts to 26%. The study concludes that 'Marriage is associated with higher salaries for both men and women, but

Conclusions

- These are preliminary results – but they indicate the large, widely untapped potential of women.
- Research is loosing out on a high potential of highly qualified people.
- Indicators and benchmarking are needed for stimulating and monitoring progress and for comparing the effects of national and industrial policies.
- Better sex-disaggregated data and studies are needed.
- There are significant differences in the employment of women in industrial research between countries, sectors, and disciplines.
- There is an urgent need to harmonise supporting structures across Europe to allow for better mobility for working parents.
- In addition, in order to meet the challenges of the future more girls have to be attracted to science in order to widen the recruitment base (EURAB http://europa.eu.int/comm/research/eurab/index_en.html).
- The needs of (job-)"returners" have to be addressed.

Box 3.8

Median annual salaries of employed scientists and engineers, by broad occupation and sex in the US (1999)

Source: NSB, Sciences and Engineering Indicators (2002)