Meta-analysis of gender and science research

RTD–PP–L4–2007–1

Project methodology

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1. Introduction

The purpose of the "Meta-analysis of gender and science research" study is to collect and analyse gender and science research on the following topics:

- Horizontal segregation in research careers: this topic covers the issue of choice of scientific subjects by girls and occupational choices by women, the perception and attractiveness of science, engineering and technology, the causes underlying these choices (e.g. stereotypes, influence of family and role models, etc.), the causes of success and failure at university level, etc.
- Vertical segregation in research careers: this topic covers the barriers for women to reach top scientific positions ("glass ceiling" or "sticky floor"), mentoring/tutoring initiatives, etc.
- The underlying causes and effects of these two aspects, including work-life balance issues, pay gap, mobility-related obstacles, dual careers, evidence of discrimination, working culture, stereotypes, gender in research contents, etc.

The objectives of the study are to:

- Provide an exhaustive overview and analysis of all research carried out on gender and science at European, national and regional levels.
- Make the study results accessible to researchers and policy-makers via publishable reports and an informed bibliography available in a database (the GSD).
- Steer policy-making on gender and science in the years to come and define future research priorities within the Seventh Framework Programme, in particular through good practice examples and gap analysis in the various research topics.

For the purposes of the study, science is understood in its broadest meaning, including social sciences and humanities.

The study covers the 27 EU Member States as well as the Associated States to the Seventh Framework Programme (Norway, Iceland, Israel, Switzerland, Turkey, and Croatia). The research produced in all European languages, from 1980 to 2008, will be revised.

2. Conceptual approach

The purpose of the study is to collect and analyse research on horizontal and vertical gender segregation in research careers, addressing the underlying causes and effects of these two aspects.

The under-representation of women in science, and more specifically in natural sciences and engineering, is attracting growing interest in the last decade. In 1999, the European Technology Assessment Network (ETAN) Expert Working Group on Women and Science was set to identify the challenges to women's participation in European science and technological development. This led to the publication and wide dissemination of what became known as the "ETAN Report" (Osborn *et al.*, 2000). The core message was that women did not want to be treated as a special case: the concern was that excellence of science in Europe was being compromised by patronage, institutional discrimination and old-fashioned approaches to human resource management.

There are two great classic theoretical frameworks which aim at explaining the low presence of women in science, especially in senior positions. The first theoretical framework, very present in the economic analysis of the labour market, is based on the different types of human capital men and women have. This approach, rather than explaining the inequalities between men and women, analyses the difference between the sexes in their personal choices, especially as regards their professional lives, maternity and paternity. The unequal careers of women and men would be the result of their unequal investment on human capital. In its extreme version, it is stated that women make the rational choice of investing less in human capital than men, because women are aware that in the future they will have domestic responsibilities and will be less involved in professional activities than men (Shultz, 1961; Mincer and Polacheck, 1975; Becker, 1985).

The second theoretical framework, which dominates the academic literature of gender, work and science, is based on the unequal results of the professional careers of men and women being the fruit of the unequal treatment of men and women in the context of scientific work. Unequal treatment may affect the process of selection, the relationship with mentors and counselling, the process of promotion, the system of evaluation, the distribution of resources or the type and volume of workload (Wenneras and Wold, 1997). Authors like Knight and Richards (2003) or Probert (2005) propose a broader conceptualisation based on the systematic domination of everything related with what is traditionally considered as 'masculine' compared to the marginalisation of everything considered 'feminine'. This type of approach affects both the construction of a scientific discipline as well as the very organisation of scientific work itself, and casts doubt on concepts such as 'equal opportunities' or 'meritocracy'.

The scientific debate on the under-representation of women in science focus on two main points: on the one hand, the contributions around the "critical mass"; on the other hand, the analysis of the gender bias in the scientific community, its culture, structures and practices.

The metaphor of the "leaky pipeline" points to the decreasing proportion of women rising up in the educational/professional hierarchy. There are leaks at each moment of transition from one educational/professional stage to another: the higher the stage, the more restrictive the mechanisms for entry. The theory of the critical mass is based on the premise that a sufficient number of people, even when in the minority, can lead to a qualitative change in conditions and relations and can accelerate the dynamics of change. Positive measures for action are based on the premise that a sufficient number of women is a requirement for other women to join. However, a number of contributions consider that it is not enough. As Etzkowitz *et al.* (2000) point out, the critical mass is only a prerequisite, working slowly and giving women more support and security, but not a strategy of change in and of itself. According to Schiebinger (1999) the pipeline model fails because it is built on the uncritical assumption that women and minorities should assimilate the current practices of science, instead of providing insight into how the structure of institutions or the current practices of science need to change before women can comfortably join the rank of scientists. Kulis *et al*. (2002) analyse supply and demand explanations for gender gaps in science and show that under-representation of women among senior scientists is "more than a pipeline problem": after a comprehensive analysis of statistical data (for US), they conclude that gender composition of the science faculty is not simply a function of gender gaps in doctoral production. Women enjoy enhanced odds of holding faculty positions in the biological and health sciences, compared with most other science fields, and relatively poor odds in engineering, physics/astronomy, earth/environmental sciences and agriculture. On the other hand, the study shows that when the presence of women increases in an academic field, its prestige starts to decrease. The inverse relationship between the presence of women and the level of prestige is illustrated by the average level of salaries in each scientific field.

Empirical evidence points out the existence of gender bias in science. Gender bias is the often unintentional and implicit differentiation between men and women situating one sex in a hierarchical position to the other. Gender bias in the scientific system may impact on the selection, hiring and promotion procedures, on the distribution of resources or on the assessment of scientific excellence. Gender bias is prohibited, but still exists, though it adopts more subtle forms than in the past (Osborn *et al.*, 2000; Addis, 2004). For instance, in 1999, the Massachusetts Institute of Technology (MIT) admitted to having given the 15 female tenured professors in the School of Science less space, resources and salaries than their 197 male counterparts. In the next four years, women's salaries were raised to equal men's by an average of 20%, several women were promoted to the high-level scientific committees and it was ensured that women were awarded similar money and space to conduct research to that of men (MIT, 2002). Even the peer-review system is not as neutral, objective and fair as it is claimed to be. In the first-ever analysis of peer-review scores for postdoctoral fellowship applications in Sweden, it was found that female applicants had to be 2.5 times more productive than the average male applicant to receive the same score (Wennerås and Wold, 1997).

Many studies have pointed out the importance of studying scientific careers over time, since it is the cumulative effect of several positive and negative effects that shape scientific careers. Xie and Shauman (2003) propose a more complex and comprehensive theoretical approach than that implicit in the "leaky pipeline" model, focusing on the life course perspective. The authors point out three main limitations of the pipeline model: 1) the pipeline model is implicitly referred to an unidirectional, orderly and rigid series of stages, and does not capture the complexity of the educational and career processes of becoming a scientist; 2) in the pipeline model the successful completion of all stages within and ideal time schedule means a positive outcome and this model has precluded the consideration of alternative educational and career trajectories or gender differences in career path and; 3) the pipeline model does not situate the science career in the context of other life course events and it implicitly assumes that the pipeline is independent of other life domains, such as family expectations and the demands of familial roles. The life course perspective allows for a more multidimensional and nuanced understanding of career processes and outcomes. It posits that the significant events and transitions in an individual's life are age-dependent, interrelated and contingent on (but not determined by) earlier experiences and societal factors (Xie and Shauman, 2003). A key strength of the life course perspective is the recognition of the multidimensionality of individual lives and the recognition of the influence of events in one domain to other domains, through their effects on one's available time, interest, energy and material resources. This perspective raises new research questions and opens new lines of research in order to analyse how certain configurations of factors lead some individuals, but not others, to believe that the scientist role is desirable and attainable, to maintain and act on that belief through an extended period of the life course and why this sorting of individuals into science and non-science pools so neatly divides along gender lines.

The analysis of research on gender and science is based on two parallel and complementary lines: a thematic line (topics) and a territorial line (country-groups). The rationale behind the structure of topics and country-groups is presented below.

2.1. Structure of topics

The structure of topics will be organised along the following dimensions:

- A first descriptive dimension, which includes three topics:
  - Horizontal gender segregation – it refers to concentration rates of women and men in certain disciplines or institutional sectors.
  - Vertical gender segregation – it refers to the unequal position of women and men within the scientific hierarchy.
  - Pay and funding – it refers to the unequal pay and unequal access to research funding of women and men in science.
- A second dimension dealing with the analysis of the gender bias in structural social dynamics that are reproduced in the scientific work. It includes two topics:
  - Stereotypes and identity – it refers to the gender biased construction of cognitive abilities and identity with regard to science.
  - Science as a labour activity – it refers to gender bias in work organization, working conditions, working time uses and work-life balance issues.
- A third dimension, dealing with issues related directly with the gender bias in the scientific culture and scientific institutional practices, i.e. in the scientific research as an activity with its owns values, rules and dynamics. It includes two topics:
  - Scientific excellence – it refers to the gender bias in the definition, measurement and evaluation of scientific excellence.
  - Gender in research content – it refers to the gender biased construction of the scientific knowledge.
- A fourth and last contextual dimension, dealing with policies towards gender equality in research. It includes description, comparison and evaluation of policies.

Table 1 shows the conceptual organisation of the topics.

Table 1. Structure of topics

<table>
<tr><th colspan="3">TOPICS</th><th colspan="2">DIMENSIONS</th></tr>
<tr><td rowspan="6">Policies towards gender equality in research</td><td>Horizontal segregation</td><td>Vertical segregation</td><td colspan="2" rowspan="2">Descriptive</td></tr>
<tr><td colspan="2">Pay and funding</td></tr>
<tr><td colspan="2">Stereotypes and identity</td><td rowspan="2">Structural social dynamics</td><td rowspan="4">Causes and effects</td></tr>
<tr><td colspan="2">Science as a labour activity</td></tr>
<tr><td colspan="2">Scientific excellence</td><td rowspan="2">Scientific and institutional culture</td></tr>
<tr><td colspan="2">Gender in research content</td></tr>
</table>

2.2. Structure of country-groups

The rationale behind the territorial division is the welfare regime (Esping-Andersen, 1999, 2002; Blossfield and Drobnič, 2001). Common trends in the division of work between women and men may be counter-balanced or enhanced by broader structural, political and ideological country-specific packages. The employment structure and its gender-specific occupational patterns shape opportunities and constraints in the labour market and in this way influence the choices couples make. There are large cross-national differences in the extent of women's employment attachment over the life-course, full-time and part-time work, gender occupational segregation and gender pay gap, at least partially interrelated with welfare regimes. Accordingly, countries are clustered into five groups: Nordic countries, Anglo-Saxon countries, Continental countries, Southern countries and Eastern countries (see table 2). This territorial division provides practical advantages, in terms of nearness of countries, similarity of languages, etc. However, for analytical purposes, cross-national analysis should also take into account other strands of the literature: namely, comparative research on gender regimes (Walby, 1990, 1994, 1997) and comparative research about the education system and the scientific system (Feller, 2004; Gupta et al., 2004).

Table 2. Structure of country-groups

COUNTRY-GROUPS	COUNTRIES
Nordic countries	Iceland Sweden Finland Denmark Norway
Anglo-Saxon countries	United Kingdom Ireland
Continental countries	Belgium Netherlands Luxembourg France Germany Austria Switzerland
Southern countries	Italy Spain Portugal Greece Malta Cyprus Turkey Israel
Eastern countries	Hungary Poland Slovakia Czech Republic Latvia Lithuania Estonia Croatia Slovenia Bulgaria Romania

3. Literature review

3.1. Horizontal segregation

The under-representation of women in science and more specifically in natural sciences and engineering has been attracting growing concern over the past decade. The rising proportion of women in higher education and highly skilled employment has been one of the major structural changes affecting labour markets and society, but this phenomenon has not yet been translated into the substantial participation of women in traditionally male-dominated scientific and professional fields such as physics and engineering. Important gender imbalances can still be found in the educational and professional spheres. Women remain seriously under-represented in the most prestigious scientific fields.

Several recent reports confirm the persistence of horizontal gender segregation in university studies (among others, see the *She Figures* reports, i.e EC, 2003b and EC, 2006). The educational patterns of women and men differ and some fields of study are still overwhelmingly male-dominated. Table 3 and 4 indicate the proportion of female graduates on ISCED level 5A (bachelor and master graduates) and 6 (Ph.D), according with the most updated figures from Eurostat. For EU-27, women account for 59% of bachelor and master graduates, but the proportion of female graduates differ greatly depending on the field of study. It ranges from 77% in education science to 27% in engineering, manufacturing and construction. With regard to doctoral graduates, patterns are similar although the figures tend to be substantially lower: 43% of female Ph.D, with a maximum of 61% in education science and a minimum of 24% in engineering, manufacturing and construction. Among EU-27 countries Cyprus and Latvia have the highest proportion of women in both levels in total. Figure 1 compares the EU-27 data in Table 3 and 4, illustrating the first dropout rates of women in the separate fields. In total the proportion of women is 15 p.p lower among graduates on ISCED 6 than on ISCED 5A. This gap is the biggest in health and welfare (21 p.p) and in humanities and social sciences (17 p.p), while the smallest in agriculture and veterinary sciences (1 p.p), followed by engineering, manufacturing and construction and science, mathematics and computing (3 p.p). This means that the proportion of female graduates who do not continue their education on ISCED 6 is the highest in those fields where their participation is the highest on ISCED 5A.

Significant patterns of horizontal segregation are also found with regard the participation of women in science by scientific field and institutional sector (EC, 2003b; EC, 2006). Table 5 shows the most recent data on women's presence among researchers by institutional sector. Scientific research is carried out in a wide range of institutions and therefore it is relevant to take into account the differences between different kind of institutions, especially between academic and industrial research. The proportion of women among researchers in the EU-25 is 28% in total, but varies significantly by sector. Although the industrial sector is playing an increasingly important role in R&D, women are still much more under-represented in industry than in public or private non-profit research (EC, 2003a; Meulders *et al.*, 2003). Women constitute only 18% of researchers in the industrial sector, being around 35% in the other sectors (34% in the higher education sector, 36% in the government sector, and 39% in the private non-profit sector, although data is quite incomplete by country in the latter).

With regard to scientific fields, the last *She Figures* report (EC, 2006) provides data on women's presence among researchers in the higher education and the government sector for those countries in which data are available. In engineering, only 21-22% of researchers are women, although this is not surprising given the relatively small proportion of women who study engineering at the university. In contrast, women account for only 40% of researchers in medicine, whilst more than 60% of life science graduates are women.

The data on women researchers in the business sector tell us that women are under-represented in this sector, but not in which industries and scientific fields they are working. The only data on field of employment in the business sector comes from the *She Figures* report (EC, 2006). In most of the countries for which there is coverage, there are higher proportions of women researchers in companies whose main economic activity is manufacturing and business activities. Within manufacturing, the underlying data reveal that the main sector of employment for women researchers is in pharmaceuticals. This is consistent with the high share of women graduates in life sciences in many countries.

It is important to stress that there are significant gaps in the availability of adequate data concerning the participation of women and men in science by scientific fields and institutional sectors. The collection of sex-disaggregated data, even at the most aggregated level of institutional sectors, has only recently started in most countries (Meulders *et al.*, 2003). Furthermore, the breakdown by scientific fields is incomplete, not comparable among countries or directly not available, especially in the industrial sector (EC, 2006). Statistics are also incomplete with regard the collection of sex-disaggregated data of university students and graduates by disaggregated field of study, an area in which there is also a lack of cross-time data. The study should pay special attention to collecting long-term statistics and gender indicators on these issues.

Table 3.

PERCENTAGE OF FEMALE 5A GRADUATES BY FIELD OF EDUCATION, 2004

Country	Teacher training and education science	Humanities and arts	Social sciences, business and law	Science, mathematics and computing	Engineering, manufacturing and construction	Agriculture and veterinary	Health and Welfare	Services	Total
Albania	86.9	77.3	66.2	75.2	29.8	47.1	65.8	38.2	71.8
Austria	76.4	62.5	54.6	35.8	18.9	59.0	60.7	53.1	50.7
Belgium	72.0	64.0	55.2	38.7	23.3	49.0	59.9	50.6	52.7
Bulgaria	73.3	64.7	61.7	56.4	37.9	43.0	64.0	46.1	57.7
Croatia	85.5	74.7	68.0	53.5	31.0	45.8	71.1	32.6	59.2
Cyprus	79.8	90.4	74.3	61.7					76.6
Czech Republic	76.8	64.5	60.9	40.6	24.1	56.4	73.9	32.3	57.4
Denmark	73.9	67.7	51.8	38.3	26.3	59.0	83.6	24.4	62.0
Estonia	91.7	81.1	67.6	54.4	34.3	62.5	88.5	76.4	69.6
Finland	84.3	76.2	70.2	49.3	21.7	48.2	87.3	75.4	63.2
France	71.1	75.2	61.4	43.8	25.6	56.5	62.1	45.5	56.9
Germany	71.9	69.2	47.7	36.8	23.0	53.1	66.3	62.4	49.9
Greece	75.7	79.1	60.5	42.7	45.0	52.6	62.2	67.7	61.9
Hungary	78.6	71.3	67.0	36.7	24.3	46.3	79.9	44.3	65.2
Iceland	88.5	69.7	59.7	43.0	29.7	52.4	84.7	78.8	67.2
Ireland	80.8	65.9	59.6	41.2	25.0	44.8	82.6	49.5	59.4
Italy	85.1	77.0	57.2	53.6	28.6	43.5	66.3	40.6	58.1
Japan	60.6	69.1	32.9	26.1	10.8	41.2	60.0	94.5	39.4
Latvia	89.6	83.4	70.1	40.2	30.9	47.3	84.6	57.6	70.1
Liechtenstein		12.5	25.0		50.0				25.0
Lithuania	81.9	77.5	64.7	46.0	34.6	55.8	77.3	55.0	63.6
Macedonia	80.2	70.9	66.9	67.8	35.5	40.2	70.7	53.8	64.2
Malta	76.7	63.4	52.8	29.5	33.0	20.0	61.3	44.4	57.2
Netherlands	79.2	59.8	50.9	23.0	15.4	49.6	77.7	54.3	56.6
Norway	75.2	59.7	53.7	26.2	22.6	50.7	84.4	42.1	61.0
Poland	75.9	76.1	69.6	40.7	27.7	58.8	75.7	56.6	64.8
Portugal	85.1	71.5	64.8	54.2	36.0	62.0	80.1	60.2	68.2
Romania	45.3	68.1	62.5	60.9	33.2	41.1	64.6	52.1	57.4
Slovakia	73.8	56.4	60.2	41.0	31.5	42.8	76.9	34.9	55.3
Slovenia	81.7	73.2	64.6	45.0	27.0	57.0	66.0	82.5	63.1
Spain	79.2	66.3	61.4	44.0	30.9	46.5	79.2	61.7	60.0
Sweden	80.0	66.4	59.6	51.6	29.3	55.9	85.4	59.2	63.7
Switzerland	72.7	61.8	41.2	27.3	15.3	42.2	65.2	39.9	43.8
Turkey	51.8	56.1	44.2	46.5	24.2	32.5	60.3	29.5	46.3
United Kingdom	72.9	64.1	56.3	38.0	20.7	61.8	75.5	69.0	55.8
United States	77.4	60.3	55.5	43.2	22.3	49.5	75.7	56.3	57.5
EU25	*76.9*	*70.6*	*60.6*	*41.7*	*26.1*	*52.0*	*74.1*	*53.3*	*58.7*
EU27	*76.8*	*70.4*	*60.8*	*42.3*	*26.8*	*51.2*	*73.4*	*53.0*	*58.7*

Exceptions to year of reference: Albania, Finland, France and Malta; 2003

Source: Education Database; Eurostat

Table 4.

PERCENTAGE OF FEMALE 6 GRADUATES BY FIELD OF EDUCATION, 2004

Country	Teacher training and education science	Humanities and arts	Social sciences, business and law	Science, mathematics and computing	Engineering, manufacturing and construction	Agriculture and veterinary	Health and Welfare	Services	Total
Albania									
Austria	58.5	52.7	41.9	35.1	18.6	55.7	63.2	25.0	40.5
Belgium	46.4	36.6	43.6	28.9	20.2	37.3	39.1	46.2	33.9
Bulgaria	52.6	67.1	42.9	55.8	39.2	63.6	50.0	25.0	50.8
Croatia	37.5	50.0	55.6	41.4	23.9	56.7	47.0	66.7	42.0
Cyprus	100.0	0.0	0.0	83.3					61.5
Czech Republic	73.0	41.6	46.2	34.9	21.2	33.9	36.2	44.9	35.6
Denmark		50.0	39.1	26.0	27.9	56.2	46.0		35.9
Estonia	100.0	60.7	61.5	44.0	37.5	20.0	80.5	0.0	62.2
Finland	66.7	57.9	51.6	43.1	25.5	41.7	64.3	52.0	48.7
France	49.0	55.5	41.4	38.4	25.9	55.6	56.1	41.7	41.7
Germany	50.8	48.8	35.0	29.5	11.8	58.8	50.0	44.0	39.0
Greece	51.9	51.0	52.1	32.3	21.0	43.6	65.4	28.6	38.1
Hungary	66.1	50.0	45.7	32.7	33.3	30.3	39.9		42.9
Iceland		100.0	100.0	50.0			25.0		50.0
Ireland	50.0	47.9	53.1	45.3	28.7	47.6	55.0		45.3
Italy	72.5	58.5	50.4	54.0	31.2	54.4	61.5	33.3	50.9
Japan	46.6	48.0	32.5	19.7	10.1	25.2	26.3	77.8	24.8
Latvia	100.0	50.0	57.9	53.3	38.5	100.0	52.9		58.3
Liechtenstein		11.1							11.1
Lithuania		77.6	59.4	61.4	33.9	54.5	60.0		57.5
Macedonia	0.0	0.0	46.7	55.6	29.4		73.7	33.3	47.8
Malta		0.0				50.0	0.0		20.0
Netherlands		42.7	40.9	37.7	23.4	39.0	48.6		39.4
Norway	63.6	37.8	46.8		50.0	53.7	46.2	28.6	45.9
Poland		54.9	48.2	52.9	24.1	48.7	51.5	36.0	46.9
Portugal	72.0	63.6	52.4	51.5	35.6	58.8	63.9	51.6	54.6
Romania		67.8	51.7	45.7	28.7	0.0	56.3		49.3
Slovakia	68.1	46.7	50.7	46.3	29.7	35.7	48.5	29.7	45.0
Slovenia	50.0	57.5	39.0	40.9	25.6	50.0	53.8	50.0	40.6
Spain	57.5	48.8	49.0	48.9	27.9	44.1	51.8	35.9	47.8
Sweden	78.6	54.5	41.5	39.1	25.9	47.2	58.3	42.9	42.5
Switzerland	51.6	39.8	32.5	32.7	20.4	57.9	44.1	42.6	36.9
Turkey	39.1	30.5	32.5	37.8	34.9	37.5	55.8	30.4	38.0
United Kingdom	60.4	49.3	50.7	37.9	21.2	47.2	54.5	56.0	43.1
United States	66.1	47.2	48.0	40.7	18.5	34.2	71.1	56.9	47.7
EU25	*61.5*	*52.1*	*44.7*	*39.0*	*23.2*	*50.0*	*52.3*	*44.2*	*43.3*
EU27	*61.4*	*52.8*	*45.0*	*39.1*	*23.6*	*50.0*	*52.4*	*43.8*	*43.5*

Exceptions to year of reference: Albania, Finland, France and Malta; 2003

Source: Education Database; Eurostat

Figure 1. Proportion of women among ISCED graduates, EU-27, 2004

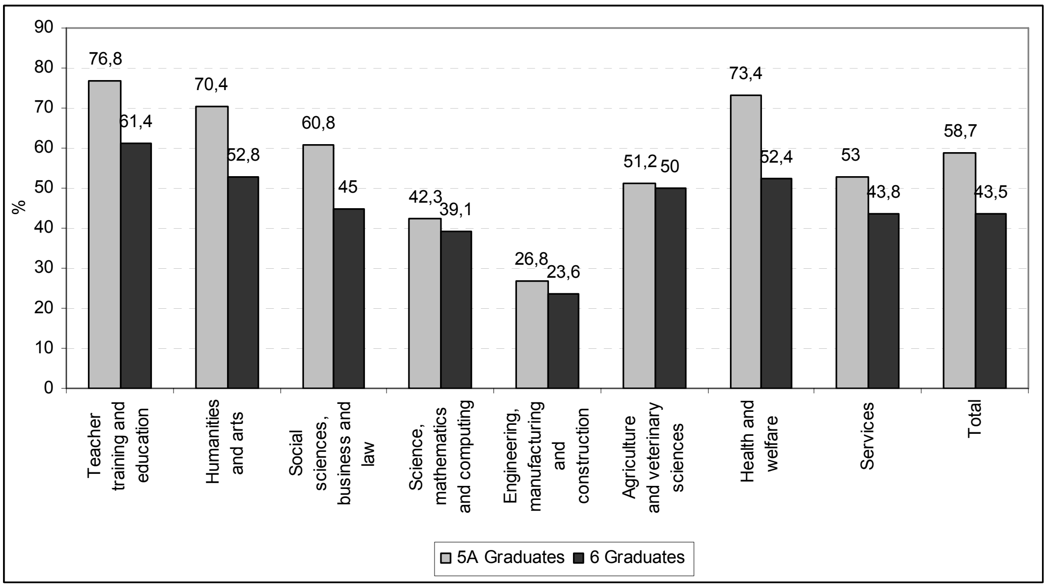


Table 5.

PERCENTAGE OF FEMALE RESEARCHERS BY INSTITUTIONAL SECTOR, 2004

Country	Business Enterprise Sector	Government sector	Higher Education Sector	Private Non-Profit sector	Total
Austria	12.6	36.2	32.8	46.3	23.6
Belgium	19.9	30.1	35.3	41.5	28.1
Bulgaria	45.1	50.8	38.1	34.2	46.2
Croatia	38.9	42.0	40.9		41.1
Cyprus	22.6	41.5	32.9	29.6	32.1
Czech Republic	19.6	35.0	32.4	22.6	28.5
Denmark	24.5	35.5	33.5	28.8	28.1
Estonia	23.9	58.3	44.9	53.7	42.5
Finland	17.0	40.2	42.9	52.6	29.0
France	20.7	32.7	33.9	38.7	27.8
Germany	11.6	28.5	25.0		19.2
Greece	36.1	38.9	36.9	53.2	37.1
Hungary	23.8	38.6	36.3		34.5
Iceland	33.0	42.1	43.1	48.9	39.4
Ireland	20.3	31.0	37.3		30.0
Italy	19.5	40.4	31.3	47.5	29.9
Japan	6.6	11.7	20.4	10.7	11.6
Latvia	50.5	53.2	53.1	40.0	52.8
Lithuania	33.3	51.0	49.2		48.6
Luxembourg	14.2	28.5	42.9		17.4
Malta	19.5	50.0	24.1		23.6
Netherlands	8.7	29.2	28.9		17.2
Norway	20.0	35.6	37.6		29.4
Poland	25.1	41.1	40.5	47.5	38.9
Portugal	29.7	57.9	45.9	42.2	44.3
Romania	41.5	49.1	39.6	60.5	42.7
Russia	41.8	45.8	38.9	53.6	42.9
Slovakia	32.3	42.6	42.6	18.9	41.2
Slovenia	24.9	41.1	34.1	15.6	32.5
Spain	26.5	45.5	37.5	55.1	36.1
Sweden	25.2	36.4	43.7		74.7
Switzerland	21.1	25.5	29.6		26.7
Turkey	25.0	27.5	37.0		35.6
United Kingdom		32.9			
EU25	*18.0*	*36.0*	*34.0*	*39.0*	*28.0*

Exceptions to year of reference: Belgium (GOV, HES, PNP, Total), Germany (BES, HES, Total), Denmark (BES, Total), Greece, Iceland, Japan, Luxembourg, Netherlands (BES, HES, Total), Norway (GOV, HES, Total), Portugal and Sweden; 2003. Latvia (PNP) and Turkey; 2002

Source: R&D Survey; Eurostat

3.2. Vertical segregation

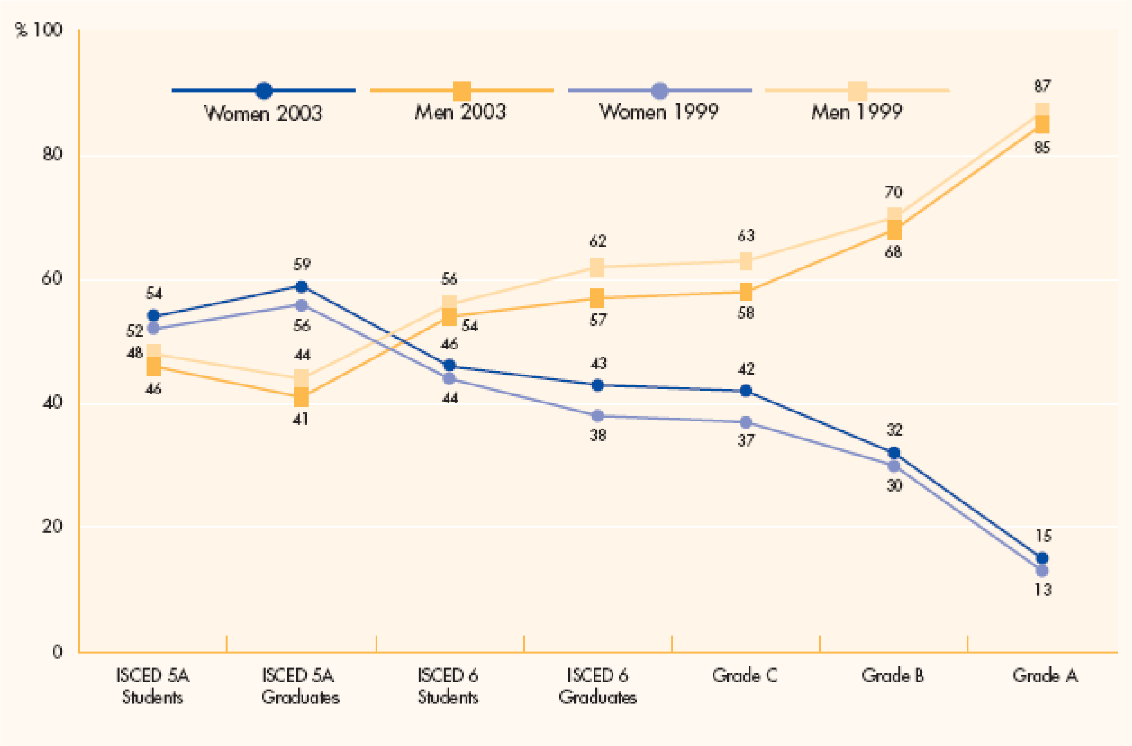
The existence of a "glass ceiling" or "sticky floor" for women trying to progress to senior positions is well documented and affects all occupational sectors, even those that are dominated by women. The absence of women in leadership positions is more acute in science and technology occupations than in other fields (Osborn *et al*., 2000; EC, 2006; OECD, 2006).

The collection of cross-national, harmonised data on seniority of researchers started with the higher education sector, and has also been piloted for the government sector; however, very few countries are able to provide data for the latter. Academia seems to have quite similar hierarchical structures across countries, but this is not the case for governmental research institutions that have more heterogeneous personnel structures (OECD, 2006). With regard to the industrial sector, data on seniority are difficult to collect, even at the national level and for specific scientific and professional fields (Meulders et al., 2003).

The empirical evidence shows that women fall off the academic hierarchy in disproportionate numbers at every rung of the ladder. Structural barriers systematically appear to exclude women from developing their careers in academia. Although the statistical base is not developed and empirical evidence is quite fragmented, similar patterns of frustrated careers appear to characterise government and industrial research (Osborn *et al*., 2000).

The "scissor diagram" (Figure 2) illustrates the evolution of the gender gap throughout the stages of an academic career, beginning with enrolment at the basic level of higher education (bachelor and master graduates, ISCED 5A) through to the highest academic position (academic staff grade A, equivalent to a full professor). In 2003, women account for 59% of bachelor and master graduates but only 15% of full professors and these figures have only slightly increased in the last four years. As shown in Table 6, the proportion of female professors, although always low, varies greatly across countries: it is above 20% in Romania, Turkey, Finland and Portugal, whilst it is below 10% in Austria, the Netherlands, Germany, Belgium and Malta.

Figure 2. Relative share of women and men in typical academic career EU-25, 1999 and 2003



Definition of academic staff grades: A: The single highest grade/post at which research is normally conducted; B: Researchers working in positions not as senior as top position (A) but more senior than newly qualified PhD holders; C: The first grade/post into which a newly qualified PhD (ISCED6) graduate would normally be recruited
Source: She Figures (EC, 2006): 55

Table 6.

PERCENTAGE OF FEMALE ACADEMIC STAFF BY GRADE, 2004

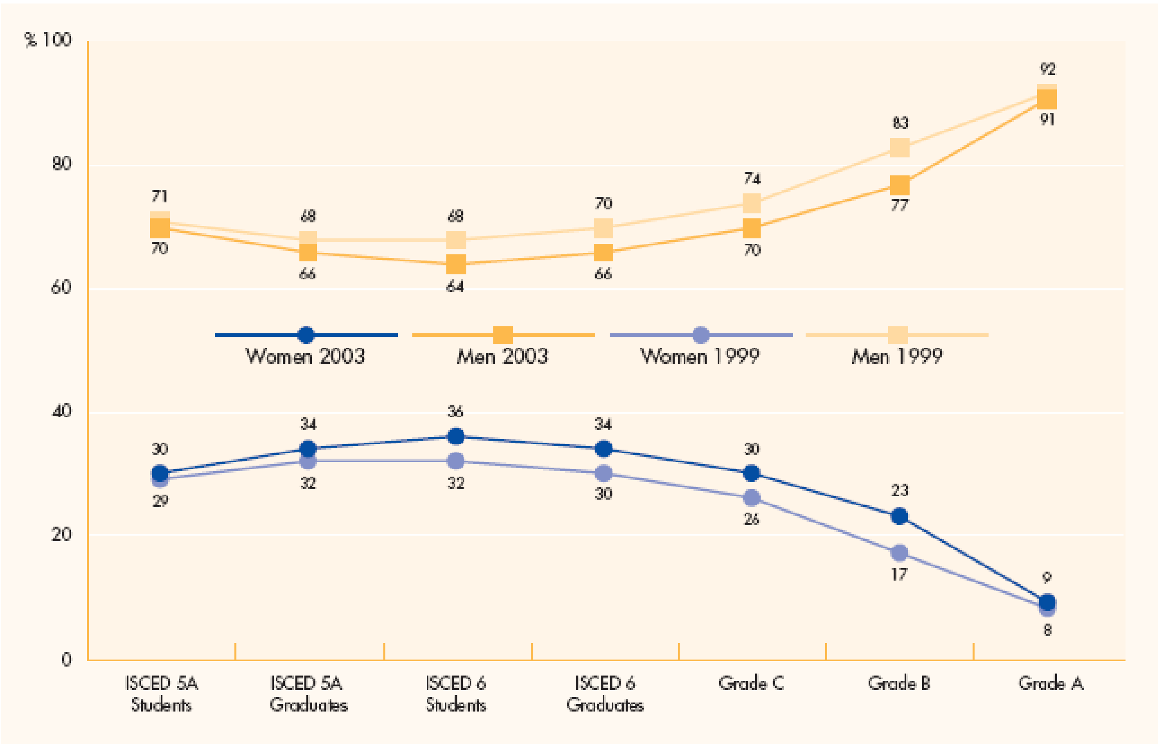
Country	Grade A	Grade B	Grade C	Grade D	Total
Austria	9.5	16.2	35.6	37.9	29.7
Belgium	9.0	20.7	33.1	46.6	32.7
Bulgaria	18.0	34.9		41.3	43.8
Cyprus	10.2	17.2	37.5	33.5	31.0
Czech Republic	10.3	22.1	40.2	48.8	34.0
Denmark	10.9	24.4	37.6	42.7	31.8
Estonia	17.2	37.1	56.6	66.6	49.2
Finland	21.2	46.6	52.9	42.8	40.9
France	16.1	38.7		39.3	32.9
Germany	9.2	16.1	25.9	35.6	29.2
Greece	11.3	22.7	31.9	39.4	29.0
Hungary	15.4	30.9	46.0	36.7	36.3
Iceland	15.1	29.9	53.0	41.6	33.8
Israel	10.6	21.6	33.6		24.6
Italy	16.4	31.4	43.8	59.9	31.2
Latvia	26.5	37.0	65.0	25.0	57.7
Lithuania	12.1	37.4	49.5	39.4	49.1
Malta	2.3	31.7	14.2	50.4	26.6
Netherlands	9.4	14.2	27.0	55.2	31.4
Norway	15.7	28.2	45.5		37.6
Poland	19.5	27.4	41.0	54.3	34.9
Portugal	20.9	34.4	43.4	47.9	41.8
Romania	29.1	49.1		50.6	42.9
Slovakia	13.5	31.5	48.5	50.0	41.1
Slovenia	12.9	25.8	39.3	46.1	31.4
Spain	17.6	36.1	52.2	52.4	42.1
Sweden	16.1	38.6	40.0	44.7	42.5
Switzerland	16.5	23.3	33.8		30.8
Turkey	25.5	27.4	40.5		35.7
United Kingdom	15.9	31.2	46.1	48.8	41.2
EU-25	*15.3*	*32.2*	*42.0*	*43.3*	*36.4*

Exceptions to the reference year: Turkey: 2000; France: 2001; Austria: 2002; Cyprus, Norway, Portugal: 2003
FTE instead of HC: Netherlands, Israel (2001)

Source: She Figures 2006

The picture is substantially different in the natural sciences and engineering, the scientific fields in which women are more seriously under-represented (see Figure 3). Women account for 34% of bachelor, master and PhD graduates, but only 9% of full professors. Despite the gains that women have made as students in natural sciences and engineering, they continue to lag behind men at the graduate level, in levels of professional participation and even more so at top level management positions in the scientific system. As shown in Table 7, the proportion of female professors is even lower in engineering (6%) than in natural sciences (11%). The countries in which the proportion of female professors in engineering is lowest are Malta, Cyprus and Denmark (0-1%), followed by the Netherlands, Austria and Germany (3%-4%) .

Figure 3. Relative share of women and men in typical academic career in natural sciences and engineering, EU-25, 1999 and 2003



SET fields of education = 400 Science, maths and computing + 500 Engineering, manufacturing and construction
SET fields of science = Engineering and Technology + Natural Sciences

Definition of academic staff grades: A: The single highest grade/post at which research is normally conducted; B: Researchers working in positions not as senior as top position (A) but more senior than newly qualified PhD holders; C: The first grade/post into which a newly qualified PhD (ISCED6) graduate would normally be recruited.

Source: She Figures (EC, 2006): 56

Table 7.

PERCENTAGE OF FEMALE ACADEMIC GRADE A STAFF BY FIELD OF SCIENCE, 2004

Country	Natural Sciences	Engineering and Technology	Medical Sciences	Agricultural Sciences	Social Sciences	Humanities
Austria	4.4	3.7	8.9	5.6	9.6	19.1
Belgium	7.7	4.2	8.3	3.6	11.5	13.0
Cyprus	18.8	0.0			11.1	0.0
Czech Republic	9.2	4.5	14.2	9.1	13.0	14.5
Denmark	6.9	1.4	14.9	16.2	13.2	15.2
Finland	11.3	6.3	21.6	16.0	28.6	35.1
France	12.3	6.5	15.3		17.0	30.1
Germany	5.6	3.8	5.8	8.9	8.0	16.3
Italy	15.9	6.1	11.1	11.8	17.1	29.4
Latvia	0.0		38.5		39.3	36.4
Malta	0.0	0.0	8.3	0.0	0.0	0.0
Netherlands	5.3	3.1	6.3	11.0	11.5	16.3
Norway	9.9	4.9	16.8	14.0	18.3	24.6
Poland	16.9	8.7	28.2	24.3	20.6	22.5
Portugal	27.5	5.0	26.2	27.0	20.4	
Slovakia	13.0	6.6	17.0	3.5	17.3	20.6
Slovenia	3.8	5.4	19.0	20.4	14.5	17.8
Sweden	11.7	7.1	15.3	18.2	19.7	25.8
Switzerland	7.3	10.1	18.1	12.8	23.4	19.9
Turkey	25.7	15.6	34.5	13.6	24.3	20.3
United Kingdom	8.2	4.9	22.0	14.7	21.2	17.2
EU-25	*11.3*	*5.8*	*15.6*	*14.9*	*16.6*	*23.9*

Exceptions to the reference year: Latvia, Turkey: 2000; France: 2001; Austria: 2003; Cyprus, Norway, Portugal: 2003
FTE instead of HC: Netherlands, Israel (2001)

Portugal: Humanities included in Social Sciences

Source: She Figures 2006

The issue of vertical segregation also includes the analysis of the gender composition at the organisational level of doing science, which means the participation of women and men in programme management and implementation processes. The Women and Science Unit collects sex-disaggregated data on members of scientific boards. Data on the share of women on scientific boards show large difference between countries. In the Member States, women constitute more than 40% of board members only in Finland and Sweden; and below these two countries, only the UK and Denmark are above 30%. Norway and Bulgaria have a better gender-balance than most of the EU in this respect, and Iceland also performs relatively well. For the majority of EU countries, by contrast, the presence of women on scientific boards varies from between one in five, to rather less than one in ten, which is a striking imbalance (EC, 2006).

3.3. Pay and funding

This topic includes differences between female and male scientists' remuneration, regardless their labour situation (employee, self-employed, internship, others) as well as the unequal access to research funding.

The gender pay gap among scientist can be seen as a result of both horizontal and vertical gender segregation. Horizontal segregation can have a relevant impact on the gender pay gap because women are under-represented in industrial research and in the most prestigious and well paid fields of science. On the other hand, vertical segregation has a direct impact on the gender pay gap, as women are under-represented in senior and leadership positions.

The pay gap between women and men in science is well documented in those countries in which information about remuneration is available. On the basis of the US *National Science Foundation's biennial Scientists and Engineers Statistical Data System* (SESTAT), Goyette and Xie (1999) concluded that women scientists overall earned about 11 percent less than men, net of demographic and human capital variables. However, it is an issue scarcely studied in Europe because of the lack of statistics about scientists at the national and the European level (see Meulders *et al*., 2003). The recent survey on "Remuneration of Researchers in the Public and Private sectors (EC, 2007) provides for the first time harmonised data on pay of researchers in EU countries.

Research on the gender pay gap in science offer two alternative general explanations: the cohort effect explanation and the glass ceiling explanation (Morgan, 1998; Prokos and Padavic, 2005). The cohort effect explanation posits that because of the discrimination of an earlier era, older cohorts of women have experienced a greater pay gap with men throughout their careers than have more recent labor market entrants. Thus, as older cohorts retire and are replaced by younger ones, the overall pay gap would decline. Alternatively, the glass ceiling hypothesis predicts that differential rates of access to higher-status jobs (regardless of cohort) account for women's reduced earnings relative to men. Gender-linked barriers to higher-status and higher-paid jobs ensure that as men's salaries increase, women's fail to keep pace. Research has supported partially both positions, and the question about the roles of cohorts and glass ceiling barriers in women's career outcomes is an open one. Prokis and Padavic (2005) studied the gender pay gap among scientists in USA on the basis of four surveys during the 1990s for cohorts graduating between 1955 and 1990. Their results indicate a continuing pay gap net of human capital, family status, and occupational characteristics that was not fully explained by either cohort effects or the glass ceiling. The authors suggest that the gender pay gap in these fields results from several unmeasured barriers that neither worsen across the life cycle nor become less problematic for recent cohorts.

There is little research about the unequal access of women and men to research funding, although the scarce empirical evidence points out significant differences between women and men. For example, looking at US NIH (National Institutes of Health) research grants, over the period from 1994 to 2004 the participation of women increased (from 20% of the awards to 25%) but research grants to women remained at about 80% of the size of research grants to men (OER, 2005). In UK, research has found no evidence for direct gender discrimination in assessment of grant applications in UK, but has revealed that women tend to apply for fewer grants than men, are less likely to apply as the principal applicant, generally apply for grants of shorter duration and for lower levels of funding, and are more likely to apply for their salary to be paid as part of the grant (Blake and La Valle, 2001). With regard to EU funded research, Caprile et al. (2008) analysed patterns of application to FP6 grants and rates of success in five thematic priorities (nanotechnologies, aeronautics and space; sustainable surface transport, sustainable energy systems and Euratom). Their analysis shows that women are less likely to apply for large-scale projects and that their rate of success is lower than men's. According to Osborn et al. (2000) it is reasonable to pose three questions relating to gender in this context. First, do women make as many applications as men? Secondly, what share do women obtain of grants from national and international sources? Thirdly, do women and men at comparable levels get grants of the same size?

The study should therefore pay a special attention to the research made in the field of the unequal pay and unequal access to research funding, in order to contribute to fill the existing gaps and disseminate results. In addition, evidence on the gender pay gap will be analysed on the basis of the secondary-data collection at both European and national level, especially through the analysis of the recent survey on remuneration and researchers (EC, 2007).

3.4. Stereotypes and identity

Gender segregation across scientific field is a complicated phenomenon that has no simple explanation. The fact that men and women choose different fields of study is attributable to a complex interplay of different individual, institutional, social and cultural factors that interact across different levels (NAS, 2006; Suter, 2006). The studies that try to find explanatory mechanisms of horizontal gender segregation may be divided in two broad theoretical frameworks.

The first theoretical framework is focused on the analysis of cognitive sex differences and the way they may influence the differential success in science and engineering of women and men. The academic success of girls now equals or exceeds that of boys at high schools and college levels. However, during the 80's and 90's, a large bulk of studies from Anglo-Saxon countries, in a variety of disciplines (including neuroscience, cognitive psychology, evolutionary biology and developmental and educational psychology) analysed gender differences in cognitive abilities in mathematical and spatial performance, verbal and written performance and in psychological development in infancy. A large body of research probed the existence and nature of cognitive sex differences and, in the same way, a large body of research probed that systematic sex differences do not exist in most cognitive functions (NAS, 2006). Summarizing, the studies of brain structure and function, of hormonal modulation of performance, of human cognitive development and of human evolution have not revealed significant biological differences between men and women in performing science and mathematics that can account for the current under-representation of women in science. On the contrary, empirical evidence shows that social and cultural factors appear to have more influence on boys and girl's motivations and preferences than their underlying abilities (NAS, 2006).

The second theoretical framework analyses the way in which individuals build their identity in a social context and also considers the way in which social values and beliefs affect in scientific and technological fields. Three main approaches appear in this theoretical debate: gender stereotypes construction, human capital theories and role modelling.

Gender stereotypes

Gender stereotypes support the continuity of specific gender roles and occupational gender segregation. According to this approach, the different choices of men and women are associated with typical male and female stereotyped characteristics (Suter, 2006). Thus, engineering is associated with male rather than female stereotypes and professions in engineering tend not to be a woman's first choice.

Some contributions assume that gender stereotypes are formed during the socialisation process whereas others suggest a lifelong process of production and reproduction of gender roles. Around these theories, an important point of debate underlines the social construction of gendered stereotypes and their permeability to change across time. In this sense, it is stated that women's representation in many fields that were previously dominated by men has increased in recent decades, such as law, medicine, and science and engineering. Therefore, gender differences in career interests are not fixed but subject to influence of social forces (Xie, 2006).

Several studies in line with this theoretical approach have analysed the extreme under-representation of women in scientific fields such as engineering and ICT (Faulkner 2000; Miller 2004). According to these studies, there are specific fields of research that are built on the hypothetical belief that they are based on masculine values. Fascination for technology and technical skills are attributes which are assigned to men, while being a woman is strongly connected with smoothness, social abilities such as caring for family/relatives, housekeeping and a certain fear of technology (Faulkner, 1985). Consequently some scientific and technical fields of research are traditionally regarded as contradictory to typical female attributes and being a woman.

Nevertheless, there are two different perspectives in these studies: the first one states that scientific-technical activity in ‘male-dominated’ disciplines is supported by traditionally male values whilst the second argues that this association is simply one stereotype more. An example of the first perspective is a study about the situation of women with extensive employment experience in the oil industry in Canada. This study revealed that there are three primary processes which structure the ‘masculinity’ of this industry (Miller, 2004): Everyday interactions which exclude women; values and beliefs specific to the dominant profession of engineering which reinforce gender divisions; a consciousness derived from the powerful symbols of the ‘frontier myth’ and the romanticised “cowboy hero”.

An example of the second perspective is the analysis of motivations and ideologies at work in disciplines like engineering and ICT carried out by Faulkner (2000). This study does not find any empirical evidence on the association of research in these fields with values and attributes traditionally considered masculine. On the contrary, the study states that not only that which is considered ‘masculine’ and ´feminine’ is stereotyped, but also the association between technology / ICT with everything masculine, since daily activities related to research involve both activities that are traditionally considered masculine and activities considered feminine.

Human capital theory

According to this perspective women and men think and decide differently when it comes to individual benefits, among other things, because women often have to combine their career with running the household and child care. From this approach, it is stated that women prefer to work in female-typical jobs that are characterized by relatively high starting earnings and have low or no penalty for withdrawal due to family-related responsibilities. However, the explanatory power of this approach for explaining horizontal gender segregation is unclear. As Xie (2006) notes, applying human capital theory to gender segregation across scientific fields, it could be predicted that women would be interested in the fields of study that reward early careers but not sustained work experience. In contrast, men would be more likely to work in careers that start at a low disadvantage but accrue rewards (pay) over time. In this sense, empirical validity of human capital theory for gender segregation by occupation is debatable, because talents for scientific work in hard sciences (as physics or others) are recognized early and rewarded early.

Role models

This perspective basically puts limits to the rational choice reasoning and human capital theory. It argues that individual choices may seem rational but are actually influenced by society at large. Success breeds future success, and failure feeds back discouragement, and this process is sex-linked.

Role modelling is suggested as one possible mechanism through which social forces affect the gender differences in career choice (Bandura, 1986). Role modelling means that youths learn from the experiences of adults actually working in the labour force. In this sense, family backgrounds, as well as inclusion and exclusion mechanisms among peer groups, are important factors to take in account (Xie and Shauman, 1997). Thus, female students in engineering and other branches of science often have at least one parent with a professional background in one of these disciplines. This also points to the importance of having a female role model working in a male-centred profession or field of study (Suter, 2006; AAUW, 2000).

3.5. Science as a labour activity

The traditional scientific career presumes the model of an out-of-date male life course (NAS, 2006). It is predicated on the assumption that the scientist will have an unlimited commitment to his or her academic career throughout his or her working life. Attention to other serious obligations, such as family, is taken to imply lack of dedication to one's career. Historically, that career model depended on a scientist having a wife to take care of all other aspects of life, including the household, family, and community. The model still fits some men but is increasingly unsuitable for both men and women who need or want to participate in other activities.

An important bulk of hypotheses and lines of research start from the need to analyse scientific activity from the viewpoint of the traditional gender division of labour and uses of time. The gender division of labour is a concept that refers to complex values, norms, rules and practices in the field of labour, where an asymmetrical distinction is produced between women and men, between unpaid and paid labour, between work inside and outside the home, and between female and male tasks and professions (Verloo and Roggeband, 1996). The gender division of labour has important repercussions in the way men and women articulate their work/life balance. The relevance given to personal life and the volume of domestic and care work is greater among women than men. According to Elg and Jonnergard (2003), the organisational structures of science radically separate public and private spheres. It involves a rationalisation according to which nothing that affects a person outside work affects that person as a worker and, at the same time, it is expected that work should not interfere with private life.

One of the core issues to be taken into account in this dimension is everything related to how time is used. As stated in several case studies (Currie *et al.,* 2000) long working days are accepted as the norm in scientific research, and therefore as a norm that must be complied with. It is considered rewarding for people working in scientific activities to be in the workplace as many hours as possible, which reflects the stereotype or belief that someone involved in scientific work must prioritise this above everything else. 'A good scientist' is someone who entirely sacrifices her/his personal and/or family life. The results or consequences of this kind of working culture, however, are different for men and for women. Bailyn (2003) analyses the professional careers of men and women at the Massachusetts Institute of Technology and shows that this kind of organisation particularly prejudices women because, as a result of their traditional role as carers, they generally do not have the same number of hours available to be in the workplace. So, while the 'perfect scientist' continues to be someone entirely dedicated to the professional career, it is not possible to speak of equality between men and women in this field.

This type of dynamics is intensified when female scientists have children. Sometimes women reduce their working hours or take a break in their professional careers. When this happens, it reduces women's professional status and promotion prospects. This is a form of indirect discrimination against women (IUPAP 2002; Osborn *et al.,* 2002) which can be related to obstacles because of age or the value given to an interrupted career, but it has its origins in the traditional gender division of labour and in the unequal organisation and management of public and private time between men and women.

The same thing is suggested in other studies about academic careers. The long years of exclusive dedication to academic life coincide with the fertile biological age of women. Nonetheless, the necessary dedication and total availability demanded for a successful academic career is very often incompatible with maternity or the time spent on personal / family life (Etzkowitz *et al.,* 2000; Gupta *et al.,* 2004; Kemelgor and Etzkowitz, 2001).

The analysis of the personal decisions that women and men take throughout their scientific careers must take into account the unequal distribution of domestic work between the sexes and the way in which scientific-technical activity integrates this work. For this reason, authors like Elg and Jonnergard (2003) underline that it is important not to analyse these strategies individually but rather to relate them to the organisational characteristics of the working institution, and particularly everyday practices allowing greater reconciliation between work and personal and family life, forms of mentoring and professional promotion (Powell and Mainiero 1992).

Some hypotheses trying to explain the low presence of women in scientific careers point out the fact that women are in a different partner situation than men. Different studies have shown that women in academic positions mostly have partners who are also highly-educated and following a scientific career (Xie and Schauman, 2003; NAS, 2006). This phenomenon is described as ‘dual career’ couples. In contrast, the female partners of men in academic and scientific careers quite often do not work or work part-time and focus mainly on family and children. Men are therefore in the position to further their careers with a partner in the background supporting them, whereas women cannot build on this support.

3.6. Scientific excellence

The report *Gender and Excellence in the Making* (EC, 2004) provided a first opportunity to move forward with the recommendations expressed in the ETAN report on avoiding gender bias in the definition and measurement of scientific excellence. As already explained, the processes that can explain the low presence of women in some disciplines and the gender division of labour indisputably condition the success of women's scientific careers. However, we can also point out some concepts that are exclusively related to gender and scientific excellence.

According to Feller (2004), in the analysis of gender bias in scientific excellence it is important to distinguish conceptually between: 1) The ways in which scientific excellence is defined and measured and 2) The specific procedures for assessing scientific excellence.

The first concept, the ways in which scientific excellence is defined and measured, includes issues such as the masculine character of the prevailing model of success, the emphasis given to scientific production through publications and the bibliometric measures used to measure productivity for research personnel. As stated in several studies (Bailyn, 2003; Knights and Richards, 2003), it seems that there is no room for doubt that the ideal scientific career is based on a masculine model of success, based on long working hours, an uninterrupted scientific career, or an active participation in extra activities such as expert panels and assessment committees. This meritocratic system strengthens unequal starting points and has particularly damaging results for many women and some men who do not meet the model of success defined as standard.

The same holds true for the bibliometric measures used to count publications and citations. One of the most relevant ways for measuring scientific excellence is through the number of publications and citations. As Feller (2004) states, these bibliometric measures should be understood as an objective measurement method that actually reflects inequalities between men and women shaped by the gender bias in the organisation of scientific work and have to do with the situations described in the previous paragraphs transferred to the world of publications (EC, 2004). Women scientists have long been considered less productive than men because they published fewer papers. Evidence shows, however, that productivity is not an independent characteristic of individuals but rather a reflection of their positions in the academic hierarchy and the access to resources that those positions make possible. When academic position, available resources, type of institution, and other personal and institutional factors are held constant, men and women scientists are equally productive (Xie and Shauman, 1998; NAS, 2006).

The second concept, the specific procedures for assessing scientific excellence, makes reference to the ways in which the scientific merit of the academic contributions is evaluated. It refers, essentially, to peer evaluation. The system of peer evaluation is based on the idea that the scientific community is the most prepared to judge other scientists (peers). However, it makes the assumption that the evaluators are free of social prejudices and issue judgements that are totally objective (EC, 2004). In this sense, leading contributions as Wenneräs and Wold (1997), for example, make it clear that the peer evaluation system cannot be considered as fully gender-neutral.

Guetzkow *et al.* (2003) and Roper (1996) have analysed homosociability as regards the evaluation of scientific excellence and selection processes. The authors confirm that in scientific evaluation processes, the evaluators prefer candidates and approaches in subjects that are similar to their own. The notion that a person's work is independent of the person is untenable and neither is the evaluation of this work independent of the evaluator. In the same way, the IUPAP International Conference about Women in Physics stated that selection and promotion processes are not transparent and may prejudice women. Other authors (Addis, 2004; Hearn, 2004) stress the need to take 'honour' into account for analysing gender relations in academic debates or in competition for obtaining a high-prestige post. When a man competes with another man, the value of gaining reputation and honour is great and, if he loses, the value of the loss is relatively small. However, when a man competes with a woman, the value of winning is small, but if he loses, the value of the loss of prestige and honour is extremely large.

Assuming this relationship, a man has a chance to earn greater honour competing with another man and thus, women are excluded from these interactions and from intellectual debate. They continue losing the opportunity of gaining reputation and honour and this leads to the progressive marginalisation of women.

The networks of men with informal relationships are basic to understanding who the candidates are and who the people selected are, just like the research topics that are inherited from what was called the 'Old Boys' network fashion' in the IUPAP conference. The absence of women both in formal and informal networks has to do with the low representation of women in certain positions and the difficulty they face in getting promoted to positions with great responsibility. Senior advisors have a huge impact on the formation of networks, the distribution of opportunities, and the provision of tacit knowledge necessary to advance successfully in science. Since men occupy the highest and most influential positions, the structure of academic careers has a host of underlying gender-biased career prerequisites and mechanisms (Gupta *et al.,* 2004). For women, it is difficult to enter into these networks, which are extremely hermetic, and also difficult to build new women's networks, especially in those fields where they are a minority (Meulders *et al.,* 2003).

The process of 'gate-keeping' is one of the core concepts for analysing the social construction of scientific excellence. Lewin (1947) introduced the concept of gate-keeping as the process that controls or influences entry into a particular field, to its resources, to its information, defining its standards, its agenda and external image. According to Merton (1996), one of the roles of scientists is gate-keeping and this process shapes scientific work in all its angles. As an example, we could take the selection process of scientists for the evaluation panels or the editorial committees of scientific journals, processes that are not always transparent or democratic, since the names come from members already on these teams (Griffin, 2004). In general, the gate-keepers of scientific research in Europe are middle-aged male academics (Osborn *et al.,* 2000). This affects the professional mobility of male and female scientists and reproduces gender bias, since the gate-keeping processes include the processes for recruiting new gate-keepers. Gate-keeping processes restrict women's possibilities, not simply from participating in informal networks, but more fundamentally, from doing research, from publishing, from receiving citations - to stress the most relevant signs of status and performance in science.

3.7. Gender in research content

Far away of the apparent gender neutrality in science, science should be considered as a social activity, with its own values and rules, and included in a social structure with unequal power relations. A central issue for understanding gender relations is the unequal power relations between women and men. The problem of unequal power relations becomes apparent when the unequal participation of women and men in science is analysed. However, it also adopts more subtle ways: the exclusion and segregation of women from science does also impact upon the scientific knowledge itself (Shultz *et al.*, 2001; Schiebinger, 2007).

Gender bias in research contents may be illustrated by the example of biomedicine. As Schiebinger (2008) remind us, until recently, drugs were typically tested on men and the results generalized to women. The consequence was that adverse reactions to drugs occurred twice as often in women as in men. Although it seems fairly evident that studying drugs in non-representative populations is simply bad science, this gender bias was not redressed through the self-correcting mechanisms of scientific research: it required political intervention at the highest levels of government. In the 1990s, the US National Institutes of Health founded the Office of Research on Women's Health with two missions: to increase the number of women in the medical profession and, importantly, to reconceptualize medical research. In 1993 a US federal law was passed that women must be included in clinical drug trials, and that cost could not be used as a justification for excluding them. Evidence on gender bias and how integrating the gender dimension into research contents enhances scientific knowledge may be found in social sciences, life sciences and engineering. However, the relevance of gender in research contents is lively debated in physical sciences (Schiebinger, 2008).

Engendering research contents entails systematically questioning whether, and in what sense, sex and gender are relevant in the objectives and methodology of projects. As stated by Laurila and Young (2001), gender stereotypes dominate the scientific discourse, epistemological assumptions of science are gender-biased and the shaping of the scientific agenda is male dominated. A transformative understanding of gender and science includes the need to question the dominant paradigm in relation to both gender and science. Several contributions focus on this issue, exploring constructive tensions and trying to tackle the gulf between feminist epistemologies of science, constructivist approaches to science and the practice of natural science (Kerr, 1998; Faulkner, 2000; Lohan, 2000; Wajcman, 2000).

Those approaches that try to focus on linking theory and practice assuming that feminist practitioners in natural sciences have a privileged standpoint to ascertain what a gender-sensitive science might mean, seem particularly useful. Feminist practitioner's perspectives seem closer to the feminist theories of Haraway (1988) than those of Harding (1986, 1991). Whilst Harding argues for a feminist standpoint based on "strong objectivity", Haraway emphasises diversity and "situated knowledge" –people have a multiplicity of standpoints, based on class, race, sexual orientation and gender and they do not hold one perspective on the world, but many and often contradictory. Research on gender-sensitive practitioners of natural science show that they tend to emphasise the social construction of biological differences and gender categories, the value of diversity of perspectives and experiences among scientists, the different levels of objectivity and the role of subjectivity in guiding research questions and analysing data, and the need for interdisciplinary research and developing links with the local community (Kerr, 1998).

These approaches point out that interdisciplinary science—linking natural, technological and social sciences and social diversity among scientists are two major issues. The integration of the gender dimension into research content requires a re-constructive perspective in the scientific approach, focusing on interdisciplinary and transdisciplinary research and methods and integrating natural, technological and social sciences. The recognition of socio-economic elements provides entry-points for the identification of gender issues relevant for research (Schiebinger, 1999; Laurila and Young, 2001).

In the same line, the integration of the gender dimension into research content is related to the acknowledgement of diversity of all kinds. There is no universal woman as there is no universal man. From a gender perspective, not only gender but also other forms of diversity are considered, such as age, ethnicity or sexual orientation. In order to meet the needs of all citizens, science should acknowledge all the biological and social differences between individuals (Laurila and Young, 2001). Biological differences between women and men may be relevant whenever impact on health and physical well-being is considered. Differences related to gender relations may be relevant whenever equity in the allocation of resources, opportunities and life chances is addressed. Insofar as research adopts an end-user perspective, sex and gender, together with other social diversity issues (e.g. age, ethnicity, income inequality) should be considered in order to ensure that research addresses the needs of all citizens (Caprile *et al*., 2008).

3.8. Policies towards gender equality in research

Gender equality policies in science have become and important issue in all EU Member States, being mainly embedded in Equal Treatment Legislation. To mainstream policies to promote gender equality in science, many countries have established structures such as national committees and units dedicated to women in science in relevant government departments. Some countries have recently established national resources and coordination centres for women in science activities. At the same time, gender mainstreaming strategy of the European Commission will condition the way in which gender mainstreaming and policy measures for gender equality in science will be developed in each country. The report of Rees (2002) on *National Policies on Women in Science in Europe* is a reference document about national policies and programmes towards gender equality in research. In this report, measures were organised as follows:

- Positive action measures to promote gender equality in science

  Positive action measures are based on the recognition that members of a group (in this case, women in scientific careers) experience disadvantages as a consequence of indirect discrimination. Such measures are designed to compensate for those disadvantages. The main positive action measures in science identified by Rees (2002) are:

  - Networks, i.e. the setting up of or support for women's scientific networks and equal opportunities networks.
  - Quotas and targets, i.e. specific procedures for preferring women to men in appointments, where equally suitable candidates exist, in order to achieve a better gender balance.
  - Role models and mentoring, i.e. actions to demonstrate that it is possible to be a senior figure in science and also a woman (role models) and schemes to link senior women scientists with junior colleagues for advice and support (mentoring).
  - Earmarked chairs, research funds and prizes, i.e. earmarking of resources for women scientists, either in terms of encouraging the participation of women, setting women's targets or devoting these resources only to women.

- Gender mainstreaming measures to promote gender equality in science

  Gender mainstreaming is a long-term and strategic approach to fostering gender equality, designed to complement equal treatment (under the law) and positive action measures. It entails the systematic integration of gender equality into all systems and structures, policies, programmes, processes and projects, into ways of seeing and doing, into cultures and their organisations. The main gender mainstreaming measures in science identified by Rees (2002) are:

  - Legislation, i.e. including equal opportunities issues into the legislation regulating higher education, and legislation to ensure a gender balance on public bodies, including scientific committees.
  - Gender studies, i.e. gender-sensitive studies on science, addressing issues such as gender relations in scientific careers, gender impact assessment of institutional practices and gendering excellence.
  - Modernising human resource management, i.e. measures aimed at avoiding nepotism, patronage and sexism in human resources management, such as measures for ensuring transparency in appointment and promotion procedures and for avoiding any potential gender bias in assessing merit and scientific excellence.

- Gender-proofing the pedagogy of science education, i.e. a thorough examination of pedagogy, its methods and instruments, in order to avoid potential gender biases.
- Work-life balance measures, i.e. policies promoting a good life-course work-life balance for both women and men.

In spite of the existence of many policy measures and initiatives, there is an urge on continuing working in this area, specially with regard to the evaluation and effectiveness. Taking as a basis this urgency, the OECD (2006) has made an overview, presented below, of the existing programmes and measures as a starting point towards the evaluation and analysis of policies and measures on gender equality in science:

Direct support measures

Most EU countries have specific programmes in place which aim to achieve a better gender balance in science education and research (*e.g*. improved childcare, measures to balance work and family responsibilities, mentoring programmes). Such programmes are very important at the level of individual institutions. Most of these instruments and measures are geared to the universities and public sector research. The picture is quite different when it comes to promoting women's recruitment in business R&D. In general, governments, with the exception of affirmative action laws, have not adopted any specific laws or regulations to increase the proportion of women in the business research sector. However, some have programmes to encourage industry to recruit women (Austria, Finland, and France); others rely on voluntary agreements with industry (Germany). The United Kingdom has a comprehensive programme to foster women's entrepreneurship, including in R&D.

More specific measures range from grants to support positions for women at universities to preferential policies towards equally qualified women candidates. Recent research suggests that efforts to close the gender gap in science must begin at the earliest levels of schooling. On the employment side, equal opportunity policies, flexible working hours and parental leave are also important for encouraging women to pursue research careers in the public and private sectors.

As to programmes aiming to increase the *participation* of women in research and science, most countries – with a few exceptions (Czech Republic, Hungary) –have adopted such programmes or measures. Generally, it can be said that all measures and programmes in place very much depend on their implementation by individual research institutions or companies. Many countries have very comprehensive programmes in this field (Austria, Denmark, Finland, Germany, Switzerland and the United Kingdom). Such programmes comprise initiatives targeting girls in secondary schools, students in colleges and universities and university graduates. They also vary from informal measures aimed at breaking up stereotypes and creating role models, to formally funded government programmes for the recruitment, retention, returning and progression of girls and women in science, engineering and technology, in academia as well as in business R&D units.

Coaching and mentoring

With regard to programmes and measures to retain women in scientific careers, a few countries have extensive programmes which focus on coaching, mentoring and other instruments to encourage women to take research positions. Many such programmes are established and implemented at the decentralised level of individual institutions.

Specific funding schemes

According to countries' responses there is no evidence that new funding instruments influence the participation of women in research. However, some data show that a shift in funding priorities – such as less physics more biotechnology – clearly increases the participation of women.

Some countries have special funding schemes addressed to women researchers. These can be programmes at decentralised level (Germany), scholarship programmes (Austria),return-to-work programmes after a family care break (Switzerland, United Kingdom) or more comprehensive schemes (Netherlands).

Family/work life issues

Results from the OECD project on work and family life balance show that high female employment rates are not incompatible with fertility rates close to replacement level (OECD, 2005). Framework policies such as fiscal and social policy also influence the choice of women with children with regard to the decision to seek certain types of employment or even to continue working at all. That said, the situation may be somewhat more complex when it comes to balancing the demanding careers of research and family life. Research has shown there is a family effect on productivity for both men and women with men having a greater productivity in their early career years (EC, 2004). All EU countries have a scheme of maternal leave; however, many countries go beyond this in order to facilitate the balance between work and family responsibilities (*e.g.* lifting age limits for women with children to apply for grants and posts). But overall working life is still experienced very differently by men and women. Even in the Nordic countries, which have gone the farthest in publicly subsidising parents who wish to work, the result is that female employment rates are high, but women work in the public sector, predominantly in non-managerial posts. What policies could help eliminate the existing penalty against women in the labour market? One example would be to encourage men to take leave to look after young children, rather than only mothers having to spend extended periods out of work.

Issues relating to mobility and evaluation

In many EU countries national and international mobility is either a formal or at least tacit requirement for advancing in a scientific career. This may be a disadvantage for female researchers with families. However, very few countries address this issue in particular with measures or programmes, although some countries have increased grants for researchers taking up temporary positions abroad and wishing to take along their family (*e.g.* Finland). As to the criteria for measuring scientific excellence, research has shown barriers to career advancement for women are linked to gender bias in the indicators used to evaluate performance (such as publications). In nearly all countries publications and peer reviews are still the main criteria for advancement. Teaching is only a secondary criterion (equality between publications and teaching only in Denmark), in some countries teaching is not taken into account at all (Czech Republic and France). This situation is generally seen as being a disadvantage for the advancement of women since they tend to focus on teaching rather than on publications – though no quantitative evidence is available. Eliminating such barriers is important to attracting and retaining women in research.

4. Definition of the topics

According to the revision of literature, a set of relevant key issues is identified for each topic. These key issues are used to provide more details on the contents of the GSD entries. Overall, this section contains a concise definition of each topic and the related key issues, as well as concrete examples in which each key issue is addressed.

Horizontal segregation
This topic covers the empirical evidence about the unequal presence of women and men in different scientific fields and institutional sectors. It covers horizontal segregation in the different stages of research careers, from educational patterns to employment distributions. It is mainly focused on the compilation of statistics and gender indicators.
Key issues
Scientific field It refers to empirical evidence about horizontal segregation in scientific fields. Scientific field may refer to field of education, when the analysis focuses on students and graduates, or field of science, when the analysis focuses on scientists. For example, the under-representation of women among graduates in natural sciences (field of study) or among natural scientists (field of science). Examples in which this key issue is addressed: – Charles, M. and Bradley, K. (2002) "Equal but Separate? A Cross-National Study of Sex Segregation in Higher Education" *American Sociological Review*, Vol. 67, No. 4, pp. 573-599. – European Commission (2006) *She Figures 2006 – Women and Science Statistics and Indicators*, Luxemburg: Office for Official Publications of the European Commission, Chapter 2, pp. 33-48 – Gidlöf Regnier, C. (2006), "Statistics on women in science: examples from the European Union" in OECD, *Women in scientific careers: Unleashing the potential*, pp. 53-60.
Institutional sector It refers to empirical evidence about horizontal segregation in institutional sectors. Institutional sectors are defined according to the OCDE (2002), on the basis of the characteristic properties of the institutions performing scientific research: higher education sector, government sector, business enterprise sector and private non-profit sector. For example, the under-representation of women in the business enterprise sector, as compared to their presence in the higher education sector. Examples in which this key issue is addressed: – Meulders, D., Plasman, R., Lemière, S., Danis, S, O'Dorchai, S., Tojerow, I., Jepsen, M., Gangji, A., Moreno, D., Caprile, M. and Kruger, K. (2003) *Women in industrial research – Analysis of statistical data and good practices of companies,* Directorate-General for Research, Science and Science, Luxembourg: Office for Official Publications of the European Communities.European Commission (2006) – *She Figures 2006 – Women and Science Statistics and Indicators*, Luxemburg: Office for Official Publications of the European Commission, Chapter 2, pp. 33-48. – Gidlöf Regnier, C. (2006), "Statistics on women in science: examples from the European Union" in OECD, *Women in scientific careers: Unleashing the potential*, pp. 53-60.

Vertical segregation
This topic covers the empirical evidence about the decreasing presence of women across the scientific hierarchy, by scientific fields and institutional sectors. It includes the description of the gender composition of the scientific structure (participation of women and men in decision-making, programme management and implementation processes). It is mainly focused on the compilation of statistics and gender indicators.
Key issues
Professional career It refers to empirical evidence about the decreasing presence of women across the standard professional career, from university graduates to senior scientific positions. Examples in which this key issue is addressed: – European Commission (2006) *She Figures 2006 – Women and Science Statistics and Indicators*, Luxemburg: Office for Official Publications of the European Commission, Chapter 3, pp. 49-65. – Langberg, K. (2006) 'The Gender Gap in the Public Research Sector: The Case of Denmark', in OECD, *Women in scientific careers: Unleashing the potential*, pp. 61-77. – Palomba, R. (2006) 'Does Gender Matter in Scientific Leadership?' in OECD, *Women in scientific careers: Unleashing the potential*, pp. 133-138.
Gender composition of organisations It refers to empirical evidence about the under-representation of women in the senior and leadership positions of the scientific system (decision making, programme management and implementation processes). For example, the under-representation of women in academies or research decision-making boards. Examples in which this key issue is addressed: – Osborn M., Rees T., Bosch M., Ebeling H., Hermann C., Hilden J., McLaren A., Palomba R., Peltonen L., Vela C., Weis D. and Wolh A., (2000), *Science Policies in the EU.: promoting excellence through mainstreaming gender equality*, *A report from the ETAN Expert Working Group on Women and Science,* Luxembourg, Office for Official Publications of the European Communities, Chapter 5, pp. 47-55. – Schultz,I., Hummel, D., Hayn, D. and Empacher,C., Institut für sozial-ökologische Forschung (ISOE) GmbH in co-operation with Kluge, T., Lux, A., Schramm, E., Schubert, S. and Stiess, S. (2001*) Gender in Research - Gender Impact Assessment of the specific programmes of the Fifth Framework Programme - Environment and sustainable development sub-programme*, European Commission, Directorate General for Research, Energy, environment and sustainable development, Chapter 3, pp.13-28.

Pay and funding
This topic covers empirical evidence of pay inequality between female and male scientists. It includes the analysis of unequal pay by institutional sectors and scientific fields, taking into account that women are less represented in the most prestigious and well-rewarded. This topic also addresses the unequal access of women and men to research funding. It is mainly focused on the compilation of statistics and gender indicators.
Key issues
Gender pay gap It refers to empirical evidence of unequal earning between female and male scientists, regardless of their labour situation (employee, self-employed, internship, others). Examples in which this key issue is addressed: – European Commission (2007) *Remuneration of researchers in the Public and Private sectors.* Luxembourg, Office for Official Publications of the European Communities. – Prokos, A. and Padavik, I. (2005) 'An examination of competing explanations for the pay gap among scientists and engineers, *Gender & Society*, 19 (4), 523-543.
Access to research funding It refers to empirical evidence about the unequal access of female and male scientists to research funding. It includes the analysis of gender differences in the application to research funding, success rates and share of grants awarded. Examples in which this key issue is addressed: – Hosek, S.D., Cox, A.G., Ghosh-Dastidar, B., Kofner, A., Ramphal, N., Scott, J. and Berry, S.H. (2005) *Gender Differences in Major Federal External Grant Programs*, Washington DC, RAND. – Blake, M. and La Valle, I. (2001) 'Who applies for research funding? Key factors shaping funding application behaviour among women and men in British higher education institutions', National Centre for Social Research, published by Wellcome Trust (http://www.wellcome.ac.uk/stellent/groups/corporatesite/@policy_communications/documents/web_document/wtd003210.pdf)

Stereotypes and identity
This topic covers theories and explanations about the gender biased construction of cognitive abilities and individual identity with regard to science. This topic addresses the issue of how certain configurations of factors lead some individuals but not others to some fields of study and/or to scientific careers, and the analysis of mechanisms that articulate the gender biased construction of science.
Key issues
Cognitive abilities It deals with the analysis of cognitive sex differences and the way they may influence educational/and professional choices and lead to the under-representation of women in science. Examples in which this key issue is addressed: – [NAS] National Academy of Sciences (2006), *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*, Washington, D:C:, The National Academies Press, Chapter 2, pp. 24-29.
Social construction of identity It deals with the analysis of the gender biased construction of individual identity with regard to science and their impact on educational and professional choices of women and men. Examples in which this key issue is addressed: – Fox, M.F. and Stephan, P.E. (2001) 'Careers of Young Scientists: Preferences, Prospects and Realities by Gender and Field' *Social Studies of Science*, February 2001, No. 31, pages 109 – 122. – Xie, Y. and Shauman. K.A. (1997), 'Modeling the Sex-Typing of Occupational Choice: Influences of Occupational Structure', *Sociological Methods and Research,* 26, pp. 233-261. – Charles, M. and Bradley, K. (2002) "Equal but Separate? A Cross-National Study of Sex Segregation in Higher Education" *American Sociological Review*, Vol. 67, No. 4, pp. 573-599.
Social construction of science It deals with the analysis of the patterns of persistence of gendered stereotypes in science and their permeability to change. Examples in which this key issue is addressed: – Faulkner, W. (2000). Dualisms, Hierarchies and Gender in Engineering', *Social Studies of Science,* No. 30, pp. 759-792. – Miller, G. E. (2004) 'Frontier Masculinity in the Oil Industry: The Experience of Women Engineers' *Gender, Work and Organization*, Vol. 11, No. 1, pp. 47-73.

Science as a labour activity
This topic covers theories and explanations about gender inequality in science related with work organisation, working conditions, working time and work/life balance issues. As such, this topic addresses institutional constraints to the advancement of women in science related with the gender division of labour.
Key issues
Working time and work/life balance It focuses on the analysis of institutional practices of work organisation, working conditions and working time, their impact on work/life balance and their unequal consequences for the scientific careers of women and men. Examples in which this key issue is addressed: – Probert, B. (2005) 'I Just Couldn't Fit It In: Gender and Unequal Outcomes in Academic Careers' *Gender, Work and Organization*, Vol. 12, No 1, pages 51-72. – Currie, J., Jarris, P. and Thiele, B. (2000) 'Sacrifices in Greedy Universities: are they gendered?' *Gender and Education*, Vol. 12, No.3, pp 269-291.
Personal and professional life-course It focuses on the analysis of the personal and professional life-course of women and men in science and the role played by institutional constraints related with the gender division of labour. Examples in which this key issue is addressed: – Xie Y. and Shaumann, KA (2003). *Women in Science: Career Processes and Outcomes*. Cambridge, MA: Harvard University Press. – [NAS] National Academy of Sciences (2006), *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*, Washington, D:C:, The National Academies Press; Chapter 5, pp. 160-214.

Scientific excellence
This topic covers theories and explanations about the gender bias in scientific excellence. By scientific excellence it is meant the way in which scientific excellence is defined and measured, and also the specific procedures for assessing scientific excellence.
Key issues
Definition of excellence It addresses the analysis of the gender bias in the definition of scientific excellence and the exploration of alternative ways of defining and measuring it. For example, contributions about the 'masculine' model of success in science or the development of metrics that better capture scientific performance and are less gender-biased. Examples in which this key issue is addressed: – Bailyn, L. (2003) 'Academic Careers and Gender Equity: Lessons Learned from MIT' *Gender, Work and Organization*, Vol. 10, No 2, pages 137-153. – Feller, I. (2004) 'Measurement of scientific performance and gender bias' *Gender and Excellence in the Making,* Luxembourg, Office for Official Publications of the European Commission, pp. 35-40. – Laredo, Ph. (2004) 'From scientific excellence to research performance: the influence of production situations and or research collectives", in European Commission (2004), *Gender and Excellence in the Making*, Luxembourg, Office for Official Publications of the European Commission, pp. 155-160.
Scientific productivity It refers to the analysis of the differences between women and men's scientific productivity. It refers mainly to bibliometrics (i.e. the number of published articles and books and their influence) but may also include other indicators such as patents. Examples in which this key issue is addressed: – Bordons, M. and Mauleón, E. (2006) 'Women's Research Careers and Scientific Productivity in Public Research', in OECD, *Women in scientific careers: Unleashing the potential*, pp. 77-86. – Xie Y, and Shauman, K.A. (1998) 'Sex differences in research productivity: New evidence about an old puzzle' *American Sociological Review* 63(6), pp. 847-870.
Institutional practices of evaluation It refers to the analysis of the gender bias in the peer-review practices of evaluation. It includes not only research about the extent of the gender bias, but also about its explanations (male bonus, homosociability, male informal networks, gate-keeping). Examples in which this key issue is addressed: – Wenneras, C. and Wold, A. (1997) 'Nepotism and sexism in peer-review', *Nature* Vol. 387, pp. 341-343. – Griffin, G. (2004) 'Tackling gender bias in the measurement of scientific excellence: combating disciplinary containment', in European Commission (2004) *Gender and Excellence in the Making*, Luxembourg, Office for Official Publications of the European Commission, pp. 127-134.

Gender in research contents
This topic covers theories and explanations about the gender biased construction of the scientific knowledge, as well as relevant examples in which taking into account sex and gender in research content has significantly contributed to scientific excellence. In this sense, this topic covers theories and research that question the dominant paradigm in relation to both gender and science.
Key issues
Conceptual contributions It refers to theories and explanations about the gender biased construction of the scientific knowledge. Examples in which this key issue is addressed: – Haraway, D. (1988) 'Situated Knowledge: The science question in the feminism and the privilege of partial perspectives', *Feminist Studies*, 14, pp. 575-599. – Schiebinger, L. (2008) 'Getting More Women into Science and Engineering: Knowledge Issues', in Schiebinger, L. (ed.) (2008) *Gendered Innovations in Science and Engineering*, Stanford, Stanford University Press.
Examples of good practices It refers to concrete examples in which taking into account sex and gender has significantly contributed to scientific excellence. Examples in which this key issue is addressed: – Butovitsch T. (2008) 'If You Meet the Expectations of Women, You Exceed the Expectations of Men: How Volvo Designed a Car for Women Customers and Made World Headlines', in Schiebinger, L. (ed.) (2008) *Gendered Innovations in Science and Engineering*, Stanford, Stanford University Press. pp. 131-149. – Thompson, C. (2008) 'Stem cells, Women, and the New Gender and Science", in Schiebinger, L. (ed.) (2008) *Gendered Innovations in Science and Engineering*, Stanford, Stanford University Press, 109-130. – Klinge, I. (2007) 'Bringing Gender Expertise to Biomedical and Health-Related Research', *Gender Medicine*, Volume 4, Supplement B, *GenderBasic: Promoting Integration of Sex and Gender Aspects in Biomedical and Health-Related Research,* pp. 559-563.

Policies towards gender equality in science
This topic covers the analysis of national, regional and local measures and programmes towards gender equality in research. This topic is not focused on the description of the measures, but mainly on the comparison and evaluation of different policies towards gender equality in science.
Key issues
Evaluation of measures It covers the analysis of the impact of measures and programmes towards gender equality in research. Examples in which this key issue is addressed: – Donselaar, W. (2006), "Dutch Research Council policy actions to encourage the participation of women in science" in OECD, *Women in scientific careers: Unleashing the potential*, Ch. 15, pp. 161-166. – Caprile, M. (ed), Sánchez, B; Vallès, N.; Gómez, A.; Potrony, J.; Sixto, E.; Herrera, D.; Oleaga, M.; Amate, M. and and Isasa, I. (2008) *Monitoring progress towards gender equality in the Sixth Framework Programme*, European Commission, Directorate for Research. – Bailyn, L. (2003) 'Academic Careers and Gender Equity: Lessons Learned from MIT' *Gender, Work and Organization*, Vol. 10, No 2, pages 137-153.
Gender mainstreaming measures It covers the description, comparison and/or evaluation of gender mainstreaming measures and programmes towards gender equality in research. Gender mainstreaming measures includes equal opportunities legislation, gender studies, modernising human resource management, gender-proofing the pedagogy of science education and work/life balance measures. Examples in which this key issue is addressed: – Rees, T. (2002) *National Policies on Women and Science in Europe. Directorate General for Research, Women and Science*, Luxembourg: office for official Publications of European Communities. – Mouriki, A. (2005) 'Balancing Research Careers and Private Lives: Do Social Measures Matter? in OECD (2005) *Women in scientific careers: Unleashing the potential*, pp. 179-186
Positive action measures It covers the description, comparison and/or evaluation of positive action measures and programmes towards gender equality in research. Positive action measures includes networks, quotas and targets, role models and mentoring, and earmarked chairs, research funds and prizes. Examples in which this key issue is addressed: – Rees, T. (2002) *National Policies on Women and Science in Europe.* Directorate General for Research, Women and Science, Luxembourg: office for official Publications of European Communities. – Löther, A. (2005) 'Encouragement to Advance: A Programme to Promote Career Strategies for Women in German Academia' in OECD (2005) *Women in scientific careers: Unleashing the potential*, pp. 155-160.

5. Database

This chapter provides a set of methodological guidelines about the structure of the GSD, its coverage and technical design.

5.1. Structure

As already stated, the objective of the GSD is to provide an informed bibliography of all research carried out on gender and research at European, national and regional levels, making it accessible to researchers and policy-makers. The GSD should therefore be suitable for researchers and policy-makers with varying levels of expertise and different needs, ranging from obtaining the most basic information to more complex purposes, such us undertaking a conceptual map, or a meta-analysis, on the research on gender and science concerning a specific issue.

The structure of the GSD was developed according to this objective: it will contain detailed information on the contents and the methodological approach of each entry, in addition to the English abstract and the bibliographical references.

The GSD is composed of four main modules:

- Module 1: Bibliographical references
- Module 2: Title and abstract
- Module 3: Thematic module
- Module 4: Methodological module

5.1.1. Module 1: Bibliographical references

Every publication is adequately referenced following Harvard style (for further details about the Harvard style, see Harvard style, 2002; or University of Queensland, 2007).

5.1.2. Module 2: Title and abstract

This module includes the: English title, the English abstract and the indication if the abstract is the original one written by the author or was prepared for the GSD.

5.1.3. Module 3: Thematic module

This module is meant to codify the theme of the publication. It contains three different tabs: thematic coverage (which institutional sector, scientific field and life-course the publication refers to); relation with the topics and free keywords (3 to 5).

5.1.4. Module 4: Methodological module

The methodological module provides information about the methodological approach of the publication and its geographical and time coverage.

5.2. Data sources

International data sources

In every scientific field, there are well-established academic and scientific databases. They cover the most prestigious journals, indexing their articles and providing an English summary. In some cases, the coverage of these databases includes also a selection of relevant books, chapter of books, monographs, series, compilations, reports, PhD dissertations and congress papers.

Although these databases are strongly biased towards scientific journals published in English, their coverage is broadening and they index the most prestigious journals published in other languages.

The GSD is based on a systematic and exhaustive bibliographical search of the most relevant international databases. The following international databases were revised:

Scientific field	Database
Social sciences	
Sociology	CAS Sociological Abstracts
Education	ERIC - The Education Resources Information Center
Psychology	PsycINFO (APA)
Business and Economics	Econlit
	Business Source Elite
Gender studies	Gender Studies Database (NISC)
Humanities	Periodicals Index Online (earlier PCI)
Science and technology	
Science and technology	CAS Technology Research Database
Computer science & Engineering	Computer Source (Ebsco)
	IET (only UK)
	IEEE (only USA)
Chemistry	Chemical Abstracts
Life sciences	
	Medline
Multidisciplinary	
	ISI Web of Science
	JSTOR
	Academic Search Premier

National data sources

The GSD is based on a systematic and exhaustive bibliographical search of the most relevant national databases in each country:

- National academic and scientific databases

  In some countries there are official public organisms responsible of the compilation of the scientific production published at national level. They collect primarily scientific journals articles and selectively books, monographs, series, compilations, reports, PhD dissertations and congress papers.

  The main advantage of these national databases, for the purpose of the GSD, is that they focus on the scientific production published at the national level. However, their quality and coverage may vary.

- National academic and scientific repositories

  In parallel to the existence of official national academic and scientific databases, in most countries there are academic and scientific repositories. Often, these repositories are more updated than the official ones and have a broader coverage, including publications not well-accepted by the scientific establishment.

- Academic library catalogues

  In general terms, all the databases previously described are primarily focused on scientific journals. Books and other kind of publications (reports, monographs, etc) are only selectively included.

  The academic library catalogues appear to be the best option in order to carry out a systematic and exhaustive bibliographical search of books. In some countries, there is one academic library union catalogue, which includes the reference of all the books and documents contained in the libraries of the universities and academic institutions. In other countries, such a centralised catalogue is not available and the only option is to select some prestigious libraries.

In those countries where the number of potential publications is too high, the following criteria for selecting the entries are used:

- To give priority to empirical research. Other types of publications, drawing on conceptual issues, state-of-the-art, compilation of statistics or gender indicators are included only if very relevant.
- To achieve a representative balance of the national literature between scientific disciplines, time periods and topics and key issues.

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