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Structural change in research institutions: Enhancing excellence, gender equality and efficiency in research and innovation

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Enhancing excellence, gender equality and efficiency in research and innovation

2011

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Foreword

Just over a year ago, in October 2010, the European Commission presented its most ambitious policy for stimulating research and innovation to date - the Innovation Union flagship initiative. This initiative is one of the cornerstones of the Europe 2020 Strategy to stimulate smart, sustainable and inclusive growth in Europe. Boosting innovation means increasing the number of researchers in Europe by at least one million if we are to remain competitive and build on our strengths. We also need to make sure that people starting research careers find it attractive to stay in science. This is especially true for women: while 45% of doctorates are awarded to female students, only 30% of active researchers and 18% of full professors are women.

A group of high level experts has been brought together in order to investigate the reasons behind existing trends. This is their report. The experts have reviewed a large body of evidence, have identified where the problems lie, and have clearly formulated the conditions needed to remedy a waste of talent which has already lasted too long. The report argues that gender-aware management of universities and research organisations would have a positive impact on policies and practices in the recruitment, promotion and retention of both women and men, thus ultimately benefiting the very quality of research. There is no trade-off to look for between promoting gender equality and excellence in research. Instead we can achieve a win-win situation for all researchers, their institutions, and for Europe. We need to address these issues, not only for the sake of fairness and equality, but for the sake of science and research itself – we need to build our research capacity in Europe.

This report on Structural Change in Research Institutions comes at a critical moment for the implementation of the

Innovation Union flagship initiative. The Commission has just launched an open consultation on the best way of creating a truly unified European Research Area where we can exploit our research potential – including the potential of both men and women researchers – to the fullest. And later this year, the Commission will present its proposal for Horizon 2020 which will be the next-generation programme for supporting research and innovation.

The report rightly stresses that progress in integrating gender in research and innovation relies on firm and sustained top-level commitment. It is my wish that reading this report will inspire decision-makers and researchers alike – the men and women who are engaged in making the Innovation Union a success.

Máire GEOGHEGAN-QUINN

Executive Summary

The key role given to research and innovation in striving towards a smart, sustainable and inclusive growth in Europe means that the EU should make full use of its human capital – thereby involving both men and women. Evidence shows that research performance is limited by the perpetuation of direct and indirect sex discrimination and that promoting gender equality at all levels contributes to achieving excellence and efficiency.

Initiatives to promote gender equality in research have been developed in Europe and the US over a number of years. The focus was initially on specific programmes to help women pursue scientific careers. However, those programmes have proved to be insufficient to increase the number of women in science, particularly in positions of responsibility, and have not helped to address the structural barriers contributing to the well known leaky pipeline phenomenon.

This has led to a shift in focus towards addressing the structural transformation of institutions, using a systemic, comprehensive and sustainable approach. The US has led the way with the ADVANCE programme, funded by the National Science Foundation. Some initiatives have also been taken in Europe, but the scale of these needs to be increased.

Based on recent scientific findings and research practices, this report analyses the progress made so far in legislation, participation and policy, describes the problems remaining for research institutions in Europe and stresses the role that EU policy-makers, science institutions and gatekeepers of excellence must play in order to advance gender equality in research and innovation.

Five main problems faced by research institutions are identified. The first is opaqueness in decision-making: despite significant progress in Europe, lack of transparency continues to affect structures and processes, with the associated phenomenon of "old boys" networks and patronage. Evidence suggest that women and men would both benefit from a system where there is clarity of what is required from researchers, information is freely available, and clear criteria are used in decision making.

A second set of problems relate to institutional practices which, while appearing to be neutral, do have negative effects on the career opportunities of women. Cognitive errors in assessing merit, suitability for leadership, or evaluation of performance are embedded in institutional practices, often despite good intentions and a commitment to fairness.

Thirdly, a number of studies have demonstrated the considerable effect of unconscious gender bias in what is the hallmark of science: the assessment of excellence and particularly the process of peer review. The practice of evaluating excellence often conceals gender bias.

Fourth, gender inequality generates wasted opportunities and cognitive errors in knowledge, technology and innovation. Research has shown that gender bias has important implications for the content of science itself. The integration of sex and gender analysis in the research content increases the quality of research and improves the acceptance of innovation in the market.

Finally, despite the many years of European legislation on equal opportunities, statistics show that EU Member States still have a gender pay gap, and gender continues to be a structuring factor in the workplace, also in research. Work is organized in gendered ways, which makes it difficult for talented women to reconcile work and family; harassment, concentration of power, and the guru/acolytes model of power relations are also factors affecting women negatively.

This report proposes structural change in science institutions as the means to address each of these five sets of problems, so that decision making is more transparent, unconscious bias is removed from institutional practices, human resources management is modernized, excellence is promoted through diversity, and research and innovation are improved by the integration of a gender perspective.

In addition, it signals three essential elements which should be considered as a prerequisite by all organisations undertaking structural change: knowing the institution, by developing statistics and indicators, so that the situation of each institution becomes widely known and acknowledged; getting top level support from persons in positions of responsibility; generating effective management practices, by ensuring gender expertise and by raising awareness.

While a lead is required from the EU and its Member States, a wider range of actors also need to play an active role in modernizing the way in which R&I is conducted in Europe. Some of the most successful innovators are paving the way but others are still lagging behind. Universities and research institutions, funding bodies and some learned societies still operate with the stereotypical gender regime of a full time breadwinning man and a female second earner. This report also proposes key recommendations to help different types of actors to improve their performance.

Glossary[1]

Sex refers to the biologically determined characteristics of men and women in terms of reproductive organs and functions based on chromosomal complement and physiology. As such, sex is globally understood as the classification of living things as male or female

Gender refers to the social construction of women and men, of femininity and masculinity, which varies in time and place, and between cultures. The notion of gender appeared in the seventies and was put forward by feminist theorists who challenged the secondary position of women in society. It departs from the notion of sex to signal that biology or anatomy is not a destiny. It is important to distinguish clearly between gender and sex. These terms are often used interchangeably while they are conceptually distinctive

Equal opportunity indicates the absence of barriers to economic, political and social participation on the grounds of sex. Such barriers are often indirect, difficult to discern and caused by structural phenomena and social representations that have proved particularly resistant to change. Equal opportunities, which is founded on the rationale that a whole range of actions are necessary to redress deep-seated sex and gender-based inequities, should be distinguished from equal treatment, which merely implies avoiding direct discrimination

Gender mainstreaming is the systematic integration of the respective situations, priorities and needs of women and men in all mainstream policies with a view to promoting equality between women and men[2]

In **gender-sensitive** research, gender is consistently taken into account throughout the research cycle

Gender-specific research focuses on gender itself as a subject matter

Gender-blind research does not take gender into account, being based on the often incorrect assumption that possible differences between men and women are not relevant for the research at hand

Gender bias is the often unintentional and implicit differentiation between men and women by placing one gender in a hierarchical position relative to the other in a certain context, as a result of stereotypical images of masculinity and femininity. It influences both the participation of men and women in research (hence the underrepresentation of women) and the validity of research. An example of gender bias in research is research that focuses on the experience and point of view of either men or women, while presenting the results as universally valid

Gender audits are evaluations that monitor and evaluate the implementation of gender issues into procedures. Unlike regular audits, they are based on self-assessments of how gender issues are addressed in internal organizational processes, and not on external evaluation

Gender impact assessments provide help for policymakers in incorporating a gender perspective into policies that take account of the different needs, characteristics and behaviours of the users at whom they are aimed

Gender proofing is a check carried out on a policy proposal to ensure that any potential gender discriminatory effects arising from that policy have been avoided and that gender equality is promoted[3]

Gender analysis is the process of considering the impact that a development programme or project may have on women / girls and men / boys, and on the economic and social relationships between them[4]

Acronyms

ERA	European Research Area
R&I	Research & Innovation (including technical development
NSF	National Science Foundation (US)
STEM	Science, technology, engineering and mathematics

Footnotes

[1] Definitions from Gender Toolkit: http://www.yellowwindow.be/genderinresearch/downloads/YW2009_GenderToolKit_Module1.pdf
unless otherwise indicated

[2] http://www.ofmdfmni.gov.uk/index/equality/gender-equality/gender-vocabulary.htm#genderproofing

[3] http://www.ofmdfmni.gov.uk/index/equality/gender-equality/gender-vocabulary.htm#genderproofing

[4] http://www.acil.com.au/glossary.htm

Introduction

With the 7th Framework Programme in research, the European Commission's activities on women in science changed character: from *women scientists*, the focus moved to the *institutions* that employ them in order to address gender management issues and work towards a better representation and retention of women at all levels of their scientific careers. This is known as Structural Change.

In February 2011 the European Commission convened the Expert Group on Structural Change to assist the Commission in identifying the most appropriate means to reinforce structural change activities in cooperation with EU Member and Associated countries, as requested by the EU Competitiveness Council in May 2010. The Group was tasked to summarise its work in a report which would feed into the discussions on possible recommendations to the Member States.

This Report titled ***Structural Change in Research Institutions: Enhancing excellence, gender equality and efficiency in research and innovation*** reflects the mandate for the Group which required a) Problem analysis, b) Defining the objectives, c) Examining options and impact, d) Planning of future work. Therefore, Chapter 1 sets the scene for the issue of structural change and describes the objectives. Chapter 2 details the problems faced by universities and research institutions due to their institutional practices. Chapter 3 brings to the fore the essential elements of structural change: knowing the institution, securing top-level support and generating effective management practices. Solutions to the problems described in Chapter 2 are detailed in Chapter 4. The Group's recommendations form the Annex of the Report – expressed as a gender equality strategy, with key steps for actors at the EU, national and institutional level.

The Expert Group on Structural Change consisted of 8 members:

Ines Sanchez de Madariaga (*Chair*) is Director of the Women and Science Unit, Cabinet of the Spanish Minister of Science and Innovation, and Professor of city planning at the Madrid School of Architecture. Ex-Fulbright grantee, she has been Visiting Scholar at Columbia University, NY, the London School of Economics and Political Science, and the School of Architecture Bauhaus-Weimar.

Tiia Raudma (*Rapporteur)* works for the Estonian Ministry of Education and Research. She was Estonia's first representative in the European Commission's Helsinki Group on Women in Science, and rapporteur for the Commission's report *Mapping the Maze: Getting more women to the top in research*. As seconded national expert to

the Commission, she co-authored the report *Stocktaking 10 Years of Women in Science Policy by the European Commission 1999-2009*.

Thomas Eichenberger is head of the Office for Faculty Affairs at ETH Zurich. His expertise lies in the area of faculty hiring on an international scale, dual career aspects, mobility of researchers and their families and the career development of young researchers.

Alice Hogan brings expertise and experience on transforming academic institutions to advance excellence through greater participation of women. As a Program Director at the U.S. National Science Foundation, she chaired the design and the implementation committees charged with created new approaches to enhancing the advancement and full participation of women in academic science. She served as the first Program Director of the ADVANCE Program, and now serves as a consultant to universities seeking institutional transformation.

Elizabeth Pollitzer was a lecturer and researcher in the area of Human Computer Interaction. She is director of Portia Ltd, a not-for-profit organization promoting the role of women in STEM through a range of multi-stakeholder projects and support actions linking scientists, policy makers, gender research experts and other relevant actors.

Teresa Rees is Director for Wales of the Leadership Foundation for Higher Education and a Professor in the School of Social Sciences, Cardiff University. She is a long term expert adviser to the European Commission on gender mainstreaming and women and science. She was made a Commander of the order of the British Empire for services to higher education and equal opportunities.

Martina Schraudner studied Biology and Biotechnology at the Technical University of Munich. Since 2001 she has led projects in strategic research planning at the Fraunhofer headquarters, and since 2008 she is also Professor of Gender and Diversity in Organisations at the Institute for Machine Tools and Factory Management at the Technical University of Berlin.

Sophie Sergent is a specialist in labour and employment law and has worked for over 15 years in the Human Resources Department at Ifremer, the French Research Institute for the exploitation of the Sea. As deputy director, in charge of researcher/ engineer career development, she initiated the Institute's commitment to a voluntary approach towards professional equality between men and women (formalized agreement). Currently in the Department for European Affairs, she is a member of the "Parity" Network under the supervision of the French Ministry of Research.

Chapter 1:

Setting the scene and the objectives

1.1 Why Europe needs more women in science and technology

In the European Union, while men's and women's access to science in schools and universities has improved immeasurably, the same cannot be said for women's access to scientific careers. Women account today for almost 60% of university degrees in Europe, and they achieve excellent grades, better on average than their male counterparts. However, their presence at the top of scientific and academic careers is scarce. Only 18% of full professors in Europe are women; 13% of heads of higher education institutions and 22% of board members in research decision-making.[1] Women's skills, knowledge and qualifications are grossly underused in the labour market.

The low numbers of women in decision making positions throughout the science and technology system is a waste of talent that European economies cannot afford. Nor can Europe afford to waste the professional contributions of so many of its best- prepared citizens, particularly in the present context of the global economic recession and the emerging global competitors in Asia and Latin America. The Grand Challenges facing Europe (including climate change and demography) require the full participation of women in its science and technology system if it wants to develop suitable solutions for all its citizens and does not want to continue losing ground in the new economic world order.

The global recession has focused attention on the ingredients required for robust sustainable economies. It is widely acknowledged that research and innovation (R&I) are the main drivers of a prosperous economy. In today's global R&I market place, Europe has to compete with other regions where highly educated talent pools and markets for innovation exist, such as Singapore, China, India, Latin America, South Korea and the US. Many corporations are undertaking organizational change of their science and technology systems to adapt to these new conditions and have already established a presence in these regions in order to move their research and technology work closer to where scientific talent and market opportunities lie.

In this context, Europe needs to get the best out of its R&I systems and there is an urgent need to advance on gender equality in science. The mainstreaming of gender in the scientific system and in the R&I marketplace offers an important competitive advantage for strengthening the scientific endeavour through more effective deployment of the female human capital; creating new markets that recognize the importance of gender; and increasing the international competitiveness of Europe's research workforce in general.[2]

Promoting gender equality will also allow industry to benefit from a wider talent pool of human resources. It assists in the development of new economic opportunities by widening the experiences and expertise brought to creating innovation and to identifying and understanding new markets[3]. More women among scientific decision makers would enhance the robustness of the decisions made due to an increase in the diversity of viewpoints[4]. Diversity also plays a role in producing goods and services informed by a broad and in-depth knowledge of the society for which they are prepared. This is already acknowledged not just in the US, but by many leading European and international R&I companies who have focused attention on ensuring that they recruit, retain and promote the best talent. Diversity of knowledge and social capital in teams is vital to produce new ideas[5].

It is also an issue of real excellence in research. A better integration of the gender perspective in research alongside a better inclusion of women in the R&I workforce will improve the quality, objectivity and relevance of knowledge, technology and innovation for the benefit of all members of society. Through a better consideration of the sex and gender variables throughout the research process, it will reduce bias and identify gaps and missed opportunities. A system which does not provide equal possibilities for professional development to men and women is not getting the best value from the available talent. As a result it cannot produce the best results.

The full participation of women in science and technology will also contribute to social progress. Ensuring effective equality of opportunities between men and women in science and technology is obviously an issue of justice. Equality between men and women is one of the European Union's founding principles. Research findings consistently demonstrate that those countries which score highly on equality indicators are those which are more successful in wellbeing, social cohesion and integration. The costs of inequality include unemployment, crime, and poor health[6] .

1.2 Progress so far in legislation, participation and policy

Since 1957 and the Treaty of Rome, the principle of equality between women and men has formed an essential part of European Union's political, social and economic development. The principle of equal pay for equal work is also part of the Treaty of Rome. The Treaty

of Amsterdam includes the provision of eliminating inequalities and promoting equality between women and men into all its activities[7] (also known as 'gender mainstreaming'). Legislation has been developed to ensure equal opportunities and treatment for women and men on the fields of employment, working conditions and social security. In Europe, there has been significant progress in equal opportunities in the field of education – 58% of university graduates and 45% of PhD graduates are women[8]. European women's increased intellectual and social capital, and higher career aspirations, would provide an important competitive advantage in international markets for innovation and technology.

The Commission's commitment to gender equality was further confirmed in its *Strategy for Equality between women and men 2010-2015*[9], which includes amongst its priority areas equal economic independence for women and men, equal pay for work of equal value and equality in decision-making. In 2010, the EU Competitiveness Council stressed the need to step up support to structural change for the modernization of universities and research institutions, and to integrate gender issues into research as a resource to create new knowledge and stimulate innovation[10].

Current understanding of the role of gender in science has evolved over time from the early and oppositional associations of 'gender' with women and men to gender as an organizing principle for both institutions and scientific disciplines, then further to gender as biological and social factors affecting research itself. Under the leadership of the European Commission's DG Research (marked by the publication in 2001 of the ETAN report[11]), around 20 key reports have been produced over the last 10 years in support of gender equality policies[12].

Sufficient research evidence and expertise is now available across Europe to address many of the adverse effects of the gender imbalance problem in order to enhance excellence of scientific knowledge making and procedures related to scientific institutions. There is also evidence indicating that integrating a gender perspective in research can improve its relevance and quality.[13]

Many projects have been designed to increase interest among women and girls in specific fields of science, technology, engineering and mathematics (STEM)[14]. Over the years, the EU has funded numerous projects in the field of women in science, and, in particular, and more recently, concerning structural change[15] (e.g. genSET on gender action plans in science[16], and GENDERA on best practices[17]). Many universities and research institutions have sought to address the lack of women in their science departments, as students and as staff. There are significant variations in the extent to which the relative lack of women in some STEM subjects and in senior positions in the academy is recognised as a problem in different countries[18]. There are differences too in how successful initiatives designed to address the issue have been. It is not always equality policies that have the most effect; more transparency in hiring can make a difference.

Despite growing recognition of the gender imbalance in science, and the development of various projects and policies in Member States and their universities and research institutions, progress has been slow. The organization of R&I in Europe still relies on male and female stereotypes to the disadvantage of science, technology and the economy.[19] In addition, the lack of role models of women in senior positions has had a negative impact on high-level aspirations of other women. The outcome is a waste of talent, missed opportunities for scientific advancement and innovation, and a lack of clarity of what is meant by scientific excellence.[20]

Gender mainstreaming has been one of the major strategies adopted by the European Union and the Member States for achieving gender equality (and as a social policy strategy it is considered a success). However, in science it is a more recent strategy that has not yet been embraced widely in universities or research institutions. Consequently, in relation to the problem of the under-representation and under-promotion of women in science, it has not produced the hoped-for results.

Similar problems to those existing in Europe have been identified in the US, where the National Science Foundation (NSF) has invested substantially in the ADVANCE Programme[21] in supporting universities to undertake institutional transformation to enhance the participation of women in science. Sex disaggregated statistics on the hiring of faculty, the size of their pay cheques, and even the size of their laboratories have demonstrated that gender is a key organizing principle in academia. Investment in this process through the ADVANCE Programme reflects the value NSF attaches to addressing structural issues at US universities.

1.3 Engaging research institutions in structural change

'Structural change' in universities and research institutions means making them more gender-aware, thereby modernising their organizational culture. This has important implications for equal opportunities, full use of

talent, appeal of scientific careers, and quality of scientific research.[22] It implies systemic, integrated, long term approaches rather than piecemeal short term measures.

Following on from the 10th anniversary of the launching of its gender policies in science (the Women and Science Unit in DG Research and the Helsinki Group[23] were created in 1999), the European Commission continues to promote the structural transformation of science institutions in order to become a world leader in science and technology. To this end, and following the explicit call for the reinforcement of the 'structural change programme' by the EU Council[24], the European Commission is reflecting upon a recommendation to the EU Member States. This is also in tune with the recent agreement on women in science, engineering and technology (SET) adopted by the UN in March 2011 that referred to 'mainstreaming a gender perspective into science, technology and innovation policies and programmes'.[25]

There is scope for the European Commission and the Member States to step up their commitment to gender equality in research institutions. By enhancing its policy initiatives, and investing in a well funded programme like ADVANCE in the new European Framework Programme for research and innovation (Horizon 2020), the EU has the chance to capitalize on the investments made over the last twelve years[26], and to become a world leader in R&I.

Promoting organizational and cultural change implies that the academic administration of universities, research institutions and funding bodies remove obstacles to women's professional careers. Action at institutional level is required to ensure a greater presence of women in science and technology, particularly at the top of scientific careers. This can only be achieved in the framework of strengthened EU and national government policies and investments on gender equality, effectiveness of equality legislations throughout Europe, as well as incentives for cultural changes. Greater gender equality in science will ultimately also help the EU to compete on an equal footing with world economic powers.

1.4 Cost of no action

There are four consequences that are of concern:

1) Danger of flawed research or diminished relevance of results
2) Missing innovation and market opportunities
3) Unfulfilled use of human capital (women scientists) in a competitive global R&I economy
4) Increased societal distrust of, and reduced support for, science and its institutions

The core of the EU strategy for economic and social development is innovation in research and in taking ideas to markets. The Grand Challenges of the EU 2020 Strategy (i.e. energy, climate change, aging, health) have a strong gender dimension, which, if ignored, can result in missed opportunities for innovation in research and in development of markets. Not including gender perspectives in addressing the core EU2020 themes means that chances for increasing the broad acceptance of new technologies within Europe will be lost. Without strengthening the inclusion of women and integrating the gender dimension within the Innovation Union, its aims to deliver higher levels of employment, productivity and social cohesion, and to strengthen Europe's knowledge base, are simply not achievable.

Securing the supply of scientific expertise in Europe is a challenge for the European Research Area. Current practices – such as neglecting the development of transferable skills of European R&I human resources capacity or not fully utilizing the trained talent already available (in particular, women) – are not sustainable in the longer term, and will threaten European competitiveness internationally. Inaction will lead to a loss of highly educated and trained women scientists who may choose other careers or move to other global regions[27]. It will also force an even greater rate of transfer of industrial R&I functions from Europe to regions where there are ready-made markets and talent pools.

There is research evidence that shows how the integration of gender analysis in research processes can lead to innovation[28]. Ignoring how sex and gender bias limit creativity and diminish excellence in research will create barriers to the full realization of the benefits that society expects from its investment in science and engineering.

The EU and Member States' aspirations for economic and societal development enabled through R&I can only be realized through novel research planning, design and implementation, where the gender perspective is an essential element. Sufficient examples and methods for the deployment of gender analysis in R&I are available. Not utilizing this knowledge will perpetuate gender biases in the practices and content of science, which have already been shown to impact negatively on scientific quality[29].

Footnotes

[1] She Figures 2009 http://ec.europa.eu/research/science-society/document_library/pdf_06/she_figures_2009_en.pdf

[2] A nation's competitiveness depends significantly on whether and how it educates and utilizes its female talent. That is, to give women the same rights, responsibilities and opportunities as men. *World Economic Forum: Global Gender Gap Report 2010*

[3] Women now drive the world economy.'... women represent a growth market bigger than China and India combined—more than twice as big, in fact. Given those numbers, it would be foolish to ignore or underestimate the female consumer. And yet many companies do just that, even ones that are confident they have a winning strategy when it comes to women. Michael J. Silverstein and Kate Sayer, The Female Economy, Harvard Business Review, September 2009

[4] NY Times: Why we need women in science: http://www.nytimes.com/2010/03/06/world/europe/06iht-ffscience.html?pagewanted=all 5 March 2010

[5] http://www.genderinscience.org.uk/consensus.report.html

[6] Wilson, R and Pickett, K (2009) *The Spirit Level: Why more equal societies almost always do better* London: Penguin

[7] Article 8, Treaty on the Functioning of the European Union

[8] She Figures 2009 – the statistical reference year is 2006

[9] COM(2010)491

[10] 3016th EU Council (Competitiveness) meeting - "Conclusions concerning various issues related to the development of the European Research Area", 26 May 2010

[11] Promoting Excellence through Mainstreaming Gender Equality: ftp://ftp.cordis.europa.eu/pub/improving/docs/g_wo_etan_en_200101.pdf

[12] summarised in *Stocktaking 10 years of "Women in Science" policy by the European Commission 1999-2009* http://ec.europa.eu/research/science-society/document_library/pdf_06/stocktaking-10-years-of-women-in-science-book_en.pdf

[13] Gender and Excellence in the Making, 2004 http://ec.europa.eu/research/science-society/pdf/bias_brochure_final_en.pdf
See also The Gender Challenge in Research Funding http://ec.europa.eu/research/science-society/pdf/bias_brochure_final_en.pdf

[14] STEM is seen as a major driver of innovation

[15] http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=1284&lang=1

[16] See Box 4.2

[17] http://www.gendera.eu/

[18] E.g. German concern: *Looking at the numbers of students in electrical engineering, the proportion of women is 11 % and in mechanical engineering it is 18 % … we will only be able to win more women for these professions, and for our industry, if we help them reconcile family and work."* Gabriele Sons, Director General Gesamtmetall (umbrella association of regional employers' associations in the German metal and electrical industries)

[19] Report by the European Commission's High Level Group on Human Resources in Science and Technology: "Europe simply cannot reach the level of SET resources needed for its development without finding ways to remove its anachronistic science gender imbalance." http://ec.europa.eu/research/conferences/2004/sciprof/pdf/final_en.pdf Europe

needs more scientists! conference, Brussels, 2 April 2004

[20] Responses to the question *"What actions should be taken at EU level to further strengthen the role of women in science and innovation?" in the European Commission's'* Green Paper - From Challenges to Opportunities: Towards a Common Strategic Framework for EU Research and Innovation funding' emphasized the importance of the gender dimension in both the content and the processes in research (including the issue of gender balance). http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=documents

[21] see also Box 4.1

[22] http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=1281

[23] Group of national representatives formed by the European Commission in 1999 in order to place the women and science debate on a policy footing http://ec.europa.eu/research/science-society/document_library/pdf_06/gender-and-research-beyond-2009_en.pdf

[24] 3016th EU Council meeting - "Conclusions concerning various issues related to the development of the European Research Area", 26 May 2010.

[25] United Nations E/CN.6/2011/L.6 Economic and Social Council

[26] Stocktaking Report: http://ec.europa.eu/research/science-society/document_library/pdf_06/stocktaking-10-years-of-women-in-science-book_en.pdf

[27] What can be done to stop women leaving science? *The high cost of being a woman. New Scientist*, 16 July 2011

[28] Recognizing sex differences: Common colon cancer screening methods detect only 30% of cancer cases in women. *Bridging the Gender Gap: Combined Technologies Offer Promise for Detecting Colon Cancer in Women, ScienceDaily* July 20, 2010, www.sciencedaily.com/releases/2010/07/100719163241.htm

[29] Editors of peer-reviewed journals can require analysis of sex and gender effects when selecting papers for publication. The US Journal of the National Cancer Institute does it as a matter of "commitment to sound, scientific research": "where appropriate, clinical and epidemiological studies should be analysed to see if there is an effect of sex or any of the major ethnic groups. If there is no effect, it should be so stated in Results"
Women in Science and Medicine, The Lancet, Volume 377, Issue 9768, Page 811, 5 March 2011
Simone Buitendijk, Daniela Corda, Anders Flodström, Anita Holdcroft, Jackie Hunter, Elizabeth Pollitzer, Teresa Rees, Curt Rice, Londa Schiebinger, Martina Schraudner, Karen Sjørup, Rolf Tarrach

Chapter 2:

Problems faced by research institutions

of university degrees in Europe, and they achieve excellent grades, better on average than their male counterparts. However, their presence at the top of scientific and academic careers is scarce. Only 18% of full professors in Europe are women; 13% of heads of higher education institutions and 22% of board members in research decision-making.1 Women's skills, knowledge and qualifications are grossly underused in the labour market. The low numbers of women in decision making positions throughout the science and technology system is a waste of talent that European economies cannot afford. Nor can Europe afford to waste the professional contributions of so many of its best- prepared citizens, particularly in the present context of the global economic recession and the emerging global competitors in Asia and Latin America. The Grand Challenges facing Europe (including climate change and demography) require the full participation of women in its science and technology system if it wants to develop suitable solutions for all its citizens and does not want to continue losing ground in the new economic world order. The global recession has focused attention on the ingredients required for robust sustainable economies. It is widely acknowledged that research and innovation (R&I) are the main drivers of a prosperous economy. In today's global R&I market place, Europe has to compete with other regions where highly educated talent pools and markets for innovation exist, such as Singapore, China, India, Latin America, South Korea and the US. Many corporations are undertaking organizational change of their science and technology systems to adapt to these new conditions and have already established a presence in these regions in order to move their research and technology work closer to where scientific talent and market opportunities lie. In this context, Europe needs to get the best out of its R&I systems and there is an urgent need to advance on gender equality in science. The mainstreaming of gender in the scientific system and in the R&I marketplace offers an important competitive advantage for strengthening the scientific endeavour through more effective deployment of the female human capital; creating new markets that recognize the importance of gender; and increasing the international competitiveness of Europe's research workforce in general. Promoting gender equality will also allow industry to benefit from a wider talent pool of human resources. It assists in the development of new economic opportunities by widening the experiences and expertise brought to creating innovation and to identifying and understanding new markets. More women among scientific decision makers would enhance the robustness of the decisions made due to an increase in the diversity of viewpoints. Diversity also plays a role in producing goods and services informed by a broad and in-depth knowledge of the society for which they are prepared. This is already acknowledged not just in the US, but by many leading European and international R&I companies who have focused attention on ensuring that they recruit, retain and promote the best talent. Diversity of knowledge and social capital in teams is vital to produce new ideas. It is also an issue of real excellence in research. A better integration of the gender perspective in research alongside a better inclusion of women in the R&I workforce will improve the quality, objectivity and relevance of knowledge, technology and innovation for the benefit of all members of society. Through a better consideration of the sex and gender variables throughout the research process, it will reduce bias and identify gaps and missed opportunities. A system which does not provide equal possibilities for professional development to men and women is not getting the best value from the available talent. As a result it cannot produce the best results. The full participation of women in science and technology will also contribute to social progress. Ensuring effective equality of opportunities between men and women in science and technology is obviously an issue of justice. Equality between men and women is one of the European Union's founding principles. Research findings consistently demonstrate that those countries which score highly on equality indicators are those which are more successful in wellbeing, social cohesion and integration. The costs of inequality include unemployment, crime, and poor health6 . Since 1957 and the Treaty of Rome, the principle of equality between women and men has formed an essential part of European Union's political, social and economic development. The principle of equal pay for equal work is also part of the Treaty of Rome. The Treaty of Amsterdam includes the provision of eliminating inequalities and promoting equality between women and men into all activities (also known as 'gender mainstreaming'). Legislation has been developed to ensure equal opportunities and treatment for women and men on the fields of employment, working conditions and social security. In Europe, there has been significant progress in equal opportunities in the field of education– 58% of university graduates and 45% of PhD graduates are women8. European women's increased intellectual and social capital, and higher career aspirations, would provide an important competitive advantage in international markets for innovation and technology. The Commission's commitment to gender equality was further confirmed in its Strategy for Equality between women and men 2010-20159, which includes amongst its priority areas equal economic independence for women and men, equal pay for work of equal value and equality in decision-making. In 2010, the EU Competitiveness Council stressed the need to step up support to structural change for the modernization of universities and research institutions, and to integrate gender issues into research as a resource to create new knowledge and stimulate innovation10. Current understanding of the role of gender in science has evolved over time from the early and oppositional associations of 'gender' with women and men to gender as an organizing principle for both institutions and scientific disciplines, then further to gender as biological and social factors affecting research itself. Under the leadership of the European Commission's, DG Research (marked by the publication in 2001 of the ETAN report), around 20 key reports have been produced over the last 10 years in support of gender equality policies. Sufficient research evidence and expertise is now available across Europe to address many of the adverse effects of the gender imbalance problem in order to enhance excellence of scientific knowledge making and procedures related to scientific institutions. There is also evidence indicating that integrating a gender perspective in research can improve its relevance and quality. Many projects have been designed to increase interest among women and girls in specific fields of science, technology, engineering and mathematics (STEM). Over the years, the EU has funded numerous projects in the field of women in science, and, in particular, and more recently, concerning structural change (e.g. genSET on gender action plans in science, GENDERA on best practices). Many universities and research institutions have sought to address the lack of women in their science departments, as students and as staff. There are significant variations in the extent to which the relative lack of women in some STEM subjects and in senior positions in the academy is recognised as a problem in different countries18. There are differences too in how successful initiatives designed to address the issue have been. It is not always equality policies that have the most effect; more transparency in hiring can make a difference. Despite growing recognition of the gender imbalance in science, and the development of various projects and policies in Member States and their universities and research institutions, progress has been slow. The organization of R&I in Europe still relies on male and female stereotypes to the disadvantage of science, technology and the economy. In addition, the lack of role models of women in senior positions has had a negative impact on high-level aspirations of other women. The outcome is a waste of talent, missed opportunities for scientific advancement and innovation, and a lack of clarity of what is meant by scientific excellence. Gender mainstreaming has been one of the major strategies adopted by the European Union and the Member States for achieving gender equality (and as a social policy strategy it is considered a success). However, in science it is a more recent strategy that has not yet been embraced widely in universities or research institutions. 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This has important implications for equal opportunities, full use of talent, appeal of scientific careers, and quality of scientific research It implies systemic, integrated, long term approaches rather than piecemeal short term measures. Following on from the 10th anniversary of the launching of its gender policies in science (the Women and Science Unit in DG Research and the Helsinki Group23 were created in 1999), the European Commission continues to promote the structural transformation of science institutions in order to become a world leader in science and technology. To this end, and following the explicit call for the reinforcement of the 'structural change programme' by the EU Council24, the European Commission is reflecting upon a recommendation to the EU Member States. This is also in tune with the recent agreement on women in science, engineering and technology (SET) adopted by the UN in March 2011 that referred to 'mainstreaming a gender perspective into science, technology and innovation policies and programmes'. There is scope for the European Commission and the Member States to step up their commitment to gender equality in research institutions. By enhancing its policy initiatives, and investing in a well funded programme like ADVANCE in the new European Framework Programme for research and innovation (Horizon 2020), the EU has the chance to capitalize on the investments made over the last twelve years26, and to become a world leader in R&I. Promoting organizational and cultural change implies that the academic administration of universities, research institutions and funding bodies remove obstacles to women's professional careers. Action at institutional level is required to ensure a greater presence of women in science and technology, particularly at the top of scientific careers. This can only be achieved in the framework of strengthened EU and national government policies and investments in gender equality, effectiveness of equality legislations throughout Europe, as well as incentives for cultural changes. Greater gender equality in science will ultimately also help the EU to compete on an equal footing with old economic powers. In the European Union, while men's and women's access to science in schools and universities has improved immeasurably, the same cannot be said for women's access to scientific careers. Women count today for almost 60% of university degrees in Europe, and they achieve excellent grades, better on average than their male counterparts. However, their presence at the top of scientific and academic careers is scarce. Only 18% of full professors in Europe are women; 13% of heads of higher education institutions and 22% of board members in research decision-making.1 Women's skills, knowledge and qualifications are grossly underused in the labour market. The low numbers of women in decision making positions throughout the science and technology system is a waste of talent that European economies cannot afford. Nor can Europe afford to waste the professional contributions of so many of its best- prepared citizens, particularly in the present context of the global economic recession and the emerging global competitors in Asia and Latin America. The Grand Challenges facing Europe (including climate change and demography) require the full participation of women in its science and technology system if it wants to develop suitable solutions for all its citizens and does not want to continue losing ground in the new economic world order. The global recession has focused attention on the ingredients required for robust sustainable economies. It is widely acknowledged that research and innovation (R&I) are the main drivers of a prosperous economy. In today's global R&I market place, Europe has to compete with other regions where highly educated talent pools and markets for innovation exist, such as Singapore, China, India, Latin America, South Korea and the US. Many corporations are undertaking organizational change of their science and technology systems to adapt to these new conditions and have already established a presence in these regions in order to move their research and technology work closer to where scientific talent and market opportunities lie. In this context, Europe needs to get the best out of its R&I systems and there is an urgent need to advance on gender equality in science. The mainstreaming of gender in the scientific system and in the R&I marketplace offers an important competitive advantage for strengthening the scientific endeavour through more effective deployment of the female human capital; creating new markets that recognize the importance of gender; and increasing the international competitiveness of Europe's research workforce in general. Promoting gender equality will also allow industry to benefit from a wider talent pool of human resources. It assists in the development of new economic opportunities by widening the experiences and expertise brought to creating innovation and to identifying and understanding new markets. More women among scientific decision makers would enhance the robustness of the decisions made due to an increase in the diversity of viewpoints. Diversity also plays a role in producing goods and services informed by a broad and in-depth knowledge of the society for which they are prepared. This is already acknowledged not just in the US, but by many leading European and international R&I companies who have focused attention on ensuring that they recruit, retain and promote the best talent. Diversity of knowledge and social capital in teams is vital to produce new ideas. It is also an issue of real excellence in research. A better integration of the gender perspective in research alongside a better inclusion of women in the R&I workforce will improve the quality, objectivity and relevance of knowledge, technology and innovation for the benefit of all members of society. Through a better consideration of the sex and gender variables throughout the research process, it will reduce bias and identify gaps and missed opportunities. A system which does not provide equal possibilities for professional development to men and women is not getting the best value from the available talent. As a result it cannot produce the best results. The full participation of women in science and technology will also contribute to social progress. Ensuring effective equality of opportunities between men and women in science and technology is obviously an issue of justice. Equality between men and women is one of the European Union's founding principles. Research findings consistently demonstrate that those countries which score highly on equality indicators are those which are more successful in wellbeing, social cohesion and integration. The costs of inequality include unemployment, crime, and poor health6 . Since 1957 and the Treaty of Rome, the principle of equality between women and men has formed an essential part of European Union's political, social and economic development. The principle of equal pay for equal work is also part of the Treaty of Rome. The Treaty of Amsterdam includes the provision of eliminating inequalities and promoting equality between women and men into all activities (also known as 'gender mainstreaming'). Legislation has been developed to ensure equal opportunities and treatment for women and men on the fields of employment, working conditions and social security. In Europe, there has been significant progress in equal opportunities in the field of education– 58% of university graduates and 45% of PhD graduates are women8. European women's increased intellectual and social capital, and higher career aspirations, would provide an important competitive advantage in international markets for innovation and technology. The Commission's commitment to gender equality was further confirmed in its Strategy for Equality between women and men 2010-20159, which includes amongst its priority areas equal economic independence for women and men, equal pay for work of equal value and equality in decision-making. In 2010, the EU Competitiveness Council stressed the need to step up support to structural change for the modernization of universities and research institutions, and to integrate gender issues into research as a resource to create new knowledge and stimulate innovation10. Current understanding of the role of gender in science has evolved over time from the early and oppositional associations of 'gender' with women and men to gender as an organizing principle for both institutions and scientific disciplines, then further to gender as biological and social factors affecting research itself. Under the leadership of the European Commission's, DG Research (marked by the publication in 2001 of the ETAN report), around 20 key reports have been produced over the last 10 years in support of gender equality policies. Sufficient research evidence and expertise is now available across Europe to address many of the adverse effects of the gender imbalance problem in order to enhance excellence of scientific knowledge making and procedures related to scientific institutions. There is also evidence indicating that integrating a gender perspective in research can improve its relevance and quality. Many projects have been designed to increase interest among women and girls in specific fields of science, technology, engineering and mathematics (STEM). Over the years, the EU has funded numerous projects in the field of women in science, and, in particular, and more recently, concerning structural change (e.g. genSET on gender action plans in science, GENDERA on best practices). Many universities and research institutions have sought to address the lack of women in their science departments, as students and as staff. There are significant variations in the extent to which the relative lack of women in some STEM subjects and in senior positions in the academy is recognised as a problem in different countries18. There are differences too in how successful initiatives designed to address the issue have been. It is not always equality policies that have the most effect; more transparency in hiring can make a difference. Despite growing recognition of the gender imbalance in science, and the development of various projects and policies in Member States and their universities and research institutions, progress has been slow. The organization of R&I in Europe still relies on male and female stereotypes to the disadvantage of science, technology and the economy. In addition, the lack of role models of women in senior positions has had a negative impact on high-level aspirations of other women. The outcome is a waste of talent, missed opportunities for scientific advancement and innovation, and a lack of clarity of what is meant by scientific excellence. Gender mainstreaming has been one of the major strategies adopted by the European Union and the Member States for achieving gender equality (and as a social policy strategy it is considered a success). However, in science it is a more recent strategy that has not yet been embraced widely in universities or research institutions. Consequently, in relation to the problem of the under-representation and under-promotion of women in science, it has not produced the hoped-for results. Similar problems to those existing in Europe have been identified in the US, where the National Science Foundation (NSF) has invested substantially in the ADVANCE Programme in supporting universities to undertake institutional transformation to enhance the participation of women in science. Sex disaggregated statistics on the hiring of faculty, the size of their pay cheques, and even the size of their laboratories have demonstrated that gender is a key organizing principle in academia. Investment in this process through the ADVANCE Programme reflects the value NSF attaches to addressing structural issues at US universities. 'Structural change' in universities and research institutions means making them more gender-aware, thereby modernising their organizational culture. This has important implications for equal opportunities, full use of talent, appeal of scientific careers, and quality of scientific research It implies systemic, integrated, long term approaches rather than piecemeal short term measures. Following on from the 10th anniversary of the launching of its gender policies in science (the Women and Science Unit in DG Research and the Helsinki Group23 were created in 1999), the European Commission continues to promote the structural transformation of science institutions in order to become a world leader in science and technology. To this end, and following the explicit call for

BOX 2.1

Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering

- Systematic structural constraints built into academic institutions have impeded the careers of women scientists and engineers.
- Well-planned, data-driven efforts to remove institutional constraints on women academics' careers can produce significant results
- Adequate data gathering, planning, implementation, and evaluation of changes require the dedication of sufficient resources to the objective of increasing diversity

Report by National Academy of Sciences (US), National Academy of Engineering (US), and Institute of Medicine (US) Committee

One major reason why progress has been so slow for gender equality in research, despite all the knowledge available on gender to inform policy and actions, is that many universities and research institutions lack the capacity and experience to analyze and transform the rich and often complex gender knowledge into specific gender management applicable to their structures and procedures.

Direct discrimination is relatively straightforward to recognize and address. However, indirect discrimination, which characterizes the policies and processes of many universities, research institutes and companies, is more difficult to identify and put right.[1] While many employers will acknowledge that there is a gender pay gap, few will imagine that they themselves are contributing to it. Collecting and analyzing data seems unnecessary if you are a 'good employer', not one intending to discriminate. The 'problem' is a lack of awareness of how systems and structures, policies, processes and procedures can be discriminatory, even where the employers have the very best of intentions on fairness and equality.

The consequence of this is that women are marginalised in decision-making about science. They do not play a significant role in deciding what research should be funded, how it is evaluated, how excellence should be defined, what use should be made of it, who should be rewarded, promoted, published or funded. There is, then, a democratic deficit in decision-making.

The problems faced by research institutions can therefore be summarised as:

- Opaqueness in decision-making processes
- Institutional practices inhibiting career opportunities
- Unconscious bias in assessing excellence
- Wasted opportunities and cognitive errors[2] in knowledge, technology and innovation
- Employment policies and practices

2.1 Opaqueness in decision-making processes

In universities, research institutions and granting agencies, the vast majority of crucial decision-making processes were established at a time when the presence and impact of women was limited at best. These processes have been evolving over the years, thus often slowly losing whatever rational and transparent regulatory basis they might have had when they were established. While some the decision-making processes may have been adapted according to gender mainstreaming principles, the majority of them remain in a state of an unsatisfactory lack of transparency.

This lack of transparency in systems creates myths and confusion. Evidence shows women are more likely to succeed in recruitment and promotion when there is clarity about what is required, information about the opportunities freely available and clear criteria used in decision-making. These approaches also benefit men, making clear how organizations function and what their values are.

BOX 2.2

Women less likely to be promoted to professor (Spain)

During this period a national system was in place (habilitación nacional) which provides a unique random natural experiment, with 35 000 candidates, 7000 evaluators in committees of seven, all fields of knowledge. The result of this study is that for every male member of a committee of seven, a woman candidate has 14% less chance of being promoted than a male candidate. In other words, with an all male committee, the probability for a woman candidate to become a full professor comes close to zero.

Spanish study on promotions to the highest rank of the academic ladder, full professorships (cátedras) for the period 2002-06, Natalia Zinovyeva, Fedea 2010

However, in many institutions both structures and processes lack the necessary clarity. With many committees or advisory bodies it remains unclear how they function or how they are constituted. Very often membership in such bodies is established through existing members bringing in acquaintances (co-optation). Vacancies are not known to a wider public, and there is insufficient information available on how interested persons could apply if there is an opening. 'Old boys' networks and patronage for allocating opportunities prevail.

Further, the service periods on such bodies and committees are not limited which prevents the influx of fresh ideas and new perspectives. Thus many bodies and committees represent strongholds of traditional values and out-dated concepts regarding the needs and the potential of today's research and education, and thereby tend to even lag behind the overall development of an institution. It is hardly surprising that such bodies and committees do not adequately include women or that their processes and decision-making mostly fail to be gender-sensitive.

While it is true that women are undoubtedly underrepresented in the governing boards of research and higher education institutions, this can be comparatively easily fixed with upcoming vacancies. The situation is much more impenetrable with committees and bodies that advise or prepare decisions for the institutions' governing boards, such as hiring, tenure and promotions committees, strategy boards, budget commissions or nomination committees for prizes, and boards of private foundations that distribute research funds – most likely without supervision from neutral instances.[3]

Very often institutions try to improve the situation by establishing detailed regulations. As in many other aspects, compliance is often unsatisfactory. Cultural factors will also have a much greater (negative) impact – such as the lack of awareness that the missing transparency and consistency of procedures and decision-making prevent women from having a fair chance to participate, as well as preventing institutions from fully profiting from the competence and creativity of their diverse workforce.

2.2 Institutional practices inhibiting career opportunities

The commitment to excellence and to objectivity that is a hallmark of academic life can make it particularly difficult for research institutions to recognize the ways in which standard practices may give advantage to some and disadvantage others. As demands increase on faculty and researchers, the amount of time available to pay careful attention to effective recruitment practices or to mentoring junior colleagues or even to thorough review of evaluation materials for tenure and promotion decreases, leaving decision making subject to distortion by cognitive errors (see footnote 2) and bias.

Advances in research in the cognitive sciences reveal the difficulties of evaluating performance, suitability for leadership, and scientific merit objectively. From gender schemas to evaluation bias to stereotype threat, science makes clear that bias clouds judgment, often unconsciously. These tendencies are reflected in organizational practices and culture and inadvertently result in indirect discrimination. Using age bars on fellowships for example is likely to prevent more women than men from making applications because women are more likely to have had career breaks and therefore their chronological age is older than their 'academic' age. Institutionalised sexism does not necessarily mean that individuals are biased or discriminatory, but the outcome of the systems they operate may well be systematically biased.

The now well-established body of research findings demonstrates the manner in which largely unexamined errors in the way of assessing merit create inequitable outcomes for men and women. Research also demonstrates that despite good intentions and a commitment to fairness, both men and women are likely to undervalue women's accomplishments. This tendency is not surprisingly embedded in institutional processes such as recruitment, performance evaluation, and advancement. [4]

While the root causes of women's under-representation in science and technology fields are not yet widely understood, public opinion recognizes the disparate outcomes. A recent global survey by the Pew Research Centre found that 'The view that men get more opportunities than women for jobs that pay well, even when women are as qualified for the job, is widespread in most of the countries surveyed, particularly those that are wealthy or have recently experienced substantial economic growth'.[5] There is evidence that these assumptions disadvantage women, and disadvantage institutions seeking to create and maintain a productive workplace. [6] Turnover of faculty (staff), with its ensuing costs, and the institutional failure to capture a return on the investment made in new faculty, are always challenging, but even more so in economically constrained times. The success of academic scientists and engineers can be supported or inhibited by the culture of the academic department level. Administrative leaders such as department chairs are critical in setting the tone within the department,[7] yet are rarely equipped with the additional professional development

and skills necessary to affect transformation within the department that can bring about positive change.

Without conscious transformation of organizational processes in academic and research settings results, outcomes will be as usual: fewer women, less diversity of experience and outlook, and failure to capture the benefits expected from the enhancement of the potential pool of researchers and innovators reflected in the increasing number of women with doctoral degrees.

2.3 Unconscious bias in assessing excellence

The word 'excellence' appears frequently in the context of science. It is taken for granted that individuals and institutions pursue 'excellence' in all their activities: recruitment, funding, publication, awards, professional and institutional advancement. Peer review systems are designed to ensure that only 'excellent' people and work are supported.

However, what characterizes excellence is generally not itself subjected to scientific evaluation. It is a socially constructed concept, and practices in operationalising the concept in each branch of science can be idiosyncratic. Critical analysis of the 'excellence' concept and of its correspondence with practice is missing. Instead, it is assumed that the scientist in each field somehow acquires from his or her environment a notion of what excellence is, and that their judgments remain objective. This underplays the impact of context (for example, a single-sex interviewing panel) and culture (e.g. implicitly accepted gender normative expectations, such as that a scientist must be 'single-minded' - a characteristic associated with males – rather than 'dedicated', which is perceived as a female attribute).

Being evaluated or evaluating others, the assessment of excellence is a continually repeated feature of a scientist's job. It shapes the scientist's career trajectory. With the persistently low levels of women in scientific leadership, it would seem that the practice of assessing excellence treats men's accomplishments differently to women's. A variety of opportunities make this possible. Gender bias can occur because excellence is often characterized in abstract terms. For instance researchers are expected to be 'innovative', 'productive', 'coherent'. It can also occur as a result of the criteria lacking in transparency or the kinds of indicators chosen and how they are prioritized, for instance giving weight to explicit indicators such as the number of papers/citations/patents produced, or implicit indicators such as uncommon career pathways (e.g. later start, career breaks). The evaluation criteria may be applied differently to women and men (by both women and men) or certain scientific fields may be preferred over others, for instance established, single disciplines over emerging cross-disciplinary areas (often favoured by women).

BOX 2.3
Women scientists discriminated

A study published in 1997 in *Nature* by Wennerås and Wold entitled "Nepotism and sexism in peer-review", demonstrated that women had to have 2.4 more merits than men to achieve the same evaluation, equivalent to 20 articles in peer review journals, in calls of the Swedish Academy of Medicine. Publication of this study prompted the resignation of top decision makers in Sweden as well as the launching of Swedish gender policies in science.

BOX 2.4
The More, the Better? Inclusion of Women in Symphony Orchestras

What happens when members of one identity group enter an elite institution that historically has been dominated by another? The paper examines associations between the gender composition of professional symphony orchestras and several outcomes – the orchestra's functioning, the quality of the relationships among the members, and their motivation and satisfaction (all reported by the players). Outcome measures decline as women's representation increases until the proportion of women approaches 50%. Then, the downward trend flattens or reverses.

http://www.mendeley.com/research/the-more-the-better-a-fournation-study-of-the-inclusion-of-women-in-symphony-orchestras/

The lack of gender balance among excellence gatekeepers - in interviewing panels, editorial boards, among reviewers - can also differentially influence both the process and outcomes of assessment and selections of women and men. Gender-stereotyped expectations may affect not only how women's work is evaluated, but also what kinds of work women do, compared to similarly placed men. Teaching and professional activities are often undervalued, affecting women who frequently have a systematic overload of these activities as a result of their employment contracts.

Women may find their accomplishments attributed to 'luck' or the support of colleagues and mentors, while their failures are treated as the norm. Letters of recommendation

tend to be shorter for women, and they contain more 'grindstone' adjectives (e.g. 'hardworking') and fewer 'standout' adjectives (e.g. 'brilliant'), even when the applicants' accomplishments are similar.

Peer review is the principal mechanism for judging excellence in science. It is a gatekeeper of excellence and the final arbiter of what is valued in science. The method has been intensely criticized over the last ten years with regard to its reliability and validity, following a number of influential studies showing that men fared much better than women in the assessment process[8,9].

Despite the considerable literature, there is surprisingly little sound peer-review research examining the criteria or strategies for improving the process. Over the last ten years, both funding bodies and journal editorial boards have paid greater attention to the application and success rates of women and men. Progress has been made, but still there are significantly fewer grant applications from women than from men, and lower rates of publication submissions.

2.4 Wasted opportunities and cognitive errors in knowledge, technology and innovation

The goal the EU initiative *Innovation Union*[10] is to ensure that innovative ideas can be turned into products and services that create growth and jobs, and tackle societal challenges. It is therefore imperative to find ways for a greater inclusion of the gender perspective in all processes and at all levels leading to productive innovations.

Research shows that gender biases, inequalities and imbalances within the established practices of scientific institutions have important implications for the substance of science itself. For example, an underlying assumption of clinical trials conducted until the mid 1990s was that the treatment effects in women would be similar to those in men[11]. This view has been successfully challenged in medicine, where the significance of gender is gradually starting to become more recognized. The issue is now being addressed and made part of research programmes in centres of scientific excellence across the world, including in university research centres (e.g. Columbia University, US; Karolinska Institute, Sweden; LMU Munich; University of Goettingen, Germany); new scientific societies (e.g. European Society of Gender Medicine, International Society for Gender Medicine); national scientific associations on Gender Medicine; scientific journals and large international Gender Medicine conferences (e.g. *Gender Medicine*).

The implementation of the EU2020 strategy will require full participation of Europe's scientific and innovation talent. However, the practice of not recruiting and promoting women in numbers proportionate to their presence in the available pool of researchers means that the skills and experience of many highly qualified women are not being used. This can mean many opportunities are missed for innovations in research and the identification of new markets.

In the context of the EU2020 strategy, interdisciplinary research has been recommended as a solution to many

BOX 2.5
Gaps in research

- Gender bias in research can be expensive
- Between 1997 and 2000, ten drugs were withdrawn from the United States market because of life-threatening health effects—four of these were more dangerous to women.
- Part of the problem is that preclinical research uses primarily male animals

Wald and Wu 2010; Zucker and Beery 2010; U.S. GAO-01-286R Drugs Withdrawn from Market, Presented to Congress by US General Accounting Office, 17 January 2001)

BOX 2.6
Women and heart disease

- Women are currently still underrepresented in research in many important areas of cardiology
- Men have predominantly systolic failure (pumping) whilst women have predominantly diastolic failure (distensibility).
- Women also have higher early myocardial infarction mortality, a fact that is partly linked to sex, but probably also gender-related.
- Another observation, most likely also connected to gender, is that women are more frequent donors and men recipients in heart transplantation even if women are sicker

Report on the conference organized by DG Research and Innovation, Health Directorate, Medical Research unit in partnership with the European Society of Cardiology, the European Association for the Study of Diabetes and the European Kidney Health Alliance, November 2010

BOX 2.7
Gender aspect in transport research

- Public transport is designed to provide for the typically masculine pattern of mobility: commuting from homes to jobs. Public transportation is not designed for the chained, polygonally-shaped and shorter distance trips that women tend to do (resulting from their double workload as employees and family carers). Women, however, are the main users of public transportation.

The *mobility of care* is a new gender aware umbrella concept proposed by Sánchez de Madariaga, 2010, which allows for a better description and visibility of the typically feminine mobility related to care work.

BOX 2.8
Too few women involved in innovation

Greater awareness is needed of the role of gender as a dimension of competitive advantage in innovation and the application of research results:

- Gender equality has been missing from the submissions made to the European Patents Office
- The level of patent applications from women is around 8%, and Germany, which is the source of 50% of EPO's applications, has only 6% submitted by women.

Frietsch, Rainer, Inna Haller, Melanie Vrohlings et al. 2008. Gender-specific patterns in patenting and publishing. Fraunhofer ISI Discussion paper Innovation Systems and Policy Analysis, No16.

of today's complex problems[12]. With the much-increased participation of women in higher education in all Member States, interdisciplinary research may offer better use of the talent of female scientists in research and innovation, and in more effective translation of ideas to markets.

However, the lack of established interdisciplinary scientific journals, and education systems that are not geared towards producing multidisciplinary graduates and postgraduates, represent a serious career risk for women scientists taking on the interdisciplinary route. Using interdisciplinarity to attract women to science is only practical and ethical if it also promotes stable careers. Structural changes are needed because interdisciplinary research cannot be easily embedded within a scientific system that traditionally has been based on one-department, one-discipline structures, in most universities and in most research funding bodies, which tend to exclude women from key decision-making bodies.

BOX 2.9
PAIN

79% of animal studies published in Pain over the preceding 10 years included male subjects only, with a mere 8% of studies on females only, and another 4% explicitly designed to test for sex differences (the rest did not specify)

www.jpain.org

Several examples show that the integration of sex and gender analysis increases the quality and excellence of scientific production and improves the acceptance of innovations on the market. Checklists and tools are available now to identify the relevance of sex and gender perspectives in a specific research theme and describe the methods for analysis.

In science, technology and innovation women are perceived by market stakeholders as less credible or less professional[13]. Eurobarometer studies on innovation readiness found for the 25 EU sample interviewed, 49% of Europeans were either 'anti-innovation' or 'reluctant' to embrace innovation and this segment consisted predominantly of women aged 40 years and older[14]. Such stereotyping overlooks the fact that women's share in controlling customer spending worldwide is growing rapidly, as more women participate in higher education and in employment: an economic opportunity recognised in series of studies[15]. To reach the aims of the EU 2020 agenda it is therefore necessary to find ways of involving more women in innovation processes.

2.5 Employment policy and practices

Thirty-five years after the first European Community directives on Equal opportunities and equal treatment in employment[16], Member States still have a gender pay gap and statistics that demonstrate that gender continues to play a significant role in determining who gets what jobs[17].

Even though employees in the research field are covered by the Directive on equal opportunities and equal treatment,