



WOMEN in COstruction scientific REsearch

WOMEN-CORE

No 017568



D4 – ASSESSMENT OF THE STATE OF THE ART OF QUALITATIVE DATA ON WOMEN IN INDUSTRIAL AND CONSTRUCTION RESEARCH

Document Ref.: D4-WP1-T1.1
Version: 0.4
Author: CEWS
Date: 2006-09-28
Nature: Report
Dissemination: Public
Level:
File: WMC_WP1_T1-1_D4_CEWS_v0.4

Abstract:

This report is resulted from the Task 1.1 State of the art of qualitative studies of women in industrial and construction research (leader CEWS) of the WP1 State of the art and methodological approach (leader CIREM). It provides an overview of existing qualitative studies on Women in academic and industrial research and explores the existence of studies related to construction research.



DOCUMENT CHANGE LOG

Version	Date	Reason for change
0.1	2006-06-27	Creation
0.2	2006-07-24	Further reviewing of literature
0.3	2006-08-25	Final reviewing of literature
0.4	2006-09-28	Final re-structuring and text editing

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1. INTRODUCTION

The aim of this task is to review qualitative studies of women in industrial research and, more specifically, of women in construction research.

The main objectives are:

- Selecting the main qualitative studies of women in industrial research

- Exploring the existence of qualitative studies of women in construction research

- Making an overview of the main contributions of these studies: core reasons leading to under-representation of women in industrial and construction research

Different methods of reviewing literature have been applied.

First of all, the main studies from the European Commission (ETAN, WIR, ENWISE, WIST, Gender and Excellence in the Making) have been reviewed on their content of qualitative studies. Then the participating partners of our project WOMEN - CORE provided national and international reference lists of relevant studies into this field. An extensive internet research on studies as well as key words in relevant databases related to this field has been conducted. Finally, homepages of research institutions have been searched for relevant projects and publications in the field of industrial and construction research.

One of the main striking results is that there are no qualitative studies specifically related to construction research. Therefore this task will be extended to studies on women in academic and industrial research as well as male-dominated disciplines¹. The reason to include studies of women in academic research is because their situation is presumably closer to the situation of women in industrial or construction research than of women in industrial employment caused by the specific conditions within research. Studies on barriers of women in academic research highlight a lot of individual and structural factors, which hinder women in their career and will provide insights which might be transferable to construction research. Another reason to include

¹ In this report studies of women in male-dominated disciplines refer mainly to engineering science and informatics.



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women in academic research is that WOMEN-CORE will cover both the situation of women at universities and firms with construction research activities.

The WOMEN-CORE project will focus on the construction sector. The construction sector is one of the most male-dominated sectors in industrial research. Since there are no qualitative studies specifically related to the construction sector other male-dominated disciplines will be looked at as well. They could provide information about specific barriers women face in male-dominated areas in general.

After a theoretical discussion of the situation of women in science this report will provide an overview of the core reasons leading to the under-representation of women in the reviewed disciplines. The following chapter presents results of studies which investigated in the situation of female students in male-dominated disciplines in general. The employment situation of women professionals in a specific field can only be fully understood in looking at the situation of female students in that field. Therefore barriers for female students are included in this report as well. After that a variety of measures and initiatives firms can take to promote women in research will be presented. This information will help to prepare our case studies of institutions in WP3. At the end of the report a conclusion and an outlook for our own research will be provided.

2. CONCEPTUAL AND THEORETICAL DISCUSSION

This chapter delivers a conceptual and theoretical insight into the situation of women in science and pictures the gender participation at each stage of the research career ladder. It also presents an overview of the individual and structural factors which lead to an under representation of women, particular in higher positions. Finally, differences between public and industrial research are highlighted.

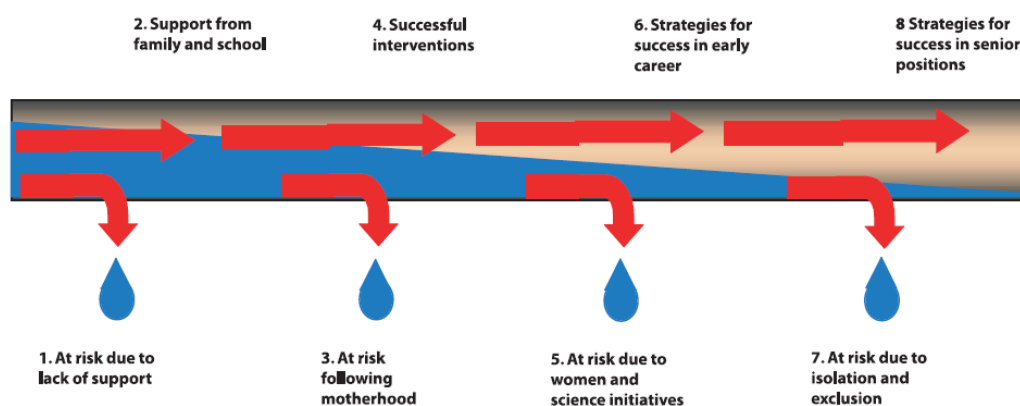


2.1. SITUATION OF WOMEN IN SCIENCE

A complex set of issues inhibits women from pursuing academic careers. She-figures (2006) have shown that if one looks at the levels of gender participation at each stage of the research career ladder, from undergraduate students (ISCED 5A) through to the single highest post at which research is conducted, equivalent to a full professorship (Grade A), it can be observed a decline in the representation of women in the career progression, which is often referred to as the 'leaky pipeline' (GRAHAM, 2006). In other words the leaky pipeline is a concept that has been used to refer to the steady attrition of girls and women throughout the formal S&T system, from primary education to S&T decision making.

If one looks at the differences between women and men in all disciplines and women and men in science and engineering there are two striking effects. Firstly, the well-known fact that many more young men enter education in science and engineering than women and secondly, which is more striking, participation levels of women are almost constant up to Grade C, indicating that there is no gender-specific "leaky pipeline" at these stages (EC, 2006).

The below graph presents several obstacles women face from the very beginning in their career, starting with a lack of support from family and school until the need of specific strategies to succeed in senior positions. These obstacles inhibit many women from pursuing professional careers.



Source: EC, 2006, p. 50



Among others the above barriers will be presented in the third chapter.

2.2. INDIVIDUAL AND STRUCTURAL FACTORS

In investigating the core reasons for the under representation of women in academic research, particularly in higher positions, scholars distinct between two different basic approaches: firstly they look at individual premises, specific repressive factors, personal attributes, gender specific conditioning, which can negatively influence a professional development of women scientists; secondly new studies analyse more and more factors which are immanent within the organisation of the scientific institutions. Alongside these approaches there are a few authors which look at the interaction of both, the individual and structural factors (Lind, 2004).

The below table provides an overview of the individual and structural barriers women face within several disciplines by the observed qualitative studies. These topics are explained in chapter 3. This table reveals firstly that in some cases it is not possible to clearly distinct between individual and structural factors and secondly that both factors can interact with each other.

Topics	Individual	Structural
1. Myth of technology		x
2. Organisational structure of science		x
3. Male-dominated structure		x
4. Lack of female aspects in science		x
5. Lack of mentoring programmes		x
6. Lack of female role models		x
7. Work-life balance	x	x
8. Dual career couples	x	x
9. Gender discrimination	x	x



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The first six barriers for women with regards to their career development are mainly caused by structural factors. Topics 7, 8 and 9 are mainly related to individual barriers of women. This means that these barriers are connected to the fact of being a women, e.g. women are naturally supposed to give birth which leads to the conclusion that they are mainly responsible for children. Because of this women face disadvantages to a certain stage of their professional life whereas men can progress in their career. This example indicates that these individual factors cannot be seen independently from structural factors; in fact they can be influenced by them. Therefore these barriers can be looked at as individual as well as structural factors. This approach implicates that with regards to the last three factors there is potential to change the situation of women.

2.3. DIFFERENCES BETWEEN ACADEMIC AND INDUSTRIAL RESEARCH

Quantitative analysis of the WIR-Study (EC, 2003a) acknowledges the low representation of women researchers in the industrial sector. Indeed, they only represent 15% of the 500,000 researchers in the industrial sector in the European Union, compared to 31% in the government sector and 30% in the higher education sector. A closer look to the working situation in these sectors reveals remarkable differences in working conditions. Since WOMEN-CORE is going to investigate in both academic and industrial research, opinions of female researchers regarding differences between both areas are presented below (EC 2003).

Research in :	Public sector	Industry
<i>Different work organisation</i>	Focus on person and number of publications	Focus on team work and success
<i>Different purpose of research</i>	Public basic research	Industrial applied research
<i>Work rhythm</i>	More relaxed way of working	More stressful and developing at a faster pace
<i>Difference in status</i>	Very uncertain contracts (temporary)	More stability in contracts

Source: own illustration based on EC, 2003, p. 49



All of these features do not seem to be neutral in terms of gender. Female researchers seem to think that the choice between private and public sector is of more concern to women.

The above could serve as a methodological line for our own research.

3. TOPICS AROUND BARRIERS FOR WOMEN IN ACADEMIC AND INDUSTRIAL RESEARCH AND IN MALE-DOMINATED DISCIPLINES

This chapter provides an overview about the different individual and structural barriers women face on the basis of the observed qualitative studies.

The myth of technology can pose a barrier for women to enter male-dominated disciplines and will be addressed first. This follows a presentation of obstacles which are immanent within the organisational structures of science and engineering such as male networks, lack of female role models, lack of mentoring and so on. After that a description of obstacles which are mainly related to the fact of being a woman will follow. These includes topics such as work-life balance, dual career couples and gender discrimination (male bonus) which are considered as individual barriers but are not completely independent from structural factors.

3.1. MYTH OF TECHNOLOGY (TECHNOLOGY AS A MAN'S BUSINESS)

Different areas of work or different professions are closely related with certain stereotypes or attributes. The area of technology or construction is clearly male-dominated and is associated with attributes like dirty and heavy (work), toughness and so on. Furthermore fascination for technology or technical skills are attributes which are assigned to men. Being a woman is strongly connected with smoothness, social abilities such as care for family/relatives, house keeping and a distance to technology (Faulkner 1985). Consequently the area of technology or construction is commonly regarded as contradictory with typical female attributes or being a woman. The strong association of these sectors with maleness is surely one reason that these disciplines are highly male-dominated. To understand the situation of women in the construction sector it is important to ask for the stereotypes women and men face in this sector and to question if this might be partly related to a social construct which can be changed.



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Some references to this give a study which scrutinises the existence of the male fascination for technology and the female distance to technology (Erb, 1996). This study focuses on a typical male dominated discipline - the informatics. One result of this study is that women more frequently decide to choose theoretical instead of technical informatics. This fact raises the question what are the reasons behind. Within the 'gender-research' this fact is often explained by women's affection to theories. Interviews with female computer scientists suggest something else. The reason why women prefer theoretical informatics are not because of an affection to theories but rather a kind of niche where they consider to be less confronted with male competition, a male predominance and the prejudice of technology as a man's business. The author concludes that more women would possibly choose technical informatics if they would find structural and symbolic conditions which ease their entrance (Erb, 1996).

These results lead to following conclusions. On the one hand it becomes apparent that there is no clear evidence for a female distance to technology and on the other hand it means that women obviously avoid typically male-dominated areas of a discipline (like technical informatics) or even whole disciplines. This seems to be based on that fact that they expect male-dominated working cultures in which they anticipate certain difficulties or discrimination. Therefore, decisions of women to choose a specific discipline or specific path within a discipline are not always a sign of a certain interest for that discipline.

Furthermore the study makes an in-depth analysis of the term *fascination for technology*. The interviews with women computer scientists show that their fascination for informatics is not only based on things expected like formal structures, logical thinking etc., but also on aspects like novelty, to meet a challenge by solving difficult tasks and the wish to break with traditional roles. Studies which investigated into the motivation of men for technical fields show as well that, besides the fascination for technology, there are a lot of other reasons which have an effect on their decision like status, promotion prospects, salaries and so on (Erb, 1996).

These findings suggest that besides the pure fascination for technology other reasons possibly exist which attract women and men to technical disciplines. It can be presumed that these reasons are often subsumed with the term fascination for technology. This awareness can contribute to ease the exclusiveness of the relationship between men and technology. Breaking with the myth of technology could be a contribution to encourage women for technical fields.



With regards to WOMEN CORE it would be beneficial to analyse if in the field of construction research structural conditions exist which could keep women away and if so, where are these so-called niches where women researchers are accumulated and why. Furthermore men and women should be asked about their motivation to study and work in the field of construction in order to light up the 'myth of technology'. The findings can work as arguments to attract more women to this sector.

3.2. ORGANISATIONAL STRUCTURE OF SCIENCES

The following section will present the main results of studies regarding structural barriers for women.

One structural factor which can negatively influence women's entrance or progress in engineering is the low rate of female professors (Erlemann, 2002). Women engineers, who had dropped out of the profession, believe that if only 50% of professorships would be occupied by women, the most serious problems would be solved. Then, the association technology with men would not be maintained any longer. They also stressed that it would be wrong to assume that an increase of the proportion of female students to 50% would automatically increase the proportion of female professors in the course of time. Regardless of this there is a need to spark interest of young girls in engineering or technology and in doing so relieve the field from its inherent mysticism.

Interviews with former women engineers confirm that an equal proportion of women is necessarily but not sufficient. There is a need for a change of structures. That means that structures have to change in a way which is more comfortable for women. In the field of engineering for example the contents of academic courses or scientific questions are mainly determined and raised by men means that perspectives of women are often ignored. The author points out that a reform of the structure of universities demands that all these aspects have to be analysed, evaluated and if necessary to be changed (Erlemann 2002).

An American study analyses the causes of why the proportion of women who attain academic ranks as full professor has not kept pace with the growth of women holding doctorates ('leaky pipeline'). Firstly they found out that women are not receiving doctoral degrees from different type of institutions than men (Fox 2001). Studies show that with some disciplinary variation women and men are likely about to have received their degrees from top-ranking institutions



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(National Research Council 1983, 1998). Likewise gender differences are small in certain indicators of financial support for graduate training². However these data do not specify the quality or character of assistantships and graduate training.

In addition, the authors found out that there are gender disparities that persist across the different types of departments. Different organisational environments for men and women are not simply a matter of being located in different types of institutions (small or big) or settings (Fox 2001).

Fox (2001) assumes further that indices to understand this mismatch lie in the organisational features of graduate education. For this, departments that increased the proportion of doctoral degrees awarded to women were compared with departments that have low or constant rates of doctoral degrees. The results show that in departments with increasing rates the qualifying exams are more likely to be written and are more likely to be reported by women as having “known, objective standards”. This is worth mentioning because several studies indicate that the more likely those criteria for evaluation are loosely defined and subjective, the more likely white men will be perceived to be the superior candidates – and that gender and racial ethnic bias will operate (Fox 1991; Long and Fox 1995).

Publications are another example which justify the need for structural changes to ensure equity. The amount of publications has an effect on promotion. Studies show that women researchers publish less than men. Sonnert and Holton (1995) analyse the reasons behind this and give one possible explanation. Women in science exercise more care, caution, and attention to detail in their publications and that they are more likely to confirm and integrate research findings before releasing them for publication.

It is hypothesised that if women have certain approaches to research, such as a tendency to confirm findings before publishing them, and if they need to conceal or even “overcome” such approaches to keep up with men could inhibit a risk that the common norm of proliferating more fragmented pieces of published work may continue to constitute an unchallenged standard for scientific productivity. This can prevail even though an increase in numbers of women in science (Fox, 1999).

² measured as percentages of women compared with men who had held research or teaching assistantship during graduate school



The solution for women's promotion does not seem to be a matter of correcting personal deficits. Rather, because science is organisational work, subject to organisational signals, priorities, and rewards. These matters of gender, social and organisational context, and participation are very important for understanding what can inhibit women's careers in science. Merton (1996) emphasise that science is a social process – a system of communication, interaction, and exchange. If women are constrained within the social networks of science – in departments or in the larger communities of science – this restrict their possibilities not simply to participate in a social circle, but more fundamentally, to do research, to publish, to be cited – to show the marks of status and performance in science (Fox 1991).

As a result it seems to be very important that our own research into the construction sector tries to identify the enabling or disabling features of the settings in which scientists study and work. To point out again, many researchers agreed that an increasing numbers of women in science will not necessarily change patterns of gender, status, and hierarchy in science.

3.3. MALE-DOMINATED STRUCTURE / MALE NETWORKS

As mentioned before in most of the European countries the proportion of women in academic posts continues to be less than the proportion of academically qualified women. Given the lack of structured graduate programmes and curricula, for example in Germany, the 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 mechanism (GUPTA, 2004).

A study, which explores the situation of women who have extensive employment experience in the oil industry in Canada, serves as an example for an analysis of structures in typical male-dominated disciplines. This study, which combines quantitative and qualitative methods, found out that there are three primary processes which structure the masculinity of the industry (Miller, 2004):

everyday interactions which exclude women

values and beliefs specific to the dominant occupation of engineering which reinforce gender divisions

a consciousness derived from the powerful symbols of the frontier myth and the romanticized cowboy hero



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Strategies that the women developed to survive are double-edged in that they also reinforced the masculine system resulting in short-term individual gains and an apparently long-term failure to change the masculine values of the industry.

The above study carried out in-depth interviews with 20 women and focused on participant's description of, and reflections on, their experiences³. Interesting is that although the drilling divisions of oil companies were described by many as the most 'macho' part of the industry, some women clearly describes being treated chivalrously. They talk about getting more respect, more cooperation, more leeway and a little bit more of an extra attention since they are women.

The attitude of condescending paternalism shown toward this geologist seems to have permeated the cultural system. Thus, she conveyed the same type of attitude toward those whom she outranked. Women may be viewed as a childlike person in need of protection, or as an oddity, rather admired, but always 'different' from her male colleagues and 'normal' women (Miller, 2004).

A number of participants suggested that being novel, and highly visible, also had business advantages. One woman explained how she got remembered at a meeting and that because you are highly visible no one ever forgets you. The other side of the currency of visibility is that it continually highlights that these women are not 'one of the boys' thereby effectively excluding them from masculine activities that take place (Miller, 2004). Exclusion from informal work-related networks has been argued by many scholars to be a significant factor on women's more general exclusion from influential positions.

Another message of this study was that society's relative valuation of women on the basis of physical attraction also creates a ranking within the small cohort of women in this non-traditional occupation, and very effectively reinforces binary gender divisions (Miller, 2004).

However, the study found out that all the participants of that study have undergone a long process of acculturation, beginning in engineering schools and then in organisations dominated by engineers and that process had convinced them that to be a 'good engineer' meant

³ Participants had between three and 28 years of experience in the energy industry. Nine of the women were professional engineers and four were professional geologists. Eleven of the participants had positions at the executive level of large multinational energy corporations, with four at the vice presidential level.



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accepting the traditional values. These women were thoroughly assimilated into that culture. One successful female engineer argued that males have made the rules and women have to adapt to them to fit in⁴ (Miller, 2004).

Also the WomEng Study (WomEng Consortium, n.d.)⁵ brings into light that the importance and influence of networks on career as an engineer was confirmed in all their partner countries⁶ except Finland. All women engineers interviewed are aware of male networks and report that women have only restricted access to men`s networks. But all women see these networks as most prominent career factor. Additional to that they are all aware of not having possibilities to change this situation by themselves. The appearance of the network is quite different and starts with formal meetings while drinking coffee or smoking cigarettes and can go to informal meeting after work.

Another qualitative study which explores the view of female computer scientist`s in their discipline, confirmed that their work-atmosphere can be described as male dominated. The women who are interviewed would prefer more cooperation instead of competition or “single combat”, more cooperative than hierarchical leadership and communication instead of profiling. In addition women report very often that they get assigned typical female roles like cultivating contacts or buying birthday presents and care for the colleagues (Erb, 1996)

According to different studies work cultures and work atmosphere might vary between different kinds and sizes of companies or institutions (small, large, multinational). To find out if there are differences between companies and why can be a challenge for our own project (q.v. the industrial vs. academic sector).

⁴ That particular comment was made by a woman with graduate level training in engineering, who had, in her almost 30-year career, reached the level of vice president of an oil company.

⁵ A research project which is exploring the occupational situation of women engineers in Europe

⁶ Countries involved in the study are the following: Austria, Finland, France, Germany, Greece, United Kingdom



3.4. LACK OF FEMALE ASPECTS IN SCIENCE

An aspect which is closely connected with male dominated structure of science – is the lack of female aspects in science. Whilst there are no studies of women in the field of the construction sector information about the lack of female aspects in science from a study of another male dominated discipline - the informatics - can be gained.

Interviews with women computer scientists refer to the assumption that there is a lack of female aspects in science.

Women in informatics often complain about the high grade of abstraction of their work. Their preference would be to know more about the background of the tasks and they want to work more close to reality e.g. they want to work more user oriented (Erb 1996). The author of the study stressed that it could be useful to attract more women to the so called typical male dominated fields of study in order to identify excluded topics, problems and subjects which are closer to women's nature to each field and then try to include these subjects into the discipline. Within informatics these are for example human centred designs and social competences. To identify this potential for changes it is essential to carry out an analysis of women's point of view. But also the perspectives of men or ethnic minorities can give information about potential for changes. The study shows that women computer scientists miss different topics within informatics and like to do things differently. But the problem is that in reality they adopt themselves to the prevailing approaches.

These findings in the field of informatics should be born in mind for planning our own survey. Potential for partly changes presumably depend on the specific discipline. Therefore female students and female researches should be asked to identify such potential for changes within the construction sector in order to attract more women to this field.

3.5. LACK OF MENTORING PROGRAMMES/ PROMOTION

To successfully follow a career in academic or industrial research there is a need for women to get a chance of a mentoring programme or to be promoted by a senior-colleague. There are different studies which analyse differences between women and men concerning the availability of mentoring programmes and the way of promoting their career.



Matthies (2006) for example who investigated gender and careers in industrial research found out that the way how women promote themselves and their work is different from men. While men are organised in male dominated networks and communicate their career often in an informal way to their bosses, which makes them more visible, women try to promote themselves in a formal way and try to bring attention to their work.

The WomEng Consortium (n.d) found indications for a correlation between the presence and absence of an induction scheme, training or mentoring programmes and developing a successful career for women engineers. In Germany, Greece and the UK where extensive training is equally available regardless of gender it seems that promotion prospects increase because of this.

Some women engineers are frustrated that they have apparently no possibility to go beyond middle management regardless their desires and skills. They assume that there is a management perception that women want to be technical experts and that they have good skills to be project leaders but that they do not want to become top managers. Different women engineers also complain that some companies have less transparent criteria or procedures for promotion: for example it can depend on an individual department head identifying potential and recommending someone for projects or for promotion – so it is a system of patronage which can work against women (WomEng Consortium, n.d.).

3.6. LACK OF FEMALE ROLE MODELS

Another aspect which can positively influence women in progressing their career are female role models.

Female role models are very important in male-dominated disciplines out of different reasons. Firstly, they can encourage and provide confidence to students and also encourage women researchers following a career in these disciplines. Introducing young women to successful role models can be a good way to enhance their chances of success.

Interviews expose that students in engineering science as well as women engineers would like to see more female role models. There seems to be a lack of female role models at the university among students and teachers/professors and also within the work area of engineers. Many participants of female focus groups would like to see more female students, thus being less visible. Results of the WomEng Study show that many women managers, who are interviewed for the project, are living examples on how to combine family and career. However



they are unknown as role models because women engineers who do not work at this career level normally have no contact with women managers (WomEng Consortium, n.d.). This fact is a sign in favour that some women who follow successfully a career are not automatically act or perceived as a role model but rather have to be recruited for this role.

The results of several studies show that there are a lot of women who drop out of their career in technical occupation (e.g. Erlemann, 2002). Therefore it has to be born in mind that every woman engineer leaving engineering can have a negative effect on student's decision and indirectly demonstrate that women cannot 'survive' in technical disciplines.

3.7. WORK-LIFE BALANCE (LIFETIME VS. RESEARCH TIME)

One of the main reasons why women do not progress in their career in the same way than men is often related to the difficulty of work-life balance. Emphasis on steady and continuous research activity especially in science in technical disciplines is one of the key elements. Any breaks or delays in the academic career were generally seen as obstacles, as the lifetime and research-time of a scientist are supposed to be harmonised. Different studies (e.g. ETAN and WomEng) point out how difficult it is for women to meet this demand of a steady and continuous career when planning a family.

This contradiction women face is emphasised within the ETAN report (EC, 2001), in which it is pointed out that the world of science is masculine and the dominant criterion, "the scientist", is male. To succeed, women need to live their lives like men; their life-clock, which is often influenced by childbearing and a stronger sense of family responsibility, is therefore a deviation which, at best, is taken into account but never seen as the natural norm.

Another study stresses that in some countries careers in academia are very long and the time of motherhood occurs to a crucial point in a woman's career. They take in their study Germany as one example in which careers in academia and science are very long, thus discouraging women from following careers in academic science. Candidates for Habilitation (postdoctoral qualification that makes one eligible for position of professor) are usually 40 years old, signalling that career requirements in science – for example, flexibility and full availability – are incompatible with having children and family (Gupta, Kemelgor, Fuchs, Etkowitz , 2004).



Work cultures- long hours

A structural requirement which makes it hard for women to reach a work-life balance is the long hours which are required especially in industrial occupations. Results of the WomEng Study show that the prevailing work culture in companies is male dominated. This means that in some of the surveyed European countries (Germany, France, Slovakia, Austria, and U.K.) it is considered as normal to provide long hours and demonstrate to be always available. Particularly for women with children this fact can pose a problem for the compatibility of family and career. In addition the fear of the pressure to do overtime when in a management position is very high for instance in Germany and can inhibit women's career aspirations (WomEng Consortium, n.d.). The same problem has been summarised in the WIR-Study (EC, 2003a) where for example respondents of a firm in Finland report that women do not want to apply for promotion to superior posts for family reasons since these posts are connected with working longer hours.

Part-time work

The absence of flexible working arrangements (e.g. part-time work or working from home) can make it difficult to balance family and working requirements as well. As the results of the WomEng Study (WomEng Consortium, n.d.) exemplify there are big cultural differences concerning part-time work in Europe. In some countries like Germany, Austria, France and Finland, part time work is quite normal and accepted at all companies, especially for women with young children. But even in these countries there are differences between companies. In other countries like the U.K. or Slovakia part time is rarely possible. Having no possibility of working part time can lead to quite different decisions concerning family and career and can cause women to drop out. But even part time can have negative effects on promotion prospects and can reduce the chance to be promoted by a research institute or a firm⁷.

⁷ For this purpose a German research project wants to look into the possibility of reducing working time also in leading position. This project just focuses on administration staff of universities. (Titel: Führen in Teilzeit. Institution: Universität Dortmund, Institut für Soziologie Professur für Frauenforschung).



Pregnancy/motherhood

As already mentioned a steady and continuous research activity is a key element in S&T getting pregnant influences women's career development significantly since motherhood often occurs at a crucial point in a woman's career. Women engineers from Germany have stated that before getting pregnant most of the women were aspirants to a higher career level, but promotion prospects disappear during pregnancy and parental leave (WomEng Consortium, n.d.). The results of the WIR-Study (EC, 2003a), which analysed 29 firms in 11 member states about good practice measures, specify this phenomenon. Some women report they have the feeling that it is difficult for them to compete on an equal basis with men in promotion matters because the age at which they are most likely to be promoted is also the age at which they are most likely to give birth and consequently take a career interruption. In addition motherhood is often considered to limit a woman's availability to her firm what can inhibit women to advance in a position.

One structural problem thereby is that prolonged breaks or part-time work slow down the accumulation of seniority which is an important precondition for holding management positions (EC, 2003a). From this it follows also that women don't have a chance to come into posts where they have the power of decision making and the influence of promoting procedures respectively. Finally fewer women will be available to act as a role model (Ministerium für Arbeit und Soziales, 2006).

Interesting is, that also interviews with women who do not have children show, that they are more likely to express concerns, fearing they will encounter difficulties in the future (WomEng Consortium, n.d.).

Childcare

The difficulty of work-life balance is also influenced by a lack of appropriate child care facilities. Good childcare is crucial for parents returning to work. There are big national differences between European countries. France and Finland for example have good public childcare as opposed to Germany and Slovakia. It can be explained by the lack of financing, of course, but more important seems the low social acceptance of working middle class or professional mothers (WomEng Consortium, n.d.).



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It is important to stress, that there are not only differences between countries but also between companies. The “good companies” surveyed take into consideration that many of the women who have children want to take care of them, so they implemented a specific policy, maternities and parental leave, sometimes child-care facilities, part time work etc. However, some of the companies – and/or society at large - consider it as a personal problem.⁸

Women researchers in the WIR-Study (EC, 2003a) also tended to formulate the problems they have in trying to reconcile their family and professional lives and to cope as working mothers. But women’s opinions tend to differ widely on the subject of care provision. Some female researchers explicitly oppose intervention by their employer in such matters. According to the WIR-Study (EC, 2003a) not all women wish for their employer to intervene in reconciliation of family and work by providing childcare amenities. They interpret such measures as a return to paternalist management. In addition they fear that result in increasing working hours, and that meetings scheduled later and later in the evening, and so on. Other female researchers favour such provisions, at least when the crèche’s opening hours correspond to the usual working hours in the firm. The question of what happens when a person loses his or her job is yet another important issue to be settled: one female researcher explained that women certainly have more to gain from such a policy measure. The general view is that it is up to the government to manage the reconciliation of work and family life (point of view especially of French and Belgian female researchers).

Another wish, which was frequently mentioned in the debate about the reconciliation of work and family life, is that the mother alone should be given the choice concerning how to go about it. Some women stress that they do not want any intervention from the firm in gender-related matters. For example, when it comes to travel or assignments, colleagues or superiors tend to consider the specific constraints of mothers and limit their options because they have children. Although these constraints exist, women would like to be offered the alternatives in order to make their own decision, whether positive or negative.

One woman from Portugal interviewed by the WIR-Study pointed out that although the company acknowledges difficulties of the reconciliation of women’s work and family life, an improvement in women’s situation depends on changes within the family such as the sharing of household

⁸ For examples of companies see Womeng Study and the WIR Brochure (consortium of WomEng, n.d.; EC 2003a)



task. Beyond societal, improvement can be reached by the reduction of work schedules, particularly for those with children under the age of 12 (EC 2003).

One striking result observed from different studies seem to be that as long as parenthood is only considered to be the problem and responsibility of the mother, not both parents, difficulties in work-life-balance will exist for women who aspiring a career. Furthermore, just the fact of being a woman seems to be an obstacle for a professional career for women since every woman is viewed as a potential mother. Not all women can be or choose to be mothers, but even childfree, single women do not progress as they should compare to male colleagues.

This means that it is not only sufficient enough to improve the childcare but more widespread solutions/changes are required.

3.8. DUAL CAREER COUPLES

After discussing the problem of work-life balance this section deals with another topic which is closely attached to the previous topic – the dual career couples.

Literature argues that women's career development is not so straight forward than it should be when aiming at a career as scientists. Women's careers in contrast to men's seem to be not so target orientated and jobs are less career relevant (Onnen-Isemann & Oßwald (1991)⁹. This might be partly due to the fact that women are in another partner situation than men. Different studies found out that women in academic and science careers mostly have partners who are also high educated and following a career (Onnen-Isemann et.al., 1991; Bundesministerium für Bildung und Forschung¹⁰, 2006). This phenomenon is described as "dual career". In contrast to that female partners of men in academic and science careers quite often are not working or working part-time and focusing mainly on family and children. Men are therefore in the position to furthering their career with a partner in the background supporting them, whereas women cannot build on this support.

⁹ The authors look at barriers related to the careers of women in universities in Germany.

¹⁰ German Federal Ministry of Education and Research



Many interviews prove the difficult situation for women in dual career couples. Women are still expected to subordinate their careers and follow their husbands or partners. Some partnerships and marriages have broken up because of the pressures caused by irreconcilable professional and family demands (WomEng Consortium, n.d.).

Even if certain companies try to help women proposing part time hours, teleworking etc. dual career is a strong brake to women`s careers and penalizing women in different ways such as facing problems within the partnership/family or social pressure of being mainly responsible to take care of the children. Besides one important key element is the attitude of the partner. It seems that there are strong differences between countries and between generations. In countries where the image of the “caring mother” is very strong and alive (Germany, Greece, Slovakia, Austria) the dual career is very difficult to handle. In contrast several young women interviewed insisted on the fact that they can have a career because of the support of their partner (WomEng Consortium, n.d.).

3.9. GENDER DISCRIMINATION OR POSITIVE DISCRIMINATION FOR MAN/‘MALE BONUS’

Another factor that is generally considered as an individual barrier for women is gender discrimination and the so called ‘male bonus’. But structures are the course of discrimination as well.

Firstly it should be point out that gender discrimination does not occur in isolation, but is closely linked to other forms of discrimination. Hence, gendered discourse is frequently used to symbolise other kinds of hierarchies, unrelated to gender or biological sex. Strong gender awareness and recognition of the diverse and often subtle forms that gender bias and gender (in)equality can take, can therefore help to increase sensitivity to and awareness of other forms of discrimination that also take place (Thorvaldsdóttir, 2004).

Examples of subtle gender discriminations are:

- gender biased language (example of gender-biased metaphors: man: “wrestling with a difficult task”; woman: “had something knitting”)
- gender characteristics
- insider connections
- department and faculty politics



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Deprecation and silencing: work and research contributions by female candidates generally received less attention than those of their 'masculine' counterparts. Deprecation is thus used to describe when contributions from women applicants were "silenced". Their work received less discussion, and deprecation terms or remarks were commonly used to minimise their scientific abilities.

A study about gender discrimination in American universities reveals that women, who enter engineering programmes in large universities, often feel as an unwelcome minority, negatively viewed by a majority. Discrimination in the graduate school is often informal, such as not being taken seriously in a research group meeting, or a devaluation of their contributions (Gupta, 2004)¹¹

The majority of women engineers interviewed within another project refer that they have not experienced serious, open discrimination, they actually stressed very good co-operation with their male colleagues. But still they mentioned that they are excluded from "old boys networks" or that their male colleagues had much higher salaries, but they strangely do not qualify this as discrimination (WomEng Consortium, n.d.). Some women who don't want to work in a male-dominated field (engineering) any longer report that they had an unreasonable amount of their time to be spent not on furthering their careers but rather on fighting stereotypes and discrimination (Erlemann 2002).

Considering these results it becomes apparent that discrimination is often subtle or indirect and does not seem to be recognised as much or played down by women. This could be an unconscious strategy for women to get on with their situation in a male-dominated area (WomEng Consortium, n.d.).

Another interesting point is that discrimination can also come from other women. A possible explanation for this is the perceived threat that women in traditional jobs (e.g. secretary) experience when confronted by women in non-traditional jobs (e.g. women engineers). Besides this women engineers have been mistaken for the secretary. This reveals that women have to

¹¹ This study utilised both qualitative and quantitative methods. 83 men and 13 women faculty members of Midwestern University (received electronic questionnaire survey) and 400 women faculty and graduate students of other universities (in-depth interviews).



face traditional stereotypes (responsible for house keeping, stay at home with children). In contrast to this men who want to go on paternity leave are often ridiculed. But even not having children is also held against women engineers as they have failed to be “real women” (WomEng Consortium, n.d.).

Discrimination can also be caused by the increasing use of ‘headhunting’ techniques. If the principle of equal treatment was applied properly, recruitment and promotion procedures would be transparent and follow good practice. In contrast to that some universities use networks and head hunters to fill posts (rather than the perfectly legitimate use to swell the pool of applicants). For example, in Finland, there has been some criticism of direct approaches being made to individuals on equal opportunities grounds since it results in fewer women being appointed. It become apparent that ‘headhunting’ techniques can cuts across good equality practice and consequently intensifies gender discrimination. (EC, 2001)

4. BARRIERS FOR FEMALE STUDENTS

The review of qualitative studies has shown that it is important not to look only at reasons for under representation of women which are already working in technical disciplines, but also have a focus on why so few women decide to study ‘male-dominated’ disciplines. To get an equal gender balance within these disciplines it is necessary to look at the barriers women face, firstly to actually start a study in S & T and secondly to finish their studies successfully. One study which considers also the view of students on their fields of study is the WomEng Study. (WomEng Consortium, n.d.). The results will be presented in the following chapter.

Example: Engineering science (WomEng Study)

The path to becoming an engineer requires a young girl to make a series of decisions at key stages in her life. For better understanding who and what influence the choice at each stage, it has to be differentiated between three interlinked themes. The first aims at understanding the internal and external influences on women’s choice towards engineering. Since not all women are successful the second theme has aimed to identify internal factors and external factors that may cause a woman to drop out of her studies. Furthermore it is evident that activities that only



focus on young women (like information days, exhibitions for girls) have not been particularly effective in encouraging more girls to enter the masculine culture of engineering. Therefore the third interlinked theme has aimed to identify gendered institutional cultures and structures in higher education and in the professional sphere which are reasons for girls to stay away and drop out respectively from these disciplines. These questions among others are subject of the WomEng Study (WomEng Consortium, n.d.).

4.1 REASONS FOR CHOICES

Early choices

It is important to bear in mind that the early choices in school life can already influence the later career or study options particularly the decision for an engineering study. The type of secondary school someone attended can have a significant impact on a student's final career options. The results of the WomEng Study show how in those countries where comprehensive secondary education prevails, students select subjects for more in-depth study after perhaps two years of secondary schooling at age 13-15 and stop studying others. This can be a key decision moment because students who fail to study the necessary mathematics and science subjects beyond this point find it extremely difficult to pick up these subjects later on. Consequently they do not have the entry qualifications for degree courses in engineering. According the results of interviews parents seem likely to be involved in the choice of subjects, but the later these choices are made, the greater the influence of teachers and peers may become. Another point is that different kinds of schools have different proportions of sciences and technical subjects on the one hand and non technical subjects on the other. This may cause problems for students once they embark on an engineering degree (WomEng Consortium, n.d.).

These findings show that our study should also consider questions to the structure of the educational system.

Student's reasons for choosing engineering

The first important element which has to be underlined is the fact that most of students in Austria, France, the UK, Germany and Slovakia had decided to study engineering before they started higher education. Either they specifically have chosen engineering (interest in technical fields) or they declare they liked science and math in secondary school or even before. It was a positive choice for almost all of them (WomEng Consortium, n.d.).



It should be stressed that also the status of engineers in a country influences the decision for an engineering science. In France for example where the engineer status is very high about half of the students declared they decided to study engineering because they liked science, the other half decided because of the school and social influence in favour of engineering. They knew at the end of the 5th year in secondary school that they would study engineering because they had to do it, considering they were good students.

The main reasons for young women not to study engineering are that it be considered as highly competitive for girls, too specialised and too narrow. Another point is the prevailing ignorance about jobs. Since girls often more mature than boys, they want precise answers to their questions concerning jobs, professions and careers and they expected a balanced live style (WomEng Consortium, n.d.).

Other influences

In addition to choose engineering is not always an individual choice. Very often students admit that others have influenced their choices and that their families and friends have influenced them more than their teachers or pedagogical advisors. Thereby the education level of the parents has an important influence. But the proportion of fathers or mothers with university degree or which are engineers themselves vary strongly between the countries. To interpret the differences more fully is not possible on the basis of the interviews.

According to the results of the WomEng Study (WomEng Consortium, n.d.) among the other influential factors concerning the student's decision to attend an Engineering school or Faculty, personal contact seems to be a decisive one. The most effective opportunity for personal contact is certainly "Open Days" at the University which are mentioned in almost all the countries. Interestingly, counselling by a professional counsellor does not seem to be highly valued and booklets or other kinds of printed information are never mentioned.

4.2 CAUSES FOR DROPPING OUT / SUCCESS AND NON- PERSISTENCE

At first it is to say that the dropout rates vary between the European countries. Countries with a high drop rate are for example Austria, Finland, Germany, Slovakia and countries with low rates



are Scotland and France. These findings point to different conditions or structures related to the engineering degree.

Expert's point of view

Experts argue that most common explanations for the high drop out rate are wrong expectations linked to poor information about course content. An example is the audio control engineering degree where students expect lots of art and music. Some experts estimate that more boys drop out than girls during the degree course (WomEng Consortium, n.d.).

Student's point of view

Students reported most frequently that the reasons for dropping out from an engineering study are related to the quantity of work and the knock out exams.

Female engineering students explain some of their difficulties by the lack of previous knowledge. They say it is different for the men who very often have already acquired this kind of knowledge. Such situation leads some women to declare that men can cope better with technology or technical subjects. In Germany women complain also about the lack of practical work.

Besides to that women from Austria and Germany are very critical of the lack of attention from staff, poor course organisation, lack of information and the poor quality of pedagogy, no dialogue with professor, no will to introduce examples more suited to female students. In other countries (Finland and Slovakia) students are not so critical and do not blame the institution for their failure but rather the subjects and their own lack of previous knowledge (WomEng Consortium, n.d.). Additionally to that it is worth mentioning that interviews done within another qualitative study (Erlemann, 2002) revealed that women engineer students are often feel that they are discriminated by male students in discussions and dialogues. Their approaches or perspectives of tasks are often rejected. Some women reported from experiences of sexual harassment in working groups. These factors can be obstacles for women during their study or can also be causes for drop out.

The results reveal that explanations for failure can vary significantly from one country to another and between persons of course.



Gender- differences

In general experts and students interviewed by WomEng Study say there are no gender specific differences for dropping out. However, some different study experiences between men and women are reported that caused them dropping out. One reason is that female engineering students always have to justify their degree choice as it is perceived as not normal for a woman to study engineering. They are also confronted with subtle but persistent discrimination in the form of jokes, remarks and even different exam standards (easier for women).

Another difference between women and men is that female students tend to drop out at an early point of their study and cross to job trainings. Male students tend to leave university at a later point. Experts presume that girls tend to finish their studies and then leave the University, raise a family and never return to their profession (WomEng Consortium, n.d.). Furthermore the results of a representative survey (LEWIN et.al., 1995) throughout Germany has clearly shown that significantly more women than men regard family reasons such as pregnancy or child care as a reason for dropping out. Male drop out rates are overrepresented in categories like failed exams or financial problems.

Over the last 30 years, a variety of initiatives have been set up to involve more women on the study of engineering. Early attempts focused primarily on young women and making them more informed. But more recently, stronger emphasis has been put on changing and improving degree courses and the cultures of engineering institutions.

With regards to our survey to individuals (students) in the field of the construction sector it is important to identify such structures and their negative effect on the achievement of women students.

Student's visions for the future

Students have been asked if they see themselves still working as engineer in seven years time. The responses to this have been differing widely between countries within Europe but only very small between genders. The visions of the work as an engineer are the same for men and women: long hours, managerial responsibilities, heavy work load are part of the job. But there are differences when it comes down to family life and personal life. There women are more worried than men, especially about bringing up children. The differences are not that huge. But the most noticeable is the fact that men do not answer the question of "*bringing up children*". Almost half of the interviewed male students did not answer this question which probably means that they have not thought about it or do not want to think about it (WomEng Consortium, n.d.).



This aspect should be considered if one will develop measures for attracting women to science and engineering in general and particularly for women in construction research.

5. WHAT FIRMS CAN DO

This part of the report will show a variety of measures and initiatives firms have implemented to promote women in research. This information will help to prepare the case studies of institutions in WP 3 and can serve as a basis to questioning companies in the construction sector what they actually do.

Companies often claim that they are 'neutral' in their human resource practices and treat women and men in exactly the same way fostering a belief that there is no discrimination at all. Neutrality ignores the specific employment characteristics of women and men and is in clear conflict with the notion of 'mainstreaming'. Firms seem to be unaware of the risks of indirect discrimination. The aim is not just to establish neutrality but rather to value diversity.

Firms can take a wide variety of actions to promote women in research. What is still lacking is motivation to do so. In order to encourage firms to invest in the cause of women's careers in science, it is important to show them how they and their employees can benefit.

This chapter presents a number of human resource measures and initiatives implemented by firms to promote women in research. To date the most comprehensive reports on this are those by the WIR- and the WIST Expert Group, thus the following is based on these two reports unless stated otherwise.

The following measures concern the whole range of human resource management, starting with initiatives concerning structural changes to pull down obstacles women face like reflections on 'feminine management'; network-building; initiatives in continuous training; recruitment, promotion, wages and diversity and time management (particularly the possibility to pursue a real career whilst working part-time) up to initiatives regarding individual factors like



management of pregnancies, maternity and career breaks and dual career couples. At the end of this chapter, initiatives by firms and government in schools to raise girl's awareness of science and attract more girls into science courses in secondary and higher education will be presented. It is important to start with initiatives already at school in order to get a more equal balance between female and male students and therefore more women entering the labour market.

In all these examples, the risk of discrimination between men and women exists. However, these measures also present many possible actions to limit such risk, to restore equality, to promote women in industrial research and show that this is possible for all firms.

5.1. EXAMPLES OF MEASURES AND INITIATIVES

It is possible to find different measures and initiatives implemented in the different European countries to pull down the remaining obstacles and to improve the working atmosphere for women.

Below programmes of different companies combine different aspects of human resource practices with the aim of increasing the participation of women in research. They can be specific to R&D departments or concern the firm as a whole. For women such programmes constitute very good practices.

5.1.1. Global integrated programmes favouring women

Some firms implement global programmes favouring women's employment in research.

Procter & Gamble is an example of a general diversity programme.

Their programme is constructed around three important axes:

1. awareness of different working styles
2. networking meetings
3. flexible work arrangements

It is important to stress that *Procter & Gamble's* top management is totally committed to the diversity programme, which is fully integrated and considered a real 'company programme'. This programme (R&D) activities is not exclusively targeted at gender issues, but rather at the larger



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concept of diversity that includes cultural differences, for example across countries, even if the primary purpose is to increase the number of women in management positions but without resorting to positive discrimination. Furthermore, Procter & Gamble produces many goods targeted at women and therefore it is considered a good business move to increase the number of women within the company since this allows for better decision-making. Taking into account different management styles enhances innovation and creativity, especially in R&D.

Pfizer represents another example of an integrated programme with good practices in a number of areas, partly mentioned above already. Additional to the above examples is that *Pfizer* set up a Gender Planning Group to examine the results and recommendations from their own gender research to shed light on the obstacles women face and to examine why there was a gender imbalance within the company. This group is also required to produce an action plan for change. The group exists of a mix of very senior and relatively junior people, women and men, from different parts of the company. They are committed to the aims and objectives of the group, and contribute to its work 'in addition to their day job'.

The company has embraced a number of practices to support and encourage women around the issues of children. A Women's Network Group, training to counter the negative effects of the organisation culture, academic liaison, creation of working environment that is conducive to women, and so on.

5.1.2. Reflections on the 'feminine management' mode

The under-representation of women which becomes even more pronounced as one moves up the hierarchical ladder shows the importance of networking and style awareness. These are especially important in cases such as the one described by a German female researcher interviewed by the WIR-Study "Dealing with and promoting women in research is particularly unusual for older supervisor. Based on their own experience they are much more orientated towards male newcomers and provide them with support much more readily than women" (EC, 2003, p.75).

Procter & Gamble (Netherlands) created a workshop to explain the differences between men and women, particularly the differences in management style. The results of the workshop led to the implementation of a compulsory training programme for all managers in order to raise their



awareness of these differences in management style. This training programme also aims at changing attitudes, for example, by getting women to speak up during meetings instead of men monopolising proceedings, so that women's ideas and views are heard alongside the men's. Reflections concerning style awareness at *Procter & Gamble* have also led to the establishment of an assignment-planning project. This ensures that everyone gets an assignment in which they can demonstrate their potential, irrespective of style. The acknowledgement of differences in management style is considered by *Procter & Gamble* as the most important pillar of the R&D department's diversity programme.

As one female German researcher explained, it is important to implement more objective assessment and selection criteria from the top down. This requires making supervisors more sensitive to the diversity approach and its implementation in operational development plans, as well as to more objective performance criteria. Moreover, it has been shown that wherever performance criteria can be measured more easily and precisely, such as for technical services, women are more successful.

5.1.3. network-building

The absence of a women's network is often put forward to explain, on the one hand, the under-representation of women in certain positions and, on the other, the far greater difficulty women encounter in obtaining promotion to positions of high responsibility. The absence of networks is one factor, among many others, that explains differences between male and female management often put forward by female researchers themselves.

Ford, a R&D company in Germany has taken on a committed diversity management. One aspect of this are the Ford Employee Resource Groups, including several Women's Groups, i.e. the Women's Marketing Panel (WMP), IT Women in Leadership (IT WIL), Women in Human Resources (WiHR) and the Women's Engineering Panel (WEP). The WEP was build to recruit, retain and develop women in engineering within Ford Motor Company, to create a diverse workforce and to add female perspectives. Activities of the WEP include Development and analyses management surveys to assess awareness of work-life balance initiatives, initiation Women@Ford, a workshop for female employees currently involved in Resource Groups, creation of a link to VDI (German Engineering Society), participation in the exhibition Women in Science etc. (EC, 2004b).



Network-building is a good practice but once again time is a problem. Indeed, women already divide their time between their work and family responsibilities and now network time needs to be added. Outokumpu, a company in France, allows women to meet or organise during working hours which can be considered as good practice.

5.1.4. Continuous training

Actions in the field of continuous training seem to meet the particular expectations of female researchers. The WIR-Study found out that it is a fact that in firms that offer significant opportunities for technical training, foreign language training and also interpersonal-skills training, women seem to be particularly at ease and satisfied about training in such skills as for example time management and team work, not so as to work more but to be more efficient during working time

Pfizer largely invests in both continuous training and awareness in order to encourage a change in the firm's culture with respect to women.

Offering training opportunities to women is often much appreciated by women themselves.

At this point the WIR-Report raises the questions, why do women need more training? Don't they have enough skills? Weren't they selected on recruitment in the same way as men? These questions illustrate the recurrent problem of women thinking they need more training or thinking their management skills are lacking. This demand for continuous improvement is consistent with technical progress and the need to perform, but it is also a good illustration of the difference in self-confidence between men and women.

5.1.5. Recruitment, promotion, wages and a mixed workforce

Some firms clearly attempt to create a diversified workforce to facilitate cooperation and to minimise conflicts. Their policy is to achieve and maintain a balance between women and men in the workforce as a whole, for reasons such as good teamwork and smooth functioning. A work situation is only considered balanced when it is mixed.

To help female promotion, every woman at IBM selected for top management (High Management Potential) is assigned a personal mentor. With respect to recruitment, firms tend to



stress the importance of criteria such as qualifications and experience, regardless of the sex of the candidate. Depending on the sector of activity, job applications are more or less feminised.

Despite developments in the position of women and despite the neutrality policies pursued by their employers, real change might require at least some degree of positive discrimination in the field of recruitment.

Some female researchers insist on the importance of a good superior and development discussion. Development discussions with a superior present a good opportunity to discuss all possible problems, personal plans and indeed everything concerning work and promotion.

5.1.6. Time management practices

Different time management practices for example flexible working time, working hours and work organisation but also teleworking (working from home) are also very well adapted to the specific characteristics of research. Work flexibility practices are considered to be particularly favourable to women's employment because they make reconciliation of family and professional life easier.

5.1.6.1. Flexibility of working organisation

Flexibility in work organisation is particularly suited to R&D work. Indeed, from all interviews the WIR-Study got the impression that the only thing that really matters is the result of one's work, rather than the number of hours worked on the way in which work is organised (EC, 2003a).

It is also recognised that productive outputs can be satisfactorily achieved in all types of places, and for scientists it appears to be especially important that they have time just to think. Scientific research is so important to a business that it is accepted that scientists cannot be constrained by traditional work models. Providing flexible working hours in industrial research is not just a beneficial policy but also a measure that companies are forced to implement due to the characteristics of research work.

Another form of flexible work organisation is teleworking. Many firms offer this possibility, which is made much easier by the new communication technologies and is well adapted to some aspects of a researcher's work. Female researchers tend to see many benefits in this way of working. Telework can help to facilitate the reconciliation of family and working life.



But there are also arguments against teleworking:

- the frontiers between work and privacy may become blurred
- an environment with children is not conducive to high performance
- women may prefer a separate work environment
- it can isolate women in their professional environment and put them in an atypical professional situation

5.1.6.2. Reduction of working time, part-time work

Practices related to the reduction of working time differ substantially across the firms in the analysis of the WIR-Study (EC, 2003a).

- Offer for parents of very young children
 - a provision allowing women to return to work on a part-time basis after giving birth (Since this possibility was made available, a significant difference has been observed in the number of women who return to work and also in the number of women who eventually return to full-time positions. Both numbers have increased.)
 - Non-rigid part-time work (a part-time job that is not constrained to fixed days or hours of work)

But also in some firms, it was said the research activity itself is not compatible with part-time employment.

Some of the firms and female researchers in the WIR-Study claimed that part-time work does not hinder one's career. This is an important argument in the discourse of women researchers themselves and it is always illustrated by examples of female researchers having been promoted although they were working part-time. This possibility seems reserved for women and not for men.

5.1.7. Management of pregnancies, maternity and career breaks

Relatively few women scientists and engineers working in the industrial sector have dependent children, compared to their male colleagues (EC, 2003a). The management of maternity poses more or fewer problems depending on the firm. For example, some large firms have stated that maternity and pregnancies are not a problem because the size of the firm makes it easy to find solutions (temporary replacement, anticipation and organisation of returns).



With respect to maternity and parental leave, some firms offer more generous provisions than are required by law. They offer a higher replacement income during the leave, prolong the duration of the leave or adopt a very open and flexible policy as to possible extensions of the leave.

IBM in Germany offers telework, also in research, for parental leave or interruptions for caring. Employees who opt to deactivate their employment contract can keep in touch with work and the company by substituting for others during vacation or illness. In addition, they can attend training schemes during their leave to keep their skills up-to-date. At the same firm, attempts are made to employ highly qualified women at least part-time after a maximum of one year of parental leave in order to keep them up-to-date.

Atofina, a Belgium firm, is remarkably open to career breaks for different reasons (children, launch of own business). The firm's only complaint with respect to career breaks is that they can be prolonged and when people finally decide to come back they have often lost most of their previous skills and operational knowledge. Here options and opinions differ widely between companies. Whereas some argue that a researcher cannot afford to become totally disconnected for a period of time and researchers must keep continuously informed about the latest developments, other say that the speed of knowledge change in its specific research area is not considered an impediment to researchers taking leave periods longer than one or two years. The professional basis of the researchers is considered so well founded that updating will be easy. However, this may actually depend on the specific area of research.

5.1.8. Management of dual career couples

For dual careers couples, the balance between work and family is complicated by a greater commitment to high demand jobs, higher costs of interruptions during child bearing years, and a more difficult coordination of work schedules and job locations. Dual career couples report that, especially when children are present, their lives need a lot of coordination and flexible management. Different issues can be related to different life cycles. With children difficulties in managing their life arise because this involves the organisation and the stress of delegating child care. (EC, 2006).

One of the WIST firms, *Gaz de France*, has made a quantitative and qualitative survey in their company. Their results reveal that among the younger dual career couples, stronger aspirations emerging for women to have a better work-life balance and for men to be more available as



fathers, have implied important changes in the allocation of time, especially concerning childcare.

TOTAL, another company who took part in the WIST-Study focused on the issue of the international mobility of dual career couples. In the past it has always been “a working man, travelling with his housewife”, now the company looks for tailor-made solutions for working spouses and also husband’s career. Hereby it is much easier to handle a “dual career in the same firm” than a “dual career in different firms” that implies more negotiation between the partners.

Different strategies of companies in order to mitigate dual career’s difficulties and constraints can be in-site childcare, flexible hours and arrangements, re-entry positions after parental leave, support for the spouse’s job in case of employee re-location (EC, 2006).

The implementation of such policies reflects an important step in the attempt to reducing the difficulties and constraints of dual career couples.

5.1.9. Initiatives in schools to raise girl’s awareness of science

Statistics have already proved that although the proportion of female university graduates has risen significantly, some fields of study such as engineering and mathematics for example are still mostly male-oriented and the proportion of women doctorates is very low compared to men. Consequently, among the actions aimed at promoting a greater presence of women in industrial research, measures should be implemented to attract more girls into science courses in secondary and higher education.

Many good practices addressing girls at school already exist and are developed at different levels (government, industry, network and education system).

For example the German government organises Girl’s days. On these occasions, girls can visit companies to get acquainted with the world of work and to gather information on working, training and earning opportunities in different companies.

A number of firms, but mostly female researchers themselves, share the opinion that a crucial step in promoting women in industrial research would be to raise the awareness of schoolgirls with respect to science and technical education opportunities. Often in biology, pharmacology and chemistry, as in the case of a particular Spanish firm, the reason for the high proportion of female research employee lies in the gender structure of students. The desire to increase the



number of girls in science, and not only in biology, is seen as a good way of attracting them into private sector research.

Some initiatives of firms and government related to awareness raising listed in the WIR-Study are:

Initiatives to promote women in technical studies, not only in the company itself, but at preparatory school level

Cooperate as a partner with a number of different schools and universities

Change mentalities in going into schools and present examples of women who have succeeded in scientific jobs in industry (policy of awareness raising)

The above measures and initiatives are just a list of different actions companies can take to promote women in industrial research. All these measures serve different aims: the pursuit of a mixed workforce; recruitment; time flexibility and work organisation; to efficiently link family and working life; to rebalance the work situations for mothers; training; net-work building. For our own study it is important to be aware of different measures companies can initiate to promote women in construction research and to question what they actually do. We need to bear in mind that differences across countries can depend on local policies and laws but also reflect cultural differences.

6. CONCLUSION AND OUTLOOK TO OUR OWN STUDY

One of the main important results is that there are no qualitative studies specifically related to construction research. Therefore this report is based on women in academic and industrial research as well as male-dominated disciplines. Barriers have been presented by structural and individual factors, as well as their interaction with each other. Where possible the significance of barriers for construction research has been identified. The illustration of initiatives and measures of companies to promote women in research can be used as a basis for questioning what companies and institutions actually do in the construction sector.



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The concept of the “leaky pipeline” reveals the difference between women in all disciplines and women in science and engineering. There are fewer women studying science and engineering compared to women who are studying at large. But there is no “leaky pipeline” for women in science and engineering up to Grade C. Another point important to mention is that an increase of women at universities or industrial research does not automatically lead to an equal presence of women in higher positions. Men are still “occupying” the most influential position and recruit or promote, conscious or not, more men than women. Therefore all stakeholders (universities, companies, government) have to actively promote women. An increase in the number of women in construction research seems necessary and important but it would not be sufficient enough and does not cause equality alone.

The concept of the “leaky pipeline” shows that there is a complex set of issues which inhibits women from pursuing academic careers.

The following structural and individual factors has been identified as barriers for women in academic and construction research:

- myth of technology (technology as a man’s business)
- organisational structures of science
- male-dominated structure / male networks
- lack of female aspects in science
- lack of mentoring programmes / promotion
- lack of female role models
- work-life balance
- dual career couples
- gender discrimination or positive discrimination for man / ‘male bonus’

The last three topics are mainly related to individual barriers of women but cannot be seen independently from structural factors; in fact they can be influenced by them.

In general individual factors which can influence a career promotion of women scientists do not necessarily relate to a specific discipline but can be transferred to any other discipline within



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science. Therefore when looking at individual factors in our own study we should put our main interests on possible solutions of how to overcome these barriers.

More recent literature to gender and science argues that in the past there has been too much emphasis on individual factors instead of structural factors. Particular in male-dominated disciplines structural factors have a significant impact on the career development from women (Lind 2004).

Looking at different disciplines within the so called “male-dominated disciplines” there are structural settings which seem to be comparable. But several studies indicate that there are also structural factors which can be different from discipline to discipline (Erb, 1996). Since there are no specific studies regarding construction research, it is very important to investigate into the specific structure in this field and how these structural factors interact with individual factors. Are there any specific structural factors within construction research which influence or even intensify individual problems for women in their career? What changes to the structure are necessary according to women needs (e.g. working hours, time spent on construction sites away from home, male dominated language, career breaks as an end to career, construction abroad etc.).

Quite frequently literature refers to the difficulty of women to combine family and children with work. One hypothesis can be that as long as women are the main person who seem to be responsible to look after children nothing will change. If it would not matter anymore if men or women look after children a lot of the obstacles women face will disappear. A lot will be achieved if a future employer not only views in every woman a potential mother but also in every man a potential father who could be the one who looks after children. Therefore in our own research we would need to take men’s view on board to find out about their intention of taking over more responsibility in raising children although this might be an obstacle to their career (whereas, if it would be natural for men and women to have same responsibility in raising children, we would not need to talk about an obstacle here anymore).

Another important point why it is important to bring men’s view on board is that there are changing structures in society as a whole. A generation ago a lot of women lived in traditional roles and stayed at home raising their children. Nowadays more and more women are having their own career and are not so prepared anymore to follow their partners to another city or country to support his career. These changes have also consequences for men, perhaps not being able anymore to react so flexible on employer’s career requirements. Therefore in our



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own research we might take such changes into account and ask employers if these (and others) career requirements are still acceptable in a changing society and what can be done to support couples and families respectively in these situations.

In general it would be important for our research to question working conditions because trying to adapt women to structures which accommodate men cannot be a satisfying solution for the future. Thereof men could also benefit from flexible working conditions, e.g. going part-time and still have a career.

After reviewing international literature about women and their career in academic and industrial research it needs to be emphasised that, besides individual and structural factors in specific disciplines, differences in the organisation of the welfare state (e.g. family friendly policies, social protection law), cultural differences regarding the responsibility of taking care of children as well as occupational settings (workplace initiatives) can influence women's (and men's) decision in their career development and family planning. Institutional settings, welfare law and social policy can also influence employer's decision in recruiting and promoting women. There probably also exist occupational segregation with different career perspectives for women in different countries. All of this needs to be taken into account when doing our own international study. It is important to be aware of different legislation, welfare policy and cultural aspects when developing our questionnaires, case and biographical studies.



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