



WOMEN in COnstruction scientific REsearch

WOMEN-CORE



Executive Summary

Abstract:

This report summarises the main conclusions of the WOMEN-CORE project and provides a set of recommendations for improving the knowledge base of women in construction research and for empowering women in this sector.

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INDEX

INDEX	2
1. WOMEN-CORE PROJECT	3
2. INTRODUCTION	6
3. CONCLUSIONS	8
4. RECOMMENDATIONS	13

1. WOMEN-CORE Project

The WOMEN-CORE¹ project has been established to address the under-representation of women working in construction research. It is a three-year STREP Project (FP6), co-funded by the European Commission.

The overall objective of the WOMEN-CORE project was strengthening women scientists' participation in construction research in Europe by means of: enhancing the knowledge of women and their influence in construction research, identifying of main research areas attractive from women's perspective and identifying and assessing gender-specific needs of R&D in construction sector. WOMEN-CORE combined different methods and techniques of data collection of existing and new sources of information, analysis (quantitative and qualitative), synthesis and evaluation, based on three main axes: the statistical analysis from existing sources; the fieldwork to explore new sources (surveys, interviews and case studies); and new developments in research content.

WOMEN-CORE relies on a clear distinction between construction as an industry and construction as a field of research. Construction research was defined according with the European Construction Technology Platform (ECTP), considering seven focus areas: Cities and buildings; Underground Construction; Networks Systems; Cultural Heritage; Quality of Life; Materials; and Processes and Information and Communication Technologies. According to this definition, the core academic disciplines related to construction research are: Architecture; Urban Planning; Mechanics including fluid mechanics and dynamics; Building structures; Water management and structures; Transport organisation and structures; Environmental engineering; Construction and economic Management; Building physics; Construction Technology and Organisation; Information Technologies; Heating, cooling, ventilation, electricity (HVAC) and networks; and Geotechnics, underground structures.

Around 1,500 European research institutions devoted to construction have been identified and classified into four main categories: Higher education institutions, research centres, construction companies (SMEs and LEs), networks and government institutions.

The analysis done in WOMEN-CORE was focused on three different targets in construction research: a) individuals, b) institutions and c) content of research:

a) Individuals: The main characteristics of the scientific career in construction research and the most relevant trends that shape the professional development of construction researchers have been identified. Significant differences between women and men have arisen as key issues with

¹ WOMEN-CORE Consortium: LBEIN-Tecnalia (Coordinator)-Spain, CIREM- Spain, GESIS-CEWS-Germany, CIFS-Denmark, CVUT-Czech Republic and Loughborough University-UK

relevant implications with regard to professional continuity and success. Gender inequalities have been seen at level of stability, pay, promotion opportunities and expertise with some of them probably related to career breaks because of family responsibilities.

Besides the inequalities at an organisation level there are other factors difficult to measure where women and men differ. They are partly related to women themselves, partly because of a lack of support outside their work, which makes it difficult for women to build up a career. In particular women seem to lack self-confidence when going for promotion and higher positions. The traditional division of labour within the researchers' household still persists and affects the career opportunities of women and men differently.

b) Institutions: Research institutions, through institutional practices and structures, play a relevant role that can either enhance or minimise gender inequality. Policies implemented to attract, retain and promote women as researchers, as well as measures for work/life balance, targets and quotas have been identified and analysed in order to define and recommend suitable initiatives to increase gender equality. Regarding the situation of female construction research in industry it seems that for women it is more difficult to have a linear career progression due to the inflexibility of working time or part-time contracts, lower level of seniority and therefore lack of role models, reasons which seems to attract women more to work in an academic environment. A higher proportion of women working in an academic environment seem also to be influenced by other gender equality measures, such as networking and mentoring and set up targets, which Higher Education Institutions (HEI) are more obliged to fulfil than private industrial companies.

c) Content of research. Results from the mapping of construction research have shown actual changes in the content of research, including fields with a more integrated and multidisciplinary approach of scientific and technological issues, often focused on environmental and socially-sensitive issues. The emergence of these new fields may constitute a good opportunity for changing old-fashioned structures and encourage a higher participation of women in construction research, although this could also be a source of horizontal segregation.

The findings of WOMEN-CORE confirmed the pertinence of a set of recommendations with respect to overcoming the difficulties met by WOMEN-CORE partnership during the analytical work, as well as offer specific means which may improve women's careers in construction research, contributing to an equal working environment and a more equal society. The recommendations could be integrated within new policies to improve gender equality in this sector. Different key groups could benefit from them: policymakers at European, national and local level, stakeholders in the construction sector, research institutions (HEI, public and private research centres and industry) and individual researchers. This approach will allow every group

to make suitable decisions about their strategy for gender mainstreaming and career management and progression.

The network ENCORE, Equality Network for Construction Researchers in Europe, was launched in December 2009 as result of WOMEN-CORE project.

2. INTRODUCTION

This report presents a summary of the results achieved in WOMEN-CORE project², including the main conclusions and recommendations reached. Since the kick-off in April 2006 up to December 2008, WOMEN-CORE project has been focused on strengthening women scientists' participation in construction research in Europe by means of:

- enhancing the knowledge of women and their influence in construction research,
- identifying the main research areas attractive from women's perspective,
- identifying and assessing gender-specific needs of R&D in construction sector,
- exploring new opportunities and anticipating tendencies for empowering Women in construction research,
- providing recommendations for empowering women in construction research, disseminating results and establishing a network of women scientist in construction.

To reach these objectives the methodological design of the WOMEN-CORE project combined different methods and techniques of data collection of existing and new sources of information, analysis (quantitative and qualitative), synthesis and evaluation, based on three main axes:

- the statistical analysis from existing sources;
- the fieldwork to explore new sources: surveys, interviews and case studies;
- the analysis of new developments in research content.

Additionally, the WOMEN-CORE Project held broad discussions with high-level experts in the framework of the Advisory Board meetings and the working National Seminars that were organised in the five WOMEN-CORE partner countries.

WOMEN-CORE relies on a clear distinction between construction as an industrial sector and construction as a field of research. For the purposes of this project, construction research was defined according with the European Construction Technology Platform (ECTP³). Thus, core academic disciplines related to construction research and considered under WOMEN-CORE are the following:

- Architecture
- Urban Planning
- Mechanics including fluid mechanics and dynamics

² WOMEN-CORE is a Strategic Targeted Research Project (STREP) of the Sixth Framework Programme for Research and Technological Development (FP6), co-funded by the Women and Science Unit of the European Commission's DG Research.

³ ECTP web site: <http://www.ectp.org/>

- Building structures (structural materials, steel structure, wooden structures, masonry structures, ...)
- Water management and structures
- Transport organisation and structures
- Environmental engineering
- Construction and economic management
- Building physics (for example acoustics, thermal performance and energy saving, day lighting)
- Construction Technology and Organisation
- Information Technologies (IT)
- Heating, cooling, ventilation, electricity (HVAC) and networks
- Geotechnics, underground structures.

However, due to the interdisciplinary character of construction research, there are many peripheral disciplines related with this field of research that have been considered within the scope of the WOMEN-CORE project. These include among others, physics, geology, history, psychology, sociology and geography.

3. CONCLUSIONS

The analysis was focused on three different targets in construction research: individuals, institutions and content of research.

The main characteristics of the scientific career in construction research and the most relevant trends that shape the professional development of construction researchers have been identified. Significant differences between women and men have arisen as key issues with relevant implications with regard to professional continuity and success. Gender inequalities have been seen at level of stability, pay, promotion opportunities and expertise with some of them probably related to career breaks because of family responsibilities.

Besides the inequalities at an organisation level there are other factors difficult to measure where women and men differ. They are partly related to women themselves, partly because of a lack of support outside their work, which makes it difficult for women to build up a career. In particular women seem to lack self-confidence when going for promotion and higher positions. The traditional division of labour within the researchers' household still persists and affects the career opportunities of women and men differently.

Research institutions, through institutional practices and structures, play a relevant role that can either enhance or minimise gender inequality. Policies implemented to attract, retain and promote women as researchers, as well as measures for work/life balance, targets and quotas have been identified and analysed in order to define and recommend suitable initiatives to increase gender equality.

Regarding the situation of female construction research in industry it seems that for women it is more difficult to have a linear career progression due to the inflexibility of working time or part-time contracts, lower level of seniority and therefore lack of role models, reasons which seems to attract women more to work in an academic environment. A higher proportion of women working in an academic environment seem also to be influenced by other gender equality measures, such as networking and mentoring and set up targets, which Higher Education Institutions (HEI) are more obliged to fulfil than private industrial companies.

Results from the mapping of construction research have shown actual changes in the content of research, including fields which are less male-dominated and often focused on environmental and socially-sensitive issues. The emergence of these new fields may constitute a good opportunity for changing old-fashioned structures and encourage a higher participation of women in construction research, although this could also be a source of horizontal segregation.

Women's presence in construction research

- *Gender educational segregation.* In 2004, women were found to account for 40.7% of bachelor and masters graduates and 33.9% of doctoral graduates in construction-related fields. It is higher than the proportion of women graduates in science and engineering.
- *Vertical and horizontal segregation in construction research.* In 2005, women only accounted for 19% of scientists and engineers in construction research. In 2006, women represented only 18% of the total membership within the ECTP.
 - Vertical segregation is strong, with high proportions of women studying construction subjects in higher education, but much smaller proportions of women in more senior positions. Only 24% of female researchers are found in the highest level of expertise whilst 34% are in the lowest levels.
 - Horizontal segregation. Women work in a higher proportion at institutions that perform R&D activities in the fields of architecture, urban planning and other non-classified activities.
- *Participation in EU funded projects.* In FP6, women represented 11.2% of coordinators and scientific managers of construction research projects funded by the EU.
- *Participation in patents.* In 2004, women comprised only 4.9% of patentees in the construction sector.
- *Participation in publication and citation.* In 2003, women accounted for 21.7% of publishing authors in construction scientific journals.

Differences between Academia and Industry

- *Women's presence in Industry and academia*
 - Industry has the lowest proportion of female construction researchers (33.5%). Higher Education Institutions have the best proportion of women in construction research (44.4%) and the best profile on gender equality measures.
 - The most decisive factors in women's choices of the public sector could be the flexible working hours and the high degree of intellectual freedom. The dynamic character of research in industry and the high degree of responsibility entrusted to researchers are the main factors attracting women to it.
- *Differences in working conditions.* In Academia the productivity is based on number of publications while in Industry on economic benefits. Full-time work is more likely in Industry while part-time work is more likely in academia. The academic research sector presents

lower salaries and the lowest gender pay gap. Views, perceptions and satisfaction on work-life balance are similar in industrial and academic research.

National Trends

- *Countries differences in women's participation in construction research.* Overall, the countries with the highest proportions of women participating across all areas of construction research are countries where the total number of people involved in construction research is very small.
- *National trends in the WOMEN-CORE partner countries.*
 - The UK, the Czech Republic and Denmark all experienced decreases in the proportion of women scientists and engineers in construction research between 2000-2005;
 - The Czech Republic and Spain both experienced higher than average increases in the proportion of women working as coordinators or scientific managers of EU funded construction projects between FP5-FP6;
 - The UK experienced decreases in the proportion of women in many of the indicators in construction research: scientists and engineers; coordinators and scientific managers in EU funded projects; and patentees. However, there was an increase in the proportion of women publishing in construction scientific journals;
 - Spain experienced a lower than average increase in the proportion of women publishing in construction scientific journals between 2000 and 2003. All other partners' countries experienced a higher than average increase, which was particularly noteworthy in the Czech Republic.

Institutional practices helping to achieve gender equality

- *Retaining women policies and patterns of seniority.* The departments of HEI and research centres have the highest proportion of women staff and also the highest frequency (generally) of gender equality measures. Research centers appear to be better at retaining women construction researchers than other types of institutions with a high proportion of more senior women construction researchers. The proportion of women decreases by level of seniority. Industrial companies have a steady decline of women construction researchers.
- *Working conditions.* The use of part-time contracts is more widespread in academia than in industrial research and in both institutional sectors, the proportion of women working part-time is far higher than men's. Whereas salaries tend to be higher in industrial than in academic research there is a relevant gender pay gap in both institutional sectors, which appears to be larger in industrial research.

- *Work-life balance and gender equality measures.* Work/life balance measures, such as flexible working hours, the ability to work from home and informal mentoring schemes are the most prevalent equality measures. Quotas are least prevalent.

Effectiveness of publications and patents in construction research careers

- *Scientific publications and participation in peer review* are very valuable in construction research careers with great differences between academia and industry. Neither editors, authors nor reviewers perceived any gender bias in the peer review process.
- *Significance of patents in construction research careers.* Women are absolutely under-represented among patent holders in construction. Patenting was not perceived as necessarily important for the career progression of either sex.

Relevance of other Supporting practices

- *Mentoring.* Both women and men surveyed agreed that mentoring is an important instrument for promoting the research careers in construction research. Informal mentoring was very prevalent in construction research, instead of formal mentoring.
 - Differences among countries were found in relation to participation in formal mentoring programmes. Germany and UK are the most experienced countries in mentoring programmes, while Spain presented the lowest experience.
 - The number of mentoring programmes related to construction in Europe is very low.
 - HEI concentrate the highest number of mentoring programmes, exceptionally large construction companies.
- *Role models* are important for the career of young women, according to many participants across the selected institutions and countries. But there are hardly any role models for women available and if so it happens more on an informal basis.
- *Networking experiences in construction research.* The influence of networking was perceived as very positive in career progression in construction research, although women showed slightly more interest in it. A high participation in professional networks has been detected with minor differences between women and men. High levels of satisfaction with existing networks were found.
 - A network specifically for construction researchers was considered a good idea, although there were reservations about how successful this would be if it was exclusive to women.

Content of construction research

- *Women's participation in the ECTP focus area varied significantly (2006). Women were mostly represented in the Cultural Heritage group, accounting for the 13% of the total representation, followed by Networks (11%), Materials (10%) and Quality of Life (9%). On the contrary, women were scarcely represented in Underground Construction (5%), Cities and Buildings (6%) and Processes and ICTs (7%).*
- *Changes in the content of research have been seen, including new fields less male-dominated and focused on environmental and social-sensitive issues. New fields of research and approaches are emerging from new social demands, environmental respect and sustainability which may lead to opportunities for women and for other groups traditionally discriminated. The emergence of these new fields may constitute a good opportunity for changing old-fashioned structures and encourage a higher participation of women in construction research, although this could also be a source of horizontal segregation.*

4. RECOMMENDATIONS

The findings of the WOMEN-CORE project confirm the pertinence of a set of recommendations with respect to gaining more quantitative and qualitative data and challenging organisation and policy, as well as society and culture as a whole, to contribute to an equal working environment in construction research and a more equal society.

(A) Addressed to policy:

Additional effort for updating surveys, databases, studies, etc. on a regular basis

- *There is a strong need for the European Commission and the Member States to make additional effort for improving access to sex-disaggregated data in industrial research.*
 - A central register or database of research institutions should be established. This is an essential need for carrying out more research about construction research institutions.
 - Patents. Patent applicants do not state their gender in the patent application form. It is recommended that patent applications collect data on the gender of patentees.
 - Funded projects by the EC. Contractors of funded research projects will be required to provide sex-disaggregated data on the participation of researchers at all levels of the project implementation.
 - Building up longitudinal databases at European level would allow the study on professional trajectories of researchers and the differences between women and men. In this sense reference databases could be the National Science Foundation databases, which allow the study of professional paths of post-doctorates.
 - The creation of national data bases where female researchers/scientists enrol themselves can be a supportive tool to positively influence the employment situation of women in science.

Establishing new rules for increasing women's presence in construction research

- *Female encouragement at educational level.* The lack of encouragement of women in scientific careers at educational level has been considered as one of the obstacles to obtaining gender equality in construction research. This can be started at school level.
- *Recruiting and retaining women in research-orientated careers in the construction sector.* Given the relatively high proportions of women undertaking construction related degrees (bachelors and masters), but lower proportions of women in scientific and more senior

construction research positions, it is important to consider measures for recruiting and retaining women in research-orientated careers in the construction sector.

- *There is a strong need to include men into gender issues.* The idea that gender discrimination is not a problem or that it affects only women has to be firmly fought. There is a strong need to include men into gender issues, since they concern both women and men as a whole society. Some of the main barriers to women-only measures include the fact that women do not want to be perceived as a 'special case', concerns that men may perceive these measures as reverse discrimination.
- *Fostering equal participation between women and men in childcare, family responsibilities and domestic work.* The reconciliation between work and private life is the main obstacle for female researchers, especially for those who have children. Work-life balance measures are mainly taken up by women with children and this fact is in many cases prejudicial for their careers. A balanced participation between women and men in childcare, family responsibilities and domestic work should be fostered by EC and National Governments. Better infrastructure of childcare facilities should be provided to ensure equal opportunities for women and men.
- *More childcare facilities are needed,* especially in countries like Spain and Czech Republic and even in Germany, particular for the first three years of children.

Other proactive measures to progress towards gender equality in construction research

- *A larger awareness campaign about mentoring programmes should be promoted.* Within the construction sector only a few comprehensive mentoring programmes have been identified. They practically always pursue the specific aims of the founder (University or large company). In SMEs sufficient conditions to guarantee a systematic long-term mentoring programme are usually difficult to create. The possibility to derive benefits from external organisers, external mentors and possibly from external financial subventions could be welcomed.
- *Additional support for networking is needed.* Further research is necessary to determine the advantages and disadvantages of women-only networks, including exploration of women's own views on this.

Promoting a gender mainstreaming approach in public R&D policies relevant for the Construction sector

- *The European Commission and National and local governments should make additional efforts to:*

- Better disseminate information among the scientific and research community regarding their interest in gender-sensitive projects. Measures include sponsoring seminars aimed at bringing together gender experts and construction experts and disseminating good examples of gender-sensitive research.
- Reach women in the research community. Measures include drawing up lists of women in senior and junior positions in construction research institutions and establishing networks of exchange with specialised networks.
- *Enabling new multidisciplinary fields and new approaches of research.* Emerging more social sensitive fields of research must be supported in terms of financing, material resources and professional recognition. Construction research areas should be redefined and provided with funding programmes to promote multidisciplinary and foster sustainable-oriented approaches. Analysis of women's rate of publication indicated that women may have a higher rate of participation in softer areas of construction research such as the environment or architecture. However, further analysis of women's horizontal segregation in construction research is necessary as this was not conclusive in other tasks. Horizontal segregation should also be considered.
- *Redefine scientific excellence minimising gender bias.* Different criteria of scientific excellence should be designed and established. Indicators of quality such as impact factors and number of citations rendered by work would define scientific excellence on a more consistent qualitative basis, although these criteria should be re-examined, to assure their fairness and equality. The current criteria in the evaluation of scientific excellence, favour high specialised career paths. New criteria should be introduced to appraise multidisciplinary curricula.
- *Other measures for progressing towards gender equality in construction research:* There is not enough information and awareness about the work done the last years by the European Commission regarding Women and Science in the research community. The European Commission should better disseminate information in the scientific community the actions taken regarding gender issues.

Further research

- *There is a need for further research into working conditions in construction research.* In order to increase knowledge on the nature of gender equality measures and employees more detailed research into organisations with both strong gender equality measures and high proportions of women staff is necessary. There is a need for further research into the position of employees, their working time, conditions of employment and distribution in

research activities and areas, and the specific nature of gender equality measures that have been implemented and the reasons for implementation.

- *Studies that include a time perspective are particularly needed.* This will improve our knowledge of the effects of the gender equality measures and thus enable a transfer of the more successful measures on to other types of institutions and other parts of society.
- *It is also necessary to further explore the significance of publishing and patenting in industrial and academic careers* and whether or not women are better represented in academia than industry.
- *Further research in specific countries.* Further research is necessary to explain the decrease in women's participation in construction research within particular countries. Additional research may explore whether this pattern is specific to construction research or a pattern reflected more generally within certain countries.

(B) Addressed to Institutions:

- *Better dissemination of equal opportunities policies should be done at organizational level* to assure that these policies do not just exist but that they are actually understood by employees and managers and implemented and updated when needed. These equality policies should be adapted in working practices to make gender equality a reality.
- *More proactive measures are recommended at institutions level*, such as positive action in selection and promotion policies, to increase the presence of women among the research community, in particular in senior management positions and industrial field.
- *Further promotion in implementing work-life balance measures in construction research institutions is needed.* The progress on addressing this issue is diverse, while there is a wide recognition of its relevance on ensuring equal opportunities. Although work-life balance measures, such as flexible working hours, working from home etc. have created some positive changes to the working practices of organizations during recent years, the promotion of these actions should continue. Still, some women consider a family as one of the main obstacles for career progression. The lack of childcare facilities combined with extremely large workload and high demands in professional skills are the main problems to be solved by mothers.
- *An employee attitude survey* can be a helpful instrument to find out what women and men really need e.g. for better work-life balance.
- *Employers should take responsibility by changing working cultures to decrease working hours.* The concept of the research career needs to be reconsidered as this project found

that extremely long working hours seem “natural” for those in the field. While recognising that research work is perceived as a hobby and a vocation by many researchers, the study also observed the existence of peer pressure. Long working hours are a threat to the reconciliation of work and private life, as well as to the health of researchers in the long run.

- *Further organisational support for networking is needed.* Networking activities are found to be very beneficial for women’s careers in construction research. Given the high value placed on networking by individuals and institutions alongside suggestions that there is a lack of time for networking, it is important that both organisations and individuals ensure that networking becomes an integral part of construction researchers’ work.
- *Role models should be fostered.* Role models are senior, experienced scientists whose profile and professional achievements are actively communicated to junior researchers in order to inspire and motivate them in their professional careers. Role models demonstrate that it is possible to be a senior figure in construction research and also a woman. Role models help to break up the stereotypes of being scientist and increase the visibility of female researchers in the construction field.

(C) Addressed to women themselves:

- *Share out the responsibilities.* Besides the inequalities at an organisation level there are other factors difficult to measure where women and men differ. They are partly related to women themselves, partly because of a lack of support outside their work, which makes it difficult for women to build up a career. Child bearing and a lack of support of partners regarding child caring and domestic work hinder women to follow a linear career progression.
- *Raise professional self-confidence when going for promotion and senior positions.* Women seem to be more critical towards their own performance, which is striking since they describe themselves as having been very successful students. In particular women seem to lack self-confidence when going for promotion and higher positions which might be a delimiting factor in their career development in construction research.