

Research Report

Comparative International Experiences in Promoting Women's Participation and Position in the Science, Engineering and Technology Fields: Possible Models for South Africa

by

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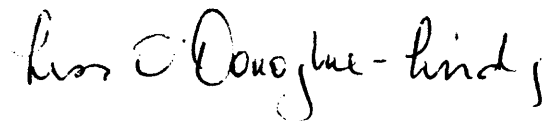
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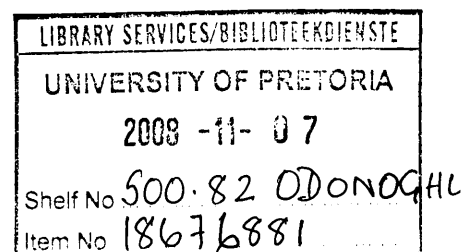
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DECLARATION

I, Lisa Marie O'Donoghue-Lindy, herewith declare that this research report is my own original work and that all sources have been reported and acknowledged; that this document has not previously in its entirety been submitted at any other university in order to obtain an academic qualification; and that the editing of this research report has been done by Aretha Roux (Postgraduate Certificate in Editing Principles & Practice, and Certificates for Language Professions and Freelance Language professionals, including editing & translation).



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ABBREVIATIONS

ABI:	Anita Borg Institute (USA)
BWASA:	Businesswomen's Association of South Africa
CEC-WYS:	Central European Centre for Women and Youth in Science
CEO	Chief Executive Officer
CEWS:	Centre of Excellence for Women in Science (Germany)
CREST:	Centre for Research on Science and Technology (University of Stellenbosch, South Africa)
CSIR	The Council for Scientific and Industrial Research (CSIR)
CWIT:	Centre for Women and Information Technology (USA)
DG:	Directorate General (e.g. Research) of the European Commission
DORIS:	The Do Resource Centre in Sandviken
DST:	Department of Science and Technology
DST & SARG:	Department of Science and Technology & South African Reference Group on Women in Science and Technology
ENWISE:	Enlarge Women in Science to East (expert group on women scientists in Central and Eastern European countries and the Baltic States)
EPWS:	European Platform for Women Scientists
ESTEEM:	Enhancing Science and Technology Education and Exploration Mentoring
EU:	European Union
FP:	Framework Programme
FP7:	Seventh Framework Programme in Research (European Commission)
FSF:	Swedish Foundation for Small Business Research
GCSE:	General Certificate of Secondary Education
GDP:	Gross Domestic Product
ICT:	Information Communication Technology
ISCED:	International Standard Classification of Education
ISETT:	Information Systems, Electronics and Telecommunications Technology (sector in South Africa)
MOUs:	Memorandums of understanding
NIS-WIST:	National Institute for Supporting Women in Science and Technology (South Korea)
NKC:	National Contact Centre for Women in Science (Czech Republic)
NRC:	National Federation of Resource Centres for Women (Sweden)
NRF:	National Research Foundation (South Africa)
NSF:	National Science Foundation (USA)

NSI:	National System of Innovation
NUTEK:	Agency for Economic and Regional Growth (Sweden)
OECD:	Organisation for Economic Cooperation and Development
PAWS:	Public Awareness of Science and Engineering
R&D:	Research and development
RTS:	Recruitment Target System
SA WISE	Association of South African Women in Science and Engineering
SARG:	South African Reference Group (on women in science and technology)
SAWEN:	South African Women Entrepreneurs' Network
SET:	Science, Engineering and Technology (including ICT)
SINNI Centre:	Northern Ostrobothnia Resource and Empowerment Centre for Women and Girls (Finland)
SITE:	Scholarships in IT and Engineering
SNRK:	National Association of Finnish Women's Resource Centres
UMBC:	University of Maryland Baltimore County
UKRC:	UK Resource Centre for Women in SET
UMYC :	Unidad de Mujeres y Ciencia (Spain)
UN:	United Nations
UNESCO:	United Nations Educational, Scientific and Cultural Organisation
UNU-IAS:	United Nations University Institute for Advanced Studies
VDC:	Virtual Development Center
WIIT	Women in IT (South Africa)
WINNET:	European Network of Women's Resource Centres
WIR:	Women in Research (European Commission)
WISE:	Women Integration and Skills for Entrepreneurship
WOIMALA:	Women's Resource Centre of Kajaani (Finland)
WRC:	Women's Resource Centre

EXECUTIVE SUMMARY

A country's science base is recognised universally as the foundation of its economy. In South Africa, the government emphasises the National System of Innovation (NSI) as a means to secure economic growth, poverty alleviation and sustainable global competitiveness. And yet more than half of the country's population is largely excluded from participating and progressing in science, engineering and technology (SET) sectors. Like elsewhere around the globe, in the South African public science system, women are younger and less qualified than men; they study and work primarily in disciplines traditionally dominated by their gender and consequently less valued in terms of scientific contribution; and they receive a smaller portion of research grants and work. In the private sector, they are equally at a disadvantage being horizontally segregated to less valued disciplines, and vertically and contractually segregated at lower, less permanent positions.

This is an important issue because in order to address its skills shortage, low productivity and need for greater innovation, South Africa has to unleash the potential of women in this area. Without female insight, creativity and experience, knowledge generation and technological development - in the public sector and business alike - would be narrow, biased and incomplete. Everyone should have equal access to a SET education and the possible job opportunities the field offers. However, more importantly, all members of society should benefit equally from, and have the possibility to influence SET innovations as they improve the quality of our lives and produce employment and wealth creation opportunities.

The barriers to women's attraction, recruitment, retention and progression in SET careers are well-established. Among others, they stem from gender stereotyping, self-efficacy doubts, poor support for reconciliation between family and work life demands, and the predominantly male SET image, culture, networks and standards for scientific enquiry. Many interventions have been developed to overcome these barriers and encourage more females to enter and remain in SET fields. International institutions such as the Organisation for Economic Cooperation and Development (OECD) and the United Nations (UN), have, at the global level, endorsed such instruments for change as effective measures. These instruments include, but are not restricted to gender-mainstreaming efforts, mentorship programmes, networking, funding (scholarships, bursaries and faculty chairs), disaggregated gender statistics and awareness-raising initiatives such as role model promotion.

This study briefly highlights some of these international experiences, but focuses primarily on resource centres for women in SET as a preferred and effective means to tackle women's

under-representation in the sector. Women's resource centres (WRCs) are exceptional in their ability to consolidate many, if not all, of the internationally-endorsed approaches and implement them – through partnerships and involving a wide stakeholder base – in a holistic manner, based on the life cycle approach. The central objective of this research is to assess whether commonalities exist across observed WRCs in terms of context, stakeholder involvement, services and other critical success factors and to present these as good practice for a WRC organisational model.

Research in this report is based on case studies of five approaches from Finland, South Korea, Sweden, the UK and the US. No developing country WRC example was readily available. A questionnaire was used to collect the data. Senior management from three WRCs, focusing on women in SET (two national and one regional), and two national non-sector specific WRCs completed a comprehensive questionnaire. Some telephone interviews were conducted for clarification purposes.

The findings revealed commonalities in terms of 1) how each Centre achieved legitimacy; 2) the kind of stakeholders who needed to be involved, to what extent and why; 3) the main areas of focus and the types of services which should be provided to meet objectives; 4) the presence of core competencies; 5) the use of partnerships to enhance the Centre's work; 6) the basic level of resources needed and key cost drivers; and 7) the evaluation and control mechanisms to ensure continuous development. As the questionnaire was open and based on experience and perceptions, the findings also revealed some personal insights into possible challenges and opportunities when establishing a Centre.

It is important to note several limitations of this study, namely that it focuses on WRCs in developed economies and does not examine interventions targeted at pre-university education or those with developmental objectives. In South Africa, emphasis is placed on education and skills, while poverty alleviation makes these issues central to any effort focused on women in SET. Although an off-the-shelf model is neither available, nor appropriate in the developing country context, significant learnings could be gained from the experiences of those intimate with the resource centre approach and its effectiveness in addressing the under-representation of women in SET fields. The author hopes the findings set out in this research would be useful and form the basis of further investigation into the possibility of establishing a South African Resource Centre for Women in SET.

CHAPTER 1. BACKGROUND TO RESEARCH

1.1 Introduction

This section provides an overview of what is meant by the term SET and briefly describes women's under-representation in SET domains at university level, in academia, the public sector and industry in South Africa. The research objectives of examining international interventions to address this problem, focusing on resource centres for women as a preferred organisational model, are clarified along with the reasons why this is an important issue to examine. The section concludes with a summary of the study's limitations and a structure of the report.

1.2 Definition

In this document, SET, including information communication technology (ICT), refers to industry, academic, scholarly and research activities in scientific domains, in both the public and private sector. This comprises the so-called "hard" sciences and "life" sciences, but excludes social sciences, arts and humanities. The term "women in SET" consequently covers females working in the following disciplines:

- physics, chemistry and related professions;
- mathematics, statistics and related professions;
- architecture, engineering and related professions;
- life sciences (excluding nursing);
- computer science and ICT (e.g. software developers and IT consultants); and
- college, university and higher education teaching.

It also includes undergraduate and postgraduate female students enrolled in higher education institutions focused on the above domains and female managers in SET sectors.

The term "high-tech" is employed in this report to describe sectors, jobs and products/services where state-of-the-art technologies are used. High-tech companies conduct a considerable amount of research and development (R&D) as they systematically apply scientific and technical knowledge to problem-solving. As a result, many of their employees have a scientific, technical or engineering background (US Department of Labor, 2002).

According to the United Nations (UN), in the context of human development, science and technology is an empowerment tool. Therefore, women's participation in SET refers to "the extent to which women have been able to utilise this tool in capturing the same opportunities available to men, ranging from research to high-skilled employment in firms" (UNU-IAS, 2005:8).

1.3 Problem statement

As in any society, SET is a fundamental driver for economic growth, job creation and social advancement, also in South Africa. It is therefore critical for the encouragement of innovation and entrepreneurship, skills development and productivity that women are given equal opportunity to contribute to and grow in SET sectors.

Despite representing 51% of the South African population, women generally have a lower participation rate and position in SET disciplines, be they in the public or private sector or academia. This is the result of barriers to recruitment, retention and career advancement stemming from gender stereotyping, SET culture, work-life imbalance and the lack of role models – to name only a few. Research into South Africa's public and private sectors has shown that although women represent 38.3% of all researchers, they tend to be younger and less qualified than their male counterparts; receive a significantly smaller share of research grants; and work, for the most part, in domains traditionally dominated by women (DST & SARG, 2004:47; DST, 2006b:17).

In the private sector, the picture is no different. Women represent the majority of service and sales workers and are clustered in clerical and administrative positions (South African Department of Labour, cited in James et al. 2006:57). In its annual leadership census, the South African Businesswomen's Association revealed that, while women's share of directorship and executive management positions increased by 1.6% and 2.4% respectively, the numbers remain low at 13.1% and 19.2% (BWASA, 2007:16). In the ICT sector alone, a skills audit highlighted the fact that while "the trend in race and gender distribution is moving away from the current generally-accepted perception of a white male dominated industry ... on the technical side, males still dominate at 76.17%" (Vukanikids, 2005:135).

The South African government recognises the need to address the relatively low number of, and lack of advancement opportunities for, women in SET and has undertaken a number of initiatives to promote SET excellence and gender equity. A study published in 2006 focusing

on women in mostly – but not strictly limited to – the ICT sector in South Africa, extensively details the ongoing interventions of government, business, civil society and academia. While the report concludes that “the political will and intent to address gender issues is firmly in place and the government can be commended for its achievements in this arena ... the challenge lies in implementation” (James et al., 2006:96). The authors argue that greater coordination of government efforts and increased visibility of corporate and civil society initiatives are needed in order to achieve greater impact. “Women themselves are not aware of the many available interventions – efforts are needed to make them far more visible to the women who will benefit from them” (James et al., 2006:97).

Hypothesis: there are a number of effective interventions which can be implemented in both the public, private and academic domain to increase the participation and enhance the position of women in SET fields.

1.4 Research objectives

This research report aims to identify initiatives outside of South Africa’s borders which promote women’s participation and career advancement in SET sectors. While many of these interventions have delivered results, their key weakness lies in the fact that they do not take a holistic approach. For this reason, the primary objective of this report is to analyse the critical success factors of WRCs – implemented in the UK, South Korea, the US, Sweden and Finland – as the preferred modality for improving women’s involvement in SET. This report promotes the WRC model because of its unique ability to consolidate the many internationally-accepted interventions, leveraging their synergies to tackle the barriers facing women in SET while addressing the entire life cycle. This would include understanding the contextual environment in which these centres were established, the role of government, academia, business and other key stakeholders as each organisation has evolved, the typical services offered, organisational competencies and resources, evaluation measures and their strategies going forward. A secondary objective would be to suggest, from commonalities emerging from the research, a possible model of good practice for a resource centre. This study would be valuable in that the key learnings derived from overseas initiatives might be applied in South Africa to promote women’s participation in SET, an objective high on the government’s agenda and vital to NSI. In addition, data set out in this research report would add to the body of knowledge on the subject as currently not much literature exists in South Africa on the topic. More specifically, the author anticipates that the

detailed analysis of specific WRCs would be useful in examining whether a South African model would be feasible.

1.5 Research questions

The research focuses on two main research questions:

- What interventions have been implemented outside of South Africa to promote the participation and career advancement of women in SET domains?
- What are the fundamentals (such as context, stakeholder involvement, services, resources and controls) of a women-in-SET resource centre model as found in the UK, South Korea and the US, and the non-SET specific approaches as experienced in Sweden and Finland, all of which have seen evidence of positive outcomes as a result of establishing a centre.

1.6 Importance of the problem

The low participation of women in SET has significant implications, not only for women, but for the South African population as a whole. Science and technology is the bedrock of a nation's innovation potential and essential factors for productivity and economic wealth. Through the development, coordination and management of innovation, the South African government aims to "bring about maximum human capital, sustainable economic growth and improved quality of life for all" (DST, 2002). However, if the participation and position of women in SET are restricted on so many levels, as literature proves convincingly, how can South Africa ever reach its innovation objectives? For a start, failure to increase the participation and career advancement of women in the sector would have serious implications for the supply of high-quality scientists and engineers, resulting in a poor return on investment and contributing to skills deficits (UKRC, 2007; Xie, 2006:105). While still low, the number of women enrolling in SET fields of study is higher than the number who pursue a career in related professions. There is a risk, therefore, that the social and individual investment in human capital is lost if a large percentage of that investment is not directly involved in economic activities (OECD, 2005:1).

Everyone should have equal access to a SET education and career opportunities, while both women and men must benefit equally from advances in science and technology (Oldham, cited in Smith, 2003:2). This leads to the question "research by and for whom?" Decision-making and research should benefit all members of society, as the South African Department

of Science and Technology (DST) has stated. There is a tremendous imbalance in the gender perspective of research being conducted today in South Africa and around the world. Most research is done by and for men. If women are not accessing or involved in research and innovation within the SET fields, particularly the ICT sector, how can they shape the processes which can improve their quality of life and generate employment and wealth creation opportunities? (Anon, 2006; Tara Research & Equity Consultants and Feedback, 2005:26; OECD, 2005:1). Moreover, the conspicuous absence of women active in society's "knowledge domain" only serves to exacerbate existing gender inequalities and resulting socio-economic implications, and leaves gaps in knowledge due to male bias in concepts and theories (UNU-IAS, 2005:7; Bosh, cited by Tara Research & Equity Consultants and Feedback, 2005:10; Asgeirsdottir, 2006:18; Cervantes, 2006:25). If women embraced SET professions and took up leadership positions in these fields, they could use their skills to influence where research was directed and how technology was designed and implemented. It would enable them to focus on solutions to problems which concern them most and which in today's environment are currently being neglected. Moreover, when female perspectives and life experiences are leveraged, organisations can approach issues differently resulting in unique and perhaps more creative outcomes than if women were excluded from the process (ABI, 2007; Monroe, 2006). For example, computers, telecommunications and electronic media guide many family, household and everyday life activities. Because women are traditionally associated more strongly with the household, they are in a far better position to respond to technology needs in this regard (Smith, 2003:2). And if women were better positioned to know what the customer wanted then, in order to compete effectively in the global ICT market by widening the skills base, South Africa would have to harness their talent and put women in a position to influence the sector (James et al., 2006:3; OECD, 2007:5).

Research has also shown that those companies who embrace diversity outperform the competition. A Catalyst investigation into 353 of America's largest corporations revealed those with the highest number of women in senior management positions (over 20% representation) experienced stronger financial performance than those with the lowest number of women (Catalyst, 2004:2). While the causal relationship between gender diversity and business performance has been questioned, according to Hunter (cited in DG Research, 2006b:20) there is clear evidence that gender diversity and financial out-performance are "expressions of the same organisational efficiency". In other words, a diverse management team is just one expression of an organisational culture which outperforms the competition. European statistics show that young women entering the labour market are currently better educated than their male counterparts so clearly a labour force comprised mostly of men is

one which is not meeting its full potential and essentially wasting female talent, values, experiences and insights, which could help the firm better anticipate customer needs, produce better results and improve its image and credibility (DG Research, 2006b:19, DG Research, 2003:7; Aaltio, 2006:121). However, for those companies that are currently reaping the benefits of a more diverse workforce, it is becoming increasingly difficult to sustain this level of diversity due to the limited pool of female technical graduates. At the same time companies who begin to understand the important implications of diversity for their business notice the risk of a plateau (DG Research, 2006b:4). The implications for a company's ability to sustain growth cannot be underestimated.

For women specifically, their lack of participation has very real repercussions. In the United States, the Bureau of Labour Statistics has found that the number of jobs requiring science and technology skills is growing by 5% annually as compared to the 1% for the remaining workforce. Women are therefore missing lucrative opportunities, economic success and personal satisfaction (Hecker, 2005). Moreover, Xie (2006:105) notes that women as scientists, in aggregate, also have a lower status than their male counterparts who tend to dominate fields of science which society values as having a higher status (e.g. physics). However, the choice of role models is often gender-linked and, therefore, the more women enter SET professions, the more their reputations and innovative products and services would influence new generations of women to follow their lead. This would result in an environment more supportive of female professionals and sensitive to gender differences (ABI, 2007; Xie, 2006:108).

1.7 Limitations of the study

This study does not aim to investigate further why women are underrepresented in the SET sector. The subject is already well-documented in the literature and therefore offered only as background information to this report. The research report will focus mostly on initiatives targeted at women already at a certain level in their careers – i.e. graduates or women with previous job histories – and will not examine in detail interventions targeted at pre-university education or those women with developmental objectives (e.g. using technology to empower disadvantaged women). While the literature review briefly touches on various international initiatives, the bulk of the research is targeted at WRCs as the preferred form of intervention. Due to time constraints, only individuals involved in five national initiatives have been selected to participate in the research: the US, South Korea, the UK, Finland and Sweden. The first three specifically focus on SET-related issues while the Finnish and Swedish

examples are broader approaches to improve women's general participation in the labour market and society. Consequently, the research fails to address the developing country context as no information was available on SET resource centres targeting women in developing countries. Moreover, the research is based on qualitative questionnaires and interviews which aim to understand individual experiences and perceptions as they relate to each resource centre. In examining case studies, research results are often context-bound and limited in the sense that generalisations cannot be made which apply to all resource centres or the experiences of individuals working with them.

An important assumption underlies the research, that is, the selected resource centres are considered "effective". This is based on factors such as the WRCs having met or exceeded measurement criteria and observed evidence of positive outcomes stemming from the centres' work. In other words, some centres may, for example, quote success as the number of women trained or the number of women in the networks. But "effective" or "successful", in the context of this report, is based on actual outcomes, such as how many women were retrained and returned to SET professions and data reflecting changes in gender composition in various sectors. Thus the intervention has made a difference in terms of the number of women in the SET workplace.

1.8 Structure of the report

Executive Summary

Chapter 1: Background to the research

Chapter 2: Literature review

Chapter 3: Research methodology

Chapter 4: Research results

Chapter 5: Conclusion and implications

References

Appendix

1.9 Summary

In the context of this report, SET encompasses industry, academic, scholarly and research activities in the hard and life sciences disciplines, as well as information technology domains in both the public and private sector. Women's participation and advancement in SET careers refers to the extent to which they have been able to access science and technology

as an empowerment tool to avail of the same opportunities open to men. As the science base is fundamental to a nation's economic growth and competitiveness, women's exclusion from, and inability to contribute to SET sectors is a worrying trend in South Africa and elsewhere around the world. Fortunately, there are a number of interventions which have showed some success in addressing this problem however, independently, these initiatives are not sustainable. They neglect the holistic approach of dealing with education through to employment and career management and often do not consider supply and demand side-needs. This report therefore aims to analyse the critical success factors of a limited number of initiatives – namely WRCs in the UK, South Korea, the US, Sweden and Finland – which have had greater success in their objectives as they consolidate many internationally-tested approaches and take a lifecycle tactic in addressing barriers to women's advancement in SET. In uncovering commonalities emerging from the research, this report suggests a possible organisational model of good practice for a WRC.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

This section aims to give an overview of the research available on women's under-representation in SET starting with their education profile, their positions as members of the research community and their progression in the workforce. It includes horizontal and vertical distribution across study fields and, within sectors, scientific recognition and success in funding. Already a heavily-researched topic, the barriers to women's inclusion and progression in SET fields are summarised. Background information on WRCs as a possible form of intervention and work done to date in South Africa is also included. Where possible, the literature is presented on a global level and then related to the South African situation. The bulk of this section focuses on comparative international experiences in promoting women in SET, with greater emphasis on Centres which participated in the research. The Centres include the Centre for Women and Information Technology (CWIT), the National Institute for Supporting Women in Science and Technology (NIS-WIST), the UK Resource Centre (UKRC) and projects from Finland and Sweden where there is a great deal of expertise in equality issues and the WRC model.

2.2 Women in SET – position, role and opportunities in education

Women have the opportunity to be involved in "knowledge production" through academic activities, be they education or subsequent employment in academia. The education stage develops skills, trains and empowers while those at later stages begin to contribute to the development of science and technology (UNU-IAS, 2005:8). In higher education, UN research has shown that, across borders, women tend to enrol mostly in humanities, arts and education, followed by social sciences and natural sciences, with computing and engineering as the least popular fields. Within SET fields, biology and life sciences attract greater numbers of women than physics or computer sciences (UNU-IAS, 2005:9, DG Research, 2006b:10). Considering the importance we place on technology today and its impact on our future, a worrying anomaly to note is that, while the number of women receiving engineering, physics and chemistry BA degrees is globally increasing, albeit still low, their share in computer science and other IT domains has dropped by almost one third in the US. It is 10% or less in almost every country for which statistics are available (Charles & Bradley and ENWISE, cited in Sanders, 2005:3).

This trend is the same in both industrialised and developing countries, as Figure 1 illustrates. In the European Union (EU) and Japan, for instance, 70% of females study traditional fields, while 75% of those who enrol in scientific domains focus on medical science and health-related services, avoiding natural sciences and engineering (UNU-IAS, 2005:9). The European Commission (DG Research, 2006b:11) points out, however, that differentiation along gender lines is not universal in Europe. Women in Southern European countries are more attracted to science and technology subjects than their Western or Northern European counterparts, indicating that national culture plays a prominent role in the career paths that men and women choose to follow. According to a UK governmental report on the difficulties faced by women in SET (cited in UKRC, 2003:6), although women outperform men at General Certificate of Secondary Education (GCSE) and A-level SET-related subjects, women remain “hugely under-represented” in the UK’s SET disciplines at university level and thereafter.

While recent OECD data has shown that the reservoir of female scientists and technology specialists is increasing in most European countries (with the exception of the Netherlands, Portugal and Turkey) and the number of women enrolling in SET fields is growing faster than men in many cases, “this is not enough by far to compensate for the existing under-representation of women and reach a balance within the next decade” (DG Research, 2006b:11).

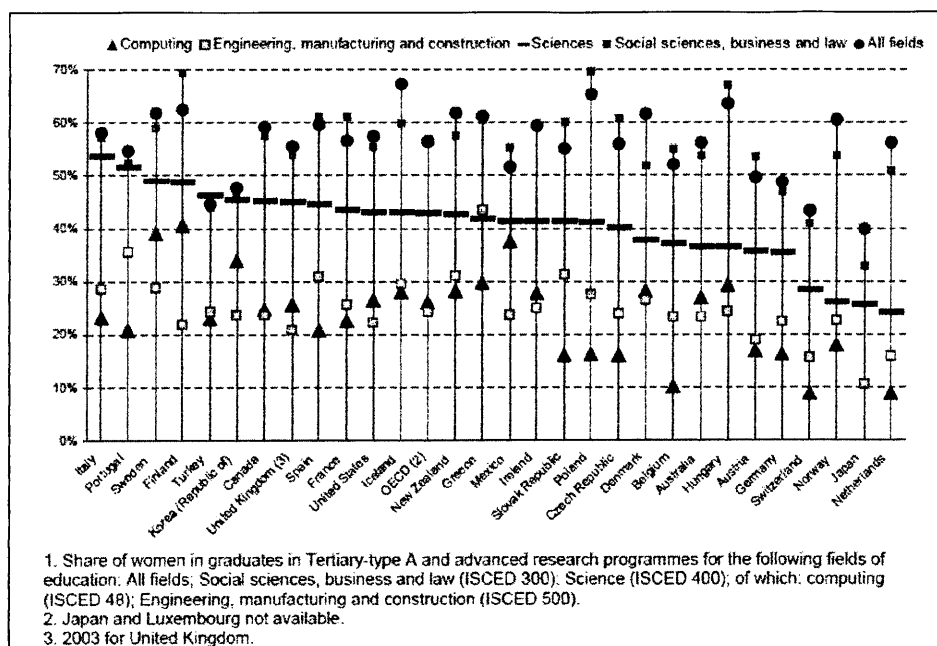


Figure 1: Women's share in selected fields of education, OECD countries, 2004
(OECD, 2007:18)

In line with international trends, while there has been a positive change in the number of women enrolling in and graduating with higher education degrees in South Africa, not only do their numbers fall as the level of study advances, but they also tend to cluster in health sciences or social sciences and humanities (DST & SARG, 2004:16). Figures 2 and 3 below illustrate this phenomenon.

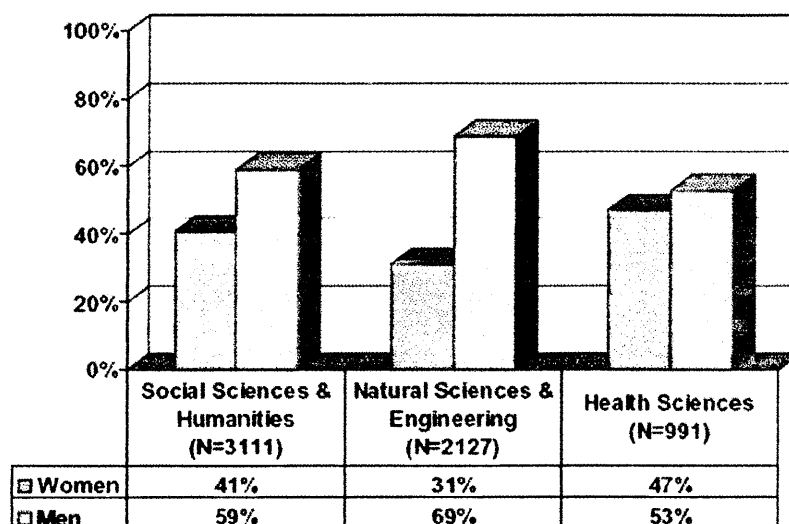


Figure 2: University doctoral enrolments by gender and broad field of study, South Africa, 2001 (DST & SARG, 2004:44)

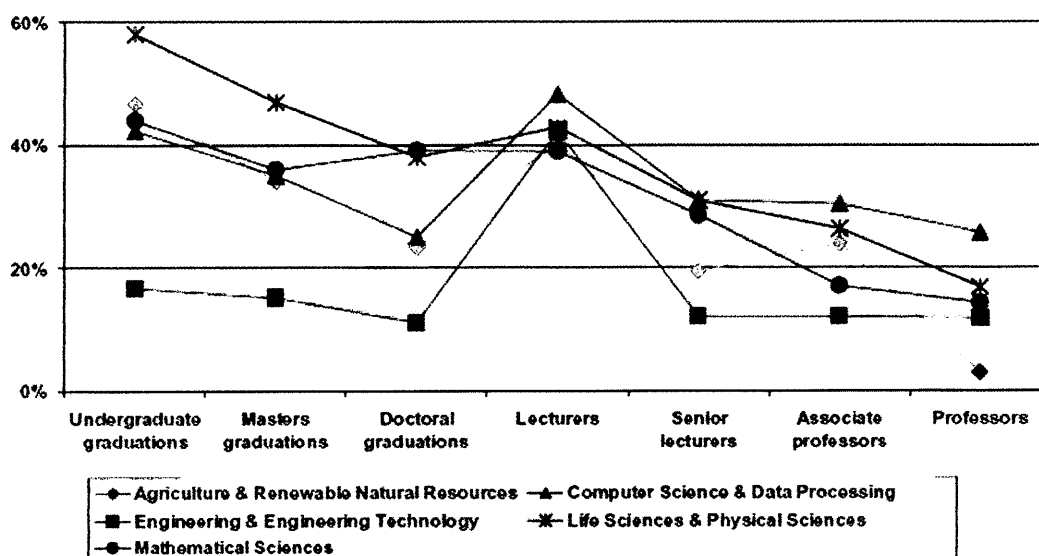


Figure 3: Percentages of women in natural sciences & engineering in the university sector by sub-field, South Africa, 2001 (DST & SARG, 2004:45)

In 2001, while women represented the majority of South African undergraduate students at university level (64%), their share of postgraduate (i.e. Master's and doctoral) graduations was less pronounced at 43%. However, this does represent an increase of more than 10% as compared to 1992. Female's share of postgraduate graduations at Technikons also grew, but only by 4% in just over six years and still remains low at 34% despite being the majority of undergraduates (DST & SARG, 2004:14).

2.3 Women in SET – position, role and opportunities in research

Although internationally comparable data is not available by gender and detailed fields of research, the OECD points to the broader picture which reveals a continued gender gap in research (as highlighted in Figure 4).

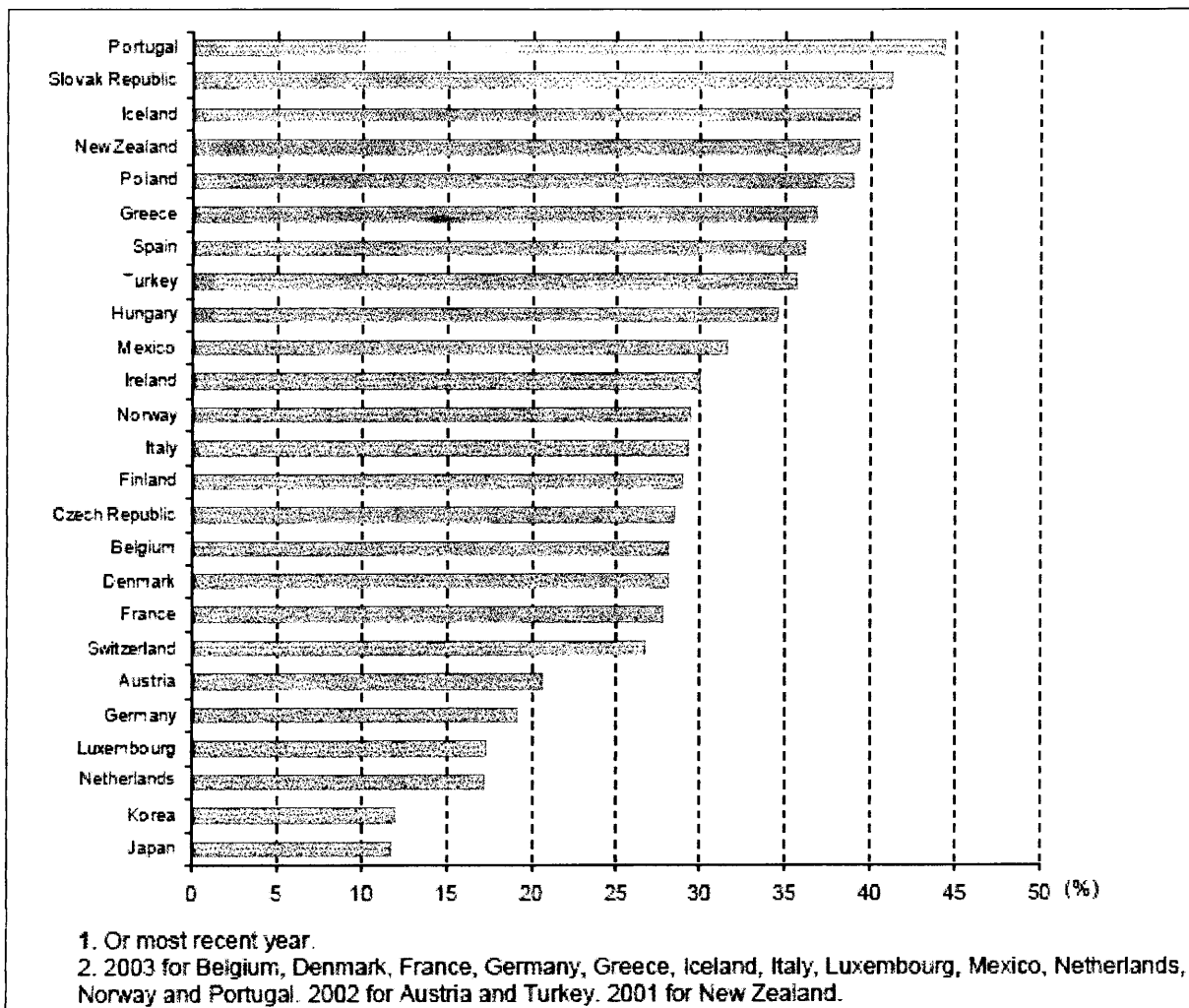
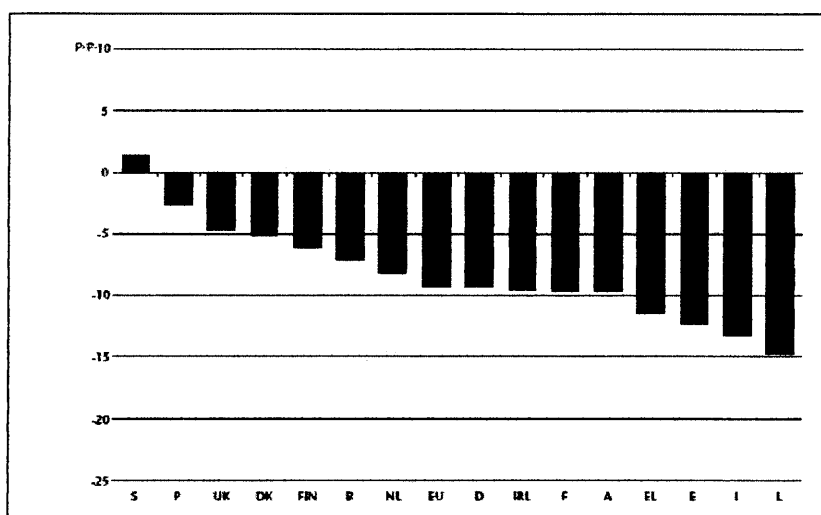


Figure 4: Female researchers as a percentage of total researchers, OECD countries, 2004 (OECD, 2007:22)

The pattern in research is much the same as in education concerning the domains women dominate and their respective position. Female faculty members dominate the humanities, social science, biology and medical science fields (OECD, 2005:2). Although women represent between 20-35% of natural science faculty members at European universities, the figure drops to between 10-20% in engineering departments. In the corporate world, the picture is equally bleak. Women make up less only 9% of industrial researchers in Japan, 15% in the EU and 19% in the US (UNU-IAS, 2005:9; DG Research, 2003:20). In Europe, the proportion of women scientists in industry is much lower than in other domains, for example, females represent about 50% of all scientists in health and social work and private not-for-profit organisations; the figure drops to between 35-40% in government and education (DG Research, 2003:21). According to Cervantes (2006:38), the proportion of industrial female researchers is higher in firms focusing on manufacturing (mostly pharmaceuticals) and business activities. Similar to the pattern in education, the figures range widely in Europe, mostly for cultural reasons, with Irish, French, Greek and Portuguese women for example representing 20% of researchers and their German and Austrian counterparts less than 10% (UNU-IAS, 2005:9).

While the industrial sector is one where the rate of employment in scientific and engineering professions is growing, especially for women, only a small number of scientists and engineers actually work as researchers (the ratio is even lower in industrial research). Consequently, growth in the number of scientists and engineers is not equally reflected in the number of researchers, particularly in industry, and even less so in the case of female researchers. In the EU, for example, studies have shown that there are 18 male industrial researchers for every 100 scientist/engineers, while the proportion drops to 13 for women (DG Research, 2003:21). And even while total female employment in industrial science and engineering professions may have increased by 33% between 1995 and 2000 (compared to 11% in science and engineering generally), it has only led to moderate growth in the number of women researchers, from 16% to 20%, over the same period (DG Research, 2003:23). According to the same European research, a good indicator of the imbalance in employment opportunities for women in industrial research is the employment gender gap for highly qualified individuals, which is calculated as the difference in percentage points between the employment rates for men and women holding 5A or 6 International Standard Classification of Education (ISCE) degrees¹. At the EU level, although the figures vary widely, on average this gap is very big (-9.9 percentage points) as Figure 5 illustrates.

¹ International Standard Classification of Education (UNESCO 1976 and 1997): individuals who have successfully completed a tertiary education. A 5A degree is a Bachelor of Arts or Master's with a more theoretical focus, while a 6 degree is exclusively a post-doctoral.



**Figure 5: Employment gender gap
for highly qualified individuals, EU 15, 2000**
(DG Research, 2003:105)

According to Figure 6, South Africa is on par with its European counterparts in terms of female researcher under-representation in engineering and mathematical sciences. Although representing 40% of permanent instruction or research staff in higher education, female personnel tend to be less qualified than their male counterparts; only 27% of staff with doctorates is female, compared to 51% who hold undergraduate degrees (see Figure 3 above). The data is not much different for the public sector where women comprised 42% of all R&D personnel in 2001 and generally were less qualified than their male colleagues as Figure 7 highlights.

Countries	Natural sciences	Engineering	Medical sciences	Agricultural sciences	Social sciences & humanities
Belgium	30%	22%	39%	35%	36%
Denmark	23%	13%	32%	43%	32%
Germany	17%	11%	33%	31%	30%
France	29%	17%	21%	(included in medical sciences)	38%
Ireland	45%	26%	68%	12%	55%
Italy	31%	14%	23%	24%	36%
Netherlands	20%	14%	37%	26%	30%
Austria	15%	6%	27%	26%	30%
Portugal	49%	29%	50%	44%	49%
Finland	34%	22%	52%	36%	48%
Sweden	31%	19%	51%	41%	44%
UK	25%	15%	52%	33%	39%
South Africa 2000	33%	11%	50%	22%	45%
South Africa 2001	35%	10%	51%	24%	46%

**Figure 6: Proportion of female researchers in the higher education section
by scientific domain, EU and South Africa, 1999**
(DST & SARG, 2004:58)

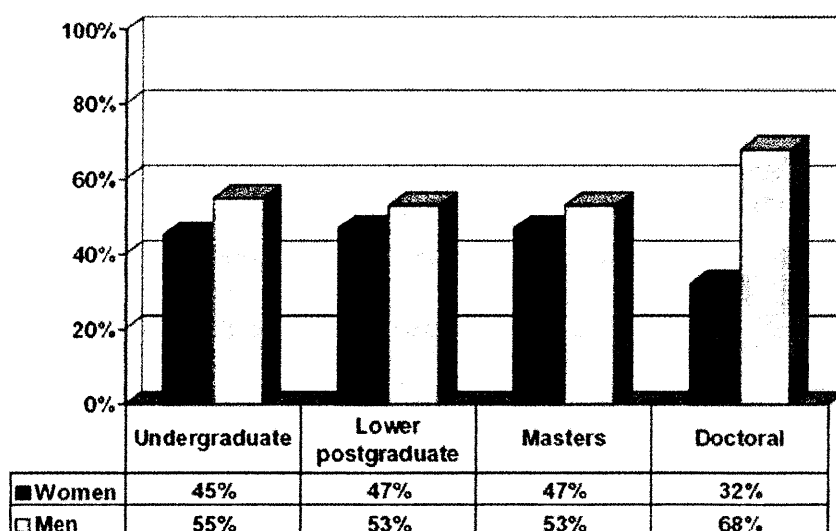


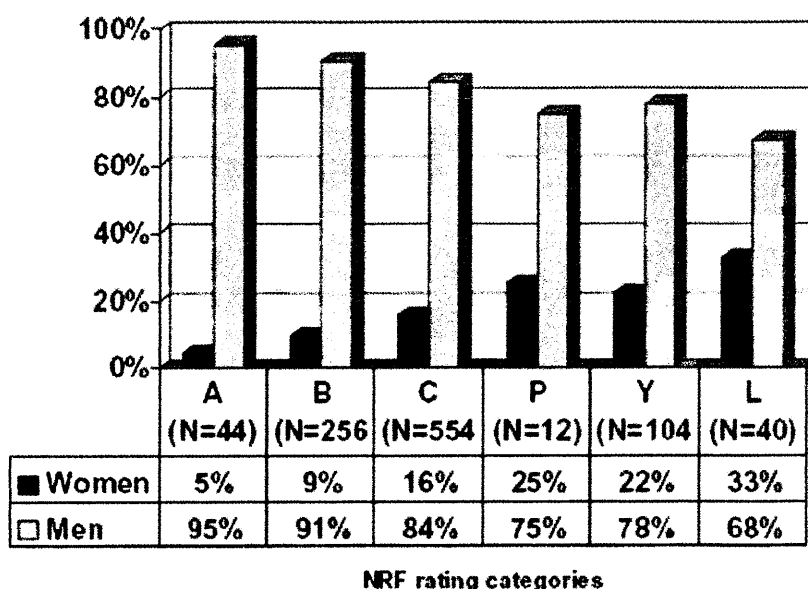
Figure 7: Qualifications of female and male R&D personnel in the science council sector, South Africa, 2001
(DST & SARG, 2004:32)

Other important indicators relating to women's position in SET research are the number of publications, funding opportunities and ratings or recognition. As per the trend overseas, the peer-reviewed article is a fundamental element of the academic reward system in South Africa. A study by Prozesky (2006:2), which aimed to understand how gender-related issues influence career publication productivity, highlighted the widening gap between the sexes in South Africa. Although more than 40% of research professionals in academia and the public sector are female, only 29% (or one third) actively publish, of which 47% were in the social sciences and humanities domain (DST & SARG, 2004:32-34). Prozesky (2006:27) found that, in line with international developments, South African female academics "tend to have less professional experience and initiate their publication careers at a later age than their male counterparts do, because they achieve doctoral status – a crucial determinant of publication productivity – at a later stage in their lives".

Her analysis reinforced recognition of the fact that "combining the roles of wife, mother, doctoral student and full-time lecturer at the initial stages of an academic career ...[is] extremely demanding" (Prozesky, 2006:27). Measures of publication productivity do not take this into consideration and therefore, according to Prozesky, systematically disadvantage women. She argues a more fair way to measure productivity would be to compare the output of male and female researchers during the actual years of publication as opposed to over their entire career.

With respect to research grants, men continue to benefit significantly more than women. In 2001, the South African National Research Foundation (NRF) provided women 21% of all research grants and 42.5% of Master's and doctoral scholarships (DST & SARG, 2004:39). The other major research body in South Africa, the Medical Research Council, only provides grants in the health sciences domain where women are well represented.

According to government research (DST & SARG, 2004:42), probably the most revealing statistics relate to scientific recognition. The NRF rates researchers in Natural Sciences & Engineering, as well as Social Sciences & Humanities domains, according to publication output and the international standing of researchers. Of the six rating categories, three (A, B and C) are for established researchers, two (P and Y) focus on young researchers and the sixth (L) is designated for previously-disadvantaged applicants and those who start later in life. Unsurprisingly, men dominate all categories, but the differential between the sexes is shocking, as Figure 8 reveals.



**Figure 8: NRF-rated researchers in the
Natural Sciences & Engineering, South Africa, 2002**
(DST & SARG, 2004:41)

2.4 Women in SET – position, role and opportunities in employment

With respect to employment opportunities, the OECD (2005:1) has found that female participation in the SET-related labour market varies significantly between countries, age groups, areas of work and educational background. European Nordic countries, the US and some West European nations show higher rates of participation, with Asian OECD members scoring much lower. Overall, in OECD countries, the number of female researchers has grown, but remains at between 25-35% of the total research community, except in Korea and Japan where it is 12% respectively (Cervantes, 2006:25).

Literature states that it is difficult to assess SET career opportunities for women due to a shortage of data, but points to career paths at universities as a feasible comparison. In general, women leave science and engineering professions at twice the rate of men. Numerous studies have found a “leaky pipeline” in the academic hierarchy as significantly more women than men are “lost” on their way up the academic ladder (UNU-IAS, 2005:10; Council of Economic Advisors, cited in Mischie and Nelson, 2006:14). Figures 9 and 10 below are a good illustration of this phenomenon in the EU, as they show the representation of men and women at each progressive stage of the research career ladder – from undergraduate through to Grade A positions or full professorship – across all disciplines and in SET domains specifically. This is despite the growing number of female participants in academic programmes. Assumptions and beliefs that women’s increasing participation in and access to education would resolve gender inequity in SET careers have proven unfounded as progress in women’s level of education has not resulted in improvements in other areas (Fox, 2001:657). In an effort to dispel the myths that keep university departments from hiring women, the US National Academy of Sciences issued a report stating that although women have received more than 30% of all PhDs in social and behavioural sciences and more than 20% in the life sciences over the last three decades, only 15% of full professors in social, behavioural and life science departments are female, while the proportion in other science departments such as chemistry, biological sciences, physics and engineering is in the single digits. This is consequently not the result of a lack of talent, but rather unintentional biases (Powledge, 2006).

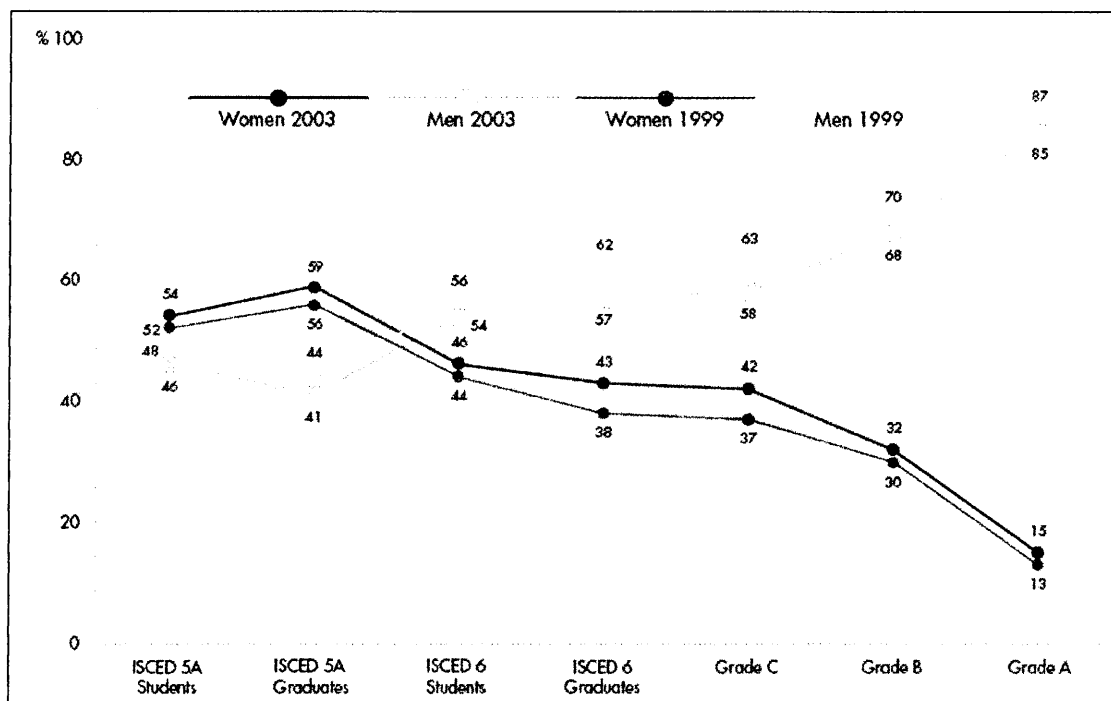


Figure 9: Percentage of male and female participation across EU-25 in all disciplines (1999 & 2003)
(DG Research, 2006b:10)

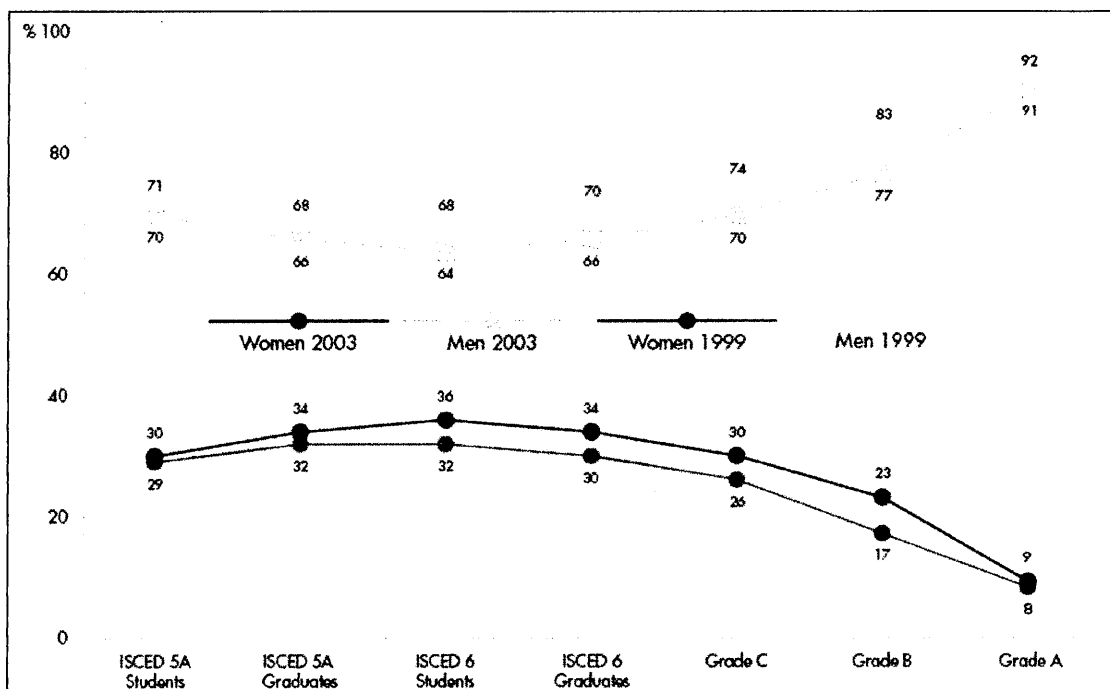


Figure 10: Percentage of male and female participation across EU-25 in SET disciplines (1999 & 2003)
(DG Research, 2006b:10)

Women's "segregation" is manifested in three ways:

- They are "vertically segregated" in that they are concentrated at certain levels, i.e. they represent more than half the undergraduates of some disciplines, but are limited to a small fraction at the professorship level;
- They are "horizontally segregated" in certain scientific domains (e.g. biological or medical science); and
- They are "contractually segregated" in that they are less likely to receive tenure and more likely to be on short-term or part-time contracts.

In the US, for example, just over one third of all university faculty members are female while in the EU, Australia and Korea the figure is less than 15%. European males are three times more likely to obtain professorship or equivalent status (OECD, 2005:2-3, UNU-IAS, 2005:10; DG Research, 2003:24; Cervantes, 2006:40).

The "segregation" of women into specific sectors – outside of academic circles – is clearly visible in Figure 11 below, which shows the proportion of women in science and engineering overall and the employment share of female industrial researchers by economic activity in Europe. The proportion of women is much greater in services (26%) than in any other sector (12%), while differences in the presence of female industrial researchers by activity are significant (64% for hotels and restaurants and only 5% in mining). Women tend to cluster in two main sectors: real estate, renting and business activities, and manufacturing, where R&D activity is most intense and yet the actual proportion of women is comparatively low (i.e., although women tend to dominate these sectors, in proportion to men, their numbers are still small).

Apart from services, the proportion of female scientists and engineers tends to be higher in those sectors with little R&D initiatives such as financial intermediation, agriculture, fishing or electricity and gas and water supply. In terms of occupational segregation, European research also points out that "the professions where women are most underrepresented are those that have the greatest demand and greater weight in overall employment. Over 75% of employment is concentrated in the two professional groups with the lowest presence of women: architects and engineers; and computing professionals" (DG Research, 2003:26).

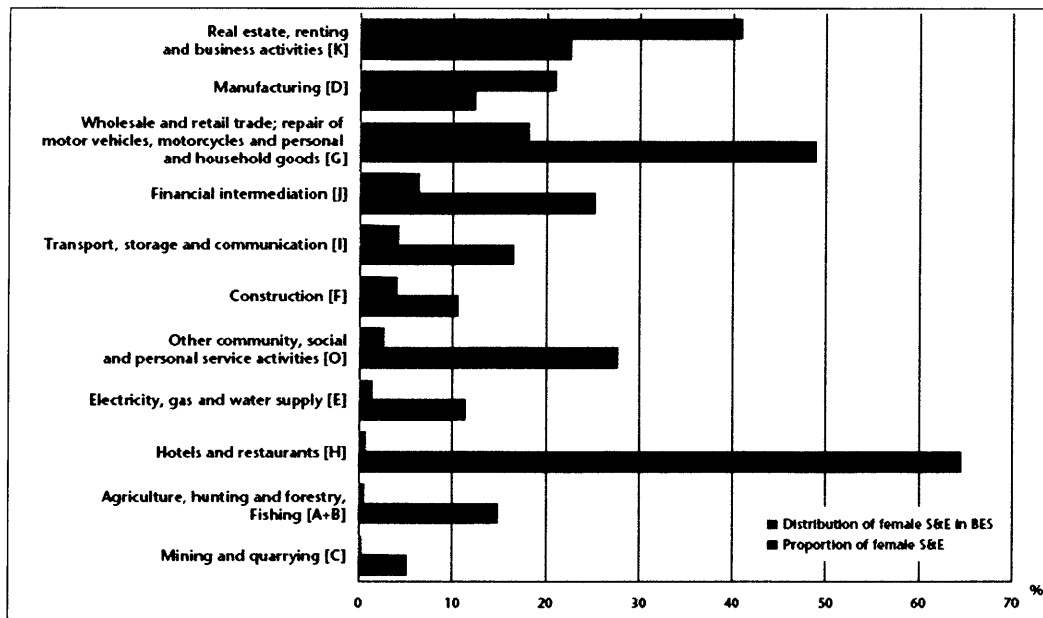


Figure 11: Female proportion & employment share of industrial scientists and engineers, EU-15, 2000
(Eurostat, cited in DG Research, 2003:105)

Looking at South Africa, a similar pattern emerges. Figure 12 highlights the seniority of women in higher education institutions where, the more senior the rank, the less women are found. According to the Centre for Research on Science and Technology (CREST, 2004:37), 47% of the total 3,894 female instruction/research staff at universities were lecturers and less than 7% professors. Rank distribution among males was much more evenly spread with an equal number of lecturer versus professor positions being held.

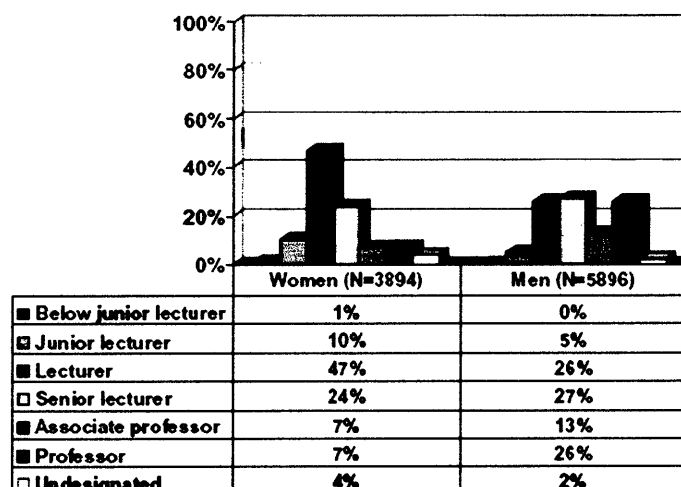


Figure 12: Sex and rank distribution of instruction/research staff in the university sector, South Africa, 2001
(DST & SARG, 2004:37)

At the level of decision-making in the private sector, figures giving an overall picture of SET sectors are not available. However, a closer look at the ICT sector – which globally has seen substantial growth in jobs and salary levels, thanks to the explosion of internet and wireless technologies² – reveals some disheartening facts.

In most OECD countries (see Figure 13), women have low shares of ICT-specialist employment shares (between 10-20% on average), which either remain constant or are declining. In ICT-using professions, females tend to dominate office and secretarial positions (more than 60% in all countries), while men hold sway over scientific and professional occupations (OECD, 2007:4).

A study carried out in Ireland (where the high-tech industry is the leading growth sector representing 34% of all exports) revealed that, despite having almost an equitable gender split in computing, IT and engineering courses, a majority of females are segregated in clerical, secretarial and unskilled jobs. Men hold 75% of all managerial and administrative positions (Cross & Linehan, 2006:30).

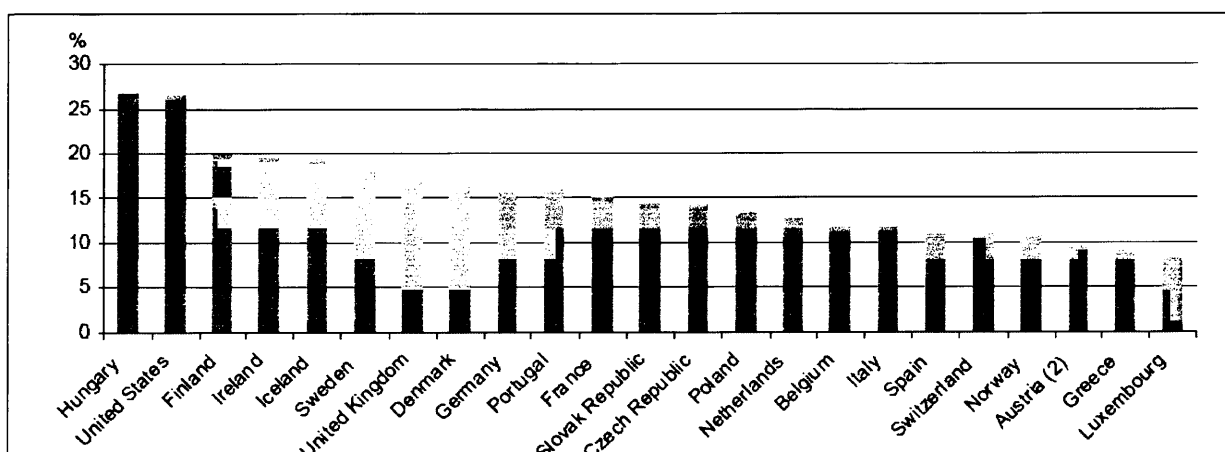


Figure 13: Share of women in ICT specialist occupations, OECD countries, 2004
(OECD, 2007: 12)

In South Africa, the situation is no different. Although a majority of ICT end-users are women (more than 74%), females represented less than 20% of ICT workers in 2005 (James et al., 2006:62). A skills audit of the South African Information Systems, Electronics and Telecommunication Technology (ISETT) sector found that men dominate the technical side of ISETT businesses, while females dominate non-technical aspects (see Figure 14).

² The US Department of Labor predicts that almost 2 million jobs will be created within ten years in the hi-tech sector, computer engineers representing the fastest growing occupation with over 664,000 new jobs.

However, training is hoped to rectify this imbalance in the coming years. In comparison to their male counterparts, few women hold positions as ICT managers, engineers, programmers or technicians, and operate mostly in sales or systems analyst posts (James et al., 2006:64). The ICT industry is important in the South African context, as the government has recognised the sector's strategic role in the future growth and prosperity of the economy. Indeed, it is ranked as one of the top five contributors to South Africa's gross domestic product (GDP) (Vukanikids, 2005:1).

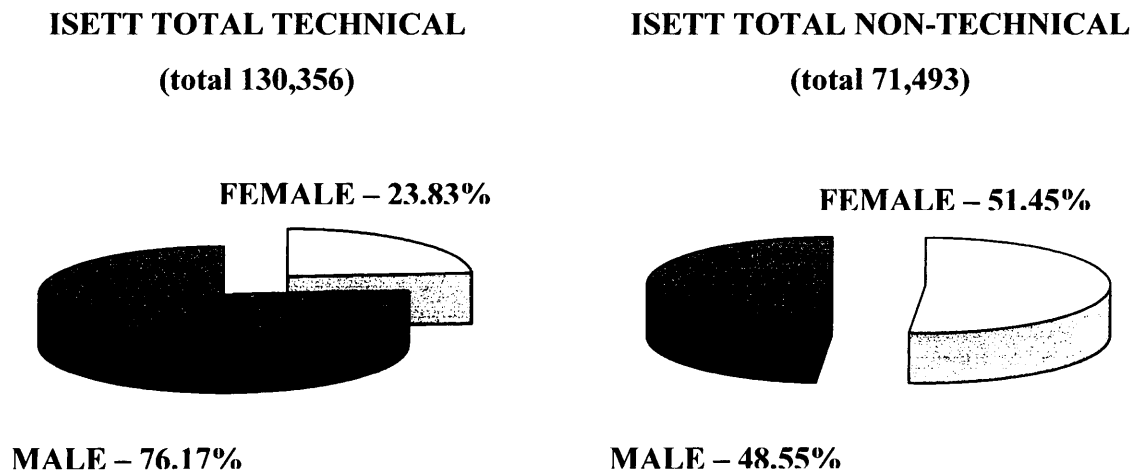


Figure 14: ISETT breakdown of employees by gender, South Africa 2005
(Vukanikids, 2005:52)

At a very general management level, according to the Economist (2005), South African women slightly outperform their US colleagues who represent only 8% of top managers, a figure which is "very low and not getting higher". The figure is even lower in Europe and Japan. Across all sectors, women represent only 19.2% of executive managers and 13.1% of all directors in South Africa while only 4.3% of board chairs and 2.6% of Chief Executive Officers (CEOs) are female (BWASA, 2007:17). Moreover, as illustrated in Figure 15, the number of females represented at the senior level is indirectly proportional to the size of the industry; the larger and more established the sector, the less number of women in director positions (BWASA, 2007:27). This is relatively promising for women seeking careers in the newer industries such as the communications technology sector, but less so for industries such as construction, engineering or automotive manufacturing.

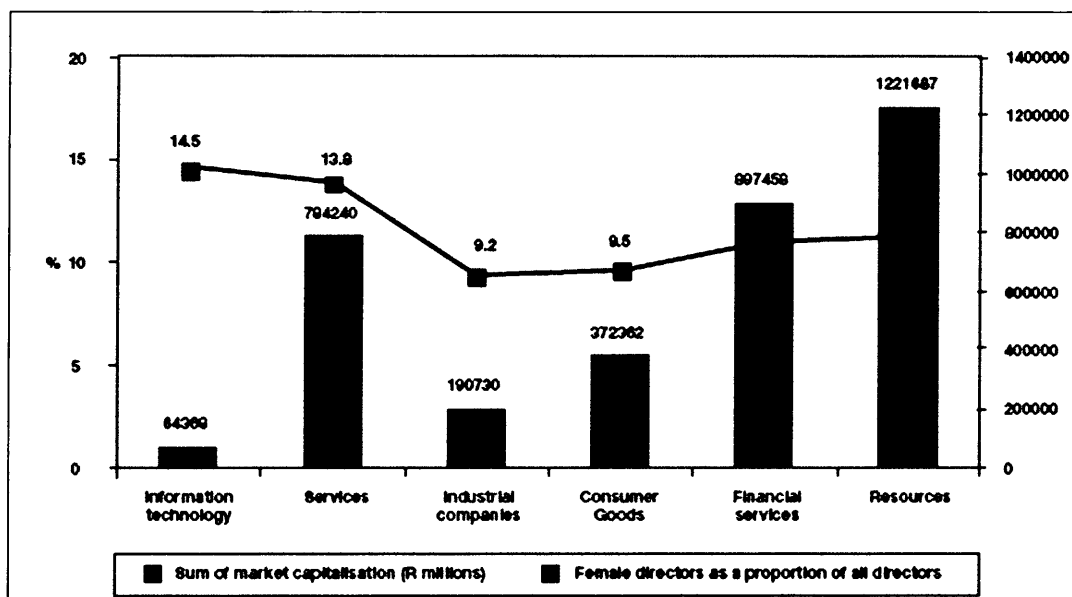


Figure 15: Female director representation relative to industry size, South Africa 2007
(BWASA, 2007:27)

2.5 Barriers to women in SET

The facts speak for themselves. Low numbers of women pursue SET-related studies and careers. When they do enter these sectors, their advancement is restricted and opportunities are limited, resulting in their decision to leave. Women obviously face challenges in this respect. Some are more obvious than others and have been repeatedly mentioned in the literature:

1. **Stereotyping and perceptions.** It is not groundbreaking to state that gender stereotyping, stemming from socialization within the family, education and the media, have limited women's access to SET careers and slowed their advancement down on the SET career path. Family often plays a fundamental part in gender role determination. Parental expectations of what a girl should and should not do often lead to "science anxiety", while in many cultures the attitude of a husband toward gender roles strongly influences his wife's work decisions (Mischie and Nelson, 2006:13; Chung and Lee, 2003; Siann and Callaghan, 2001:90 and Tara Research & Equity Consultants and Feedback, 2005:12; Newmarch, Taylor-Steele & Cumpston, 2000). Education and the media play particularly important roles in reinforcing gender role behaviour, the former being especially complicit in entrenching stereotypes. At school, teachers often actively discourage young girls from venturing into the natural sciences and engineering disciplines, while "shortfalls in

education...contribute to learners' science anxiety, exacerbating the disinclination towards studying SET related disciplines" (Tara Research & Equity Consultants and Feedback, 2005:12; Siann and Callaghan, 2001:86, Sanders, 2005:3; Brownlow, Jacobi & Rogers, 2000:120). Obviously, societal expectations vary across cultures, with some having less entrenched behavioural, cultural and religious practices, which might limit women's opportunities. German women, for instance, are less "interested" in the natural sciences and engineering than other European women, while Japanese females avoid male-dominated disciplines to a much higher degree than their European or American counterparts (Smith: 2003:34; UNU-IAS, 2005:9).

2. **Self-efficacy.** Mischie and Nelson (2006:21-22) argue that career-related self-efficacy expectations are linked to persistence in following SET professions and women's aspirations for top management positions in non-traditional domains. The more negative experiences a woman has in the "women do not fit here" environment, the more likely her self-confidence and interest for SET would be diminished, propelling her decision to exit this career path (DG Research, 2003:7). Guran (cited in Suter, 2006:100) reported a 13% gender differential in exit rates from engineering over a seven-year period. Research has shown that generally females tend to underestimate their SET skills. According to Henwood (cited in Sanders, 2005:11), the minority of women who do excel in computing, view themselves – and are viewed by men – as exceptional: "different from the majority of women who are therefore rendered incompetent and outsiders in technological culture".
3. **Work-life balance.** The work-life balance conflict between a woman's career and her family responsibilities cannot be underestimated in terms of stress, perceived job commitment and career development. Pregnancy, child rearing and other family-related commitments inevitably interrupt women's careers. Literature shows the continuous unequal burden of family responsibility on women (Asgeirsdottir, 2006:19; UNU-IAS, 2005:5; OECD, 2005:3; DG Research, 2003:7, Prozesky, 2006:27, Rees, 1992 & Gale, cited in Cross & Linehan, 2006:32; Baltes-Löhr, 2006:167; Mouriki, 2006:179). This is compounded by unaccommodating working environments, a lack of affordable and adequate childcare facilities and the requirement – specific to the SET sector – of further studies as a means of career advancement, resulting in "a constellation of demands that is very difficult to balance successfully" (Tara Research & Equity Consultants and Feedback, 2005:14). An EU report on the corporate perspective states openly that many firms are "hesitant to take risk on talented women by accelerating their career or to openly raise the issue as a strategic move

for the company” (DG Research, 2006b:4). Family commitments compounded by most SET environments’ organisational structures and policies therefore impair women’s ability to meet their potential and hinder their advancement in the dynamic and competitive SET sector.

4. **SET culture.** The structure and organisational cultures of most SET environments tend to be male-dominated, unwelcoming and even hostile to women (Margolis & Fischer and Rolden et al., cited in Mischie and Nelson, 2006:11; DG Research 2003:6, Sanders, 2005:6; von Hellens, Nielsen & Traut, 2001:117; OECD, 2006:13; Suter, 2006:101). “A salient characteristic of SET culture has been the intertwining of masculinity and technology so that technical competence has come to constitute an integral part of masculine gender identity and conversely, a particular kind of masculinity has become central to the working practices of technology” (Gill & Grint, cited in Siann and Callaghan, 2001:89). A 2005 UK study of female final year computer scientists revealed that 35% had elected not to pursue a career in their field of study as they “expect the environment to be too male and anticipate a lack of career progression” (DG Research, 2006b:12). In the research community particularly, there is low transparency in appointment procedures and strong dependency on networks to which women do not have access. Moreover, tacit gender biases limit women’s access to research grants and promotion opportunities. For example, Braithwaite (cited in Tara Research & Equity Consultants and Feedback, 2005:6) points out that age restrictions in funding conditions discriminate against women who tend to be at a later stage in their lifecycle than men, when applying for grants.
5. **Self-imposed glass ceiling.** While organisational and structural policies and the general working environment may act as a barrier to the advancement of women in SET domains (especially for those with family commitments), Cross and Linehan (2006:37) suggest personal choice may also play a role, based on the need for “harmony and balance between career success and life outside work”.
6. **Networking.** Networks provide access to social contacts, learning opportunities and job openings/promotions. Having access to networks also gives women access to organisational players who could act as mentors (Cross & Linehan, 2006:35). As there are fewer women in SET disciplines, networking is very difficult which can have an impact on career choice and, later, professional advancement. Networks tend to comprise mostly men, events are more masculine in nature (e.g. golf days) and occur

outside of working hours which can be problematic for women with family commitments (OECD, 2005:2; DG Research, 2003:6, Cross & Linehan, 2006:34). Moreover, to avoid any hint of impropriety, many women are cautious and avoid close relationships with male colleagues (Tara Research & Equity Consultants and Feedback, 2005:14).

7. **Lack of role models.** According to Sanders (2005:18), research from a US university found a strong correlation between female retention in math, science and technology and the number of courses taught by women, while the same was not true for men or women in other disciplines. Sanders (2005:18) also highlighted studies from three US states which showed that lack of access to role models was a key deterrent to girls' pursuit of technology careers. Young people choose career paths on the basis of adult experiences and such a choice is known to be gender-linked. The *catch 22* in SET career development is that, because a low number of women pursue and stay in SET jobs, few advance far enough to influence decision-making and culture or act as role models to attract young women (James et al., 2006:68, Siann and Callaghan, 2001:90, OECD, 2005:2; OECD, 2006:12; DG Research, 2003:7).
8. **Speed of development.** Due to the fast-paced nature of innovations in SET sectors, it is often difficult for women returning from career breaks because of the lack of support in maintaining their skills and knowledge base (UKRC, 2007).
9. **Standards for scientific quality.** Literature acknowledges that SET recruitment, selection and evaluation methods are not gender neutral. Deeply-rooted institutional gender bias exists in how scientific excellence is defined and assessed, the choice of explicit and implicit indicators for scientific excellence and the way in which criteria are applied to the sexes (DG Research, 2005c:8; Benschop & Brouns, 2003:194; OECD 2005:3, Prozesky 2006; Cervantes, 2006:46). For example, in most countries, publications and peer reviews are the main criteria for advancement in academic or research circles, while teaching is only a secondary criterion – if at all. Women tend to publish less and later than men, while female representation on selection and advisory committees is often weak. Georgi (2000) adds that, in selecting the best scientists, department chairs and search committees focus on assertiveness and single-mindedness. Although less appropriate and perhaps not even desirable in a scientist, these qualities, which are much easier to quantify than intellectual curiosity and dedication, are not usually encouraged in women. Women who are selected by

“the system” for their assertiveness are then at a disadvantage as they are seen as “disagreeable” by colleagues.

10. **Image of SET.** The public image of scientists and engineers is one of social isolation and introversion. Women, more commonly than men, regard “human interest” as an incentive in career choice. It comes as no surprise, consequently, that a young woman with little intrinsic interest in science and engineering would be attracted to pursuing this as a discipline (Siann and Callaghan, 2001:93; OECD, 2007:15; DG Research 2003:6, Sanders, 2005:7; von Hellens, Nielsen & Traut, 2001:118; Newmarch, Taylor-Steele & Cumpston, 2000). A European Commission study has found that the self-image of young people is not predominantly gender-based, but rather more dependent on culture. “SET talent is therefore not seen as an innate quality of men and women, it is mostly culture and therefore open to change, although [on the negative side] culture has not changed much over the years” (DG Research, 2006b:12).
11. **Nature of scientific enquiry.** As scientific research has been, for the most part, dominated by men, the basic aspects of systematic theory are dominated by masculine perspectives. As a result, scientific thought, although presented as gender-free, is pervaded by masculine biases (Siann and Callaghan, 2001:89; Mischie and Nelson, 2006:11)
12. **Gender-pay gap.** Measured as the gap between median hourly pay for full-time employees, excluding overtime, the pay gap for SET professionals acts as a deterrent for women entering SET careers and is an obvious indicator of unequal treatment. According to Löfström, (cited in DG Research, 2006b:13) wage gaps tend to be the largest in male-dominated professions. In the UK alone, women earned 91.3% of the male median wage in 2005 (UKRC, 2007).

Although the barriers to women’s position and participation in SET sectors are numerous and far-reaching, so too are the variety of interventions aimed at addressing them. In the following sections, many different approaches are highlighted but one stands out as particularly comprehensive, namely resource centres for women, and appears repeatedly in many countries as literature reveals.

2.6 Resource centres

WRCs are purported to be an effective means of gender mainstreaming. They facilitate women's integration into the working life and support their empowerment and social inclusion (Fabry, 2006:4). From a regional and local development perspective, WRCs have played an important role in Europe. According to the Swedish National Federation of Resource Centres for Women (NRC, 2006:1) they have increased the number of women contributing to the economy, which has had a positive impact on national, regional and local growth and development. They also contribute to innovation and R&D. Moreover, the NRC adds that, when women work together in a resource centre, they are better placed to plan and implement actions which improve the area's working conditions and living standards.

WRCs vary in their stakeholders and focus on various aspects, such as entrepreneurship, innovation, business development and/or equality and growth. They can even be sector-specific (e.g. aiming to improve women's participation in the ICT sector). "Some centres are oriented primarily towards developing business ideas and supporting self-employed women, others are oriented towards unemployed women, inactive women over 40 (40+), immigrant women, minority groups etc" (NRC, 2006:1). While the orientation of WRCs might differ, they usually share common objectives, including job creation, resulting from the development of women's ideas, increasing women's influence on the labour market and society, enhancing women's role in decision-making, communicating women's experiences and ensuring greater gender equity in all aspects of community life (NRC, 2006:1).

A great deal of work has been done in Sweden to develop a model and quality indicators for WRCs in their work towards enhancing gender equality in regional development. According to NRC and the Swedish Agency for Economic and Regional Growth (NUTEK), at the very minimum, a WRC should:

- be legitimised by the demands/needs of women;
- empower women;
- be a neutral meeting place (virtually and physically) for networking groups of women (and those men interested in supporting the cause of women in SET);
- be a centre for information and documentation (research, seminars);
- counsel women on their projects or business ideas;
- mediate contacts with women's networks, the corporate world, governmental and non-governmental institutions, academia, the media and at an international level where necessary;

- be endorsed by authorities and organisations at the relevant level;
- have a working plan, annual accounting and evaluation system;
- be governed by a Board or Steering Committee; and
- be not-for-profit (NUTEK & NRC, 2005: 6-8; NRC, 2006: 2, WENNET, 2006).

WRCs can also provide recruitment services, training and educational support, mentoring programmes and international exchanges (DoRiS, 2006).

In the SET field, where networks tend to be male-dominated, the networking services of a WRC are particularly valuable. Networks have a proven track record in empowering women and ensuring a more comprehensive gender dimension in research policy (European Commission, cited in Bradley Dunbar Associates, 2003:2). According to Ehrich (cited in Pini, Brown and Ryan, 2004:286), networking is critical to career success. The networks to which men belong are usually more powerful and yet women often have trouble accessing them. However, women-only networks provide a valuable means to circumvent women's exclusion from "old boy networks". According to Berkelaar and Travers et al. (cited in Pini et al., 2004:287), such networks boost self-confidence, offer greater learning opportunities, provide new skills and increased social contacts and increase women's leadership potential. However, in order to achieve their long-term goal of changing perceptions about women's role in SET and expanding women's opportunities in this field, such networks should avoid sidelining gender issues to women-only spaces. They should engage in other networks and seek to build alliances, what Berkelaar (cited in Pini et al., 2004:291) refers to as "a network of networks". Effective WRCs, many of which are covered in the following pages, do just that: they form alliances with government, industry, academia, research institutes and a wide variety of other players extending the reach of the Centre beyond its members and founding supporters.

Networks also provide access to mentors. Like networking, mentoring plays a big role in the advancement of women's careers and is also a valuable tool for sharing knowledge and generally supporting and encouraging people to "manage their own learning in order that they may maximise their potential, develop their skills, improve their performance and become the person they want to be" (Parsloe, cited in UKRC, 2007). Research has shown that women involved in mentoring programmes do better as they "gain reflected power, feedback and access to resources and senior managers through their mentor" (Headlam-Wells, 2004:212). In the academic community specifically, a study examining the growing gender gap in publication productivity in South Africa found that mentoring was a key driver of several young female researchers' decision to publish research in order to gain

international recognition and academic credibility. Interestingly, the study highlighted that women’s research needs depend on colleagues and mentors for guidance to a much greater extent than their male counterparts who “focus more on their equal-power relationships with their mentors, and on their own role as mentors” (Prozesky, 2006:27). Because of the organisational, interpersonal and individual barriers women face, Burke and McKeen (cited in Cross & Linehan, 2006:36), Cervantes (2006:44), Fox (2001:659) and Aaltio (2006:124) have suggested that mentoring is effective and essential for women. For this reason, mentoring schemes are important services offered by most WRCs.

2.7 South African initiatives to increase participation and position of women in SET

In a recent survey on innovation, conducted by the Human Sciences Research Council on behalf of the DST, South Africa was found to compare favourably with countries like Sweden (where 50% of enterprises are innovative), the United Kingdom (43%) and Portugal (41%). Nearly 52% of South African firms carried out product and process technological innovation activities (DST, 2006a:9). Equally reaffirming news for South Africa’s growth potential is the annual National Survey of Research and Experimental Development which indicated that R&D expenditure is on the increase with “the system of innovation showing real a growth of 5% per annum” (DST, 2006b:2). Women’s role in these developments cannot be overlooked as they represent 38.3% of all South African researchers – on par with or higher than many OECD nations - as highlighted in Figure 16. Between 2001 and 2004, the number of female researchers in SA grew by 3.4%.

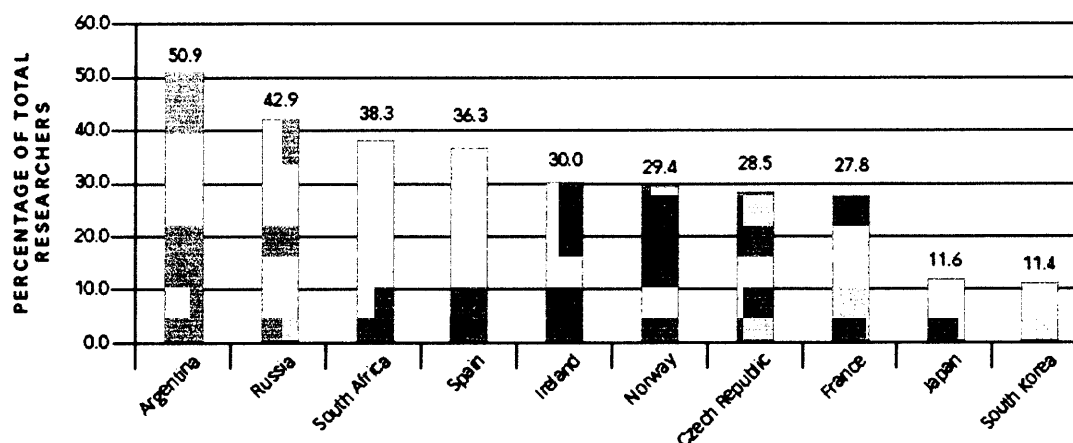


Figure 16: Number of female researchers as percentage of total researchers, 2004

(DST, 2006b:17)

Although these figures are impressive, the real story is hidden behind the numbers as Figure 17 illustrates. Female researchers are segregated to certain sectors with their largest presence being in the not-for-profit sector followed by academia and government. Female researcher representation in business, the biggest R&D funder and a key player in South Africa's NSI, is the lowest at 26.8% of total industry researchers. Business accounts for 56.3% of all South African R&D performance with higher education and government representing around 20% each and the not-for-profit only 1.7% (DST, 2006b:20). Moreover, according to the annual South African survey on R&D, the largest proportion of R&D occurred in fields relating to engineering science (23.9%) followed by the natural sciences (20.8%), the medical and health sciences (14.8%) and ICT (12.8%). Social sciences and humanities, fields dominated by women account for just over 12% of R&D funding, followed by applied sciences and technologies and agricultural sciences (DST, 2006b:25). Women are therefore found more dominantly in those sectors with less impact on innovation developments and R&D more generally.

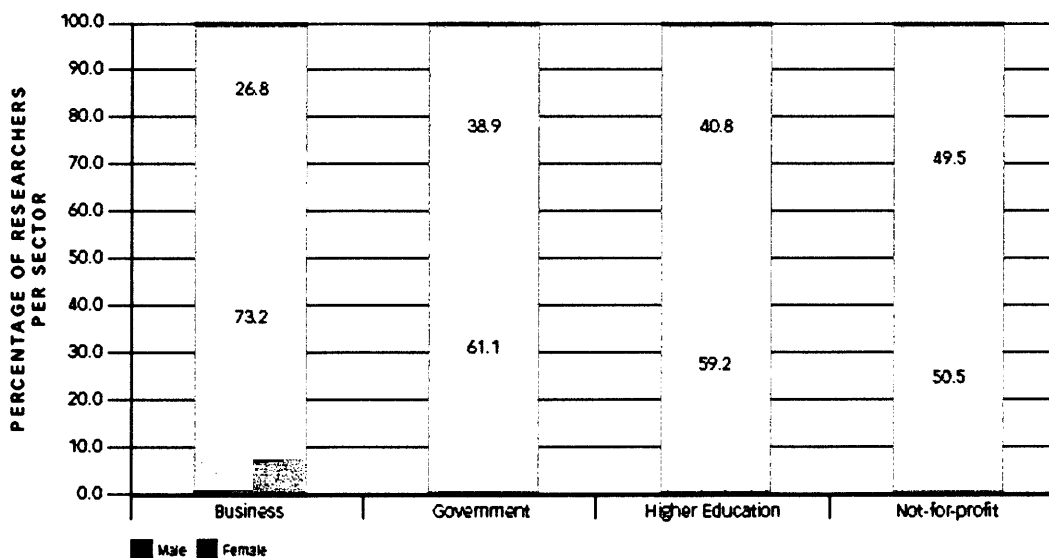


Figure 17: Researchers by sector, broken down by gender, 2004

(Source: DST, 2006b:19)

Extensive research has been carried out in recent years on South African women's under-representation in the SET sector. In a 2005 study exploring the experiences and perceptions of women working in SET, respondents were asked to highlight perceived flaws in and suggest possible improvements to current interventions (Tara Research & Equity Consultants and Feedback, 2005:19). While many expressed the view that preferential policies in favour of women were "merely bias in reverse", the growing number of women in leadership positions would appear to support the efficacy of affirmative action rather than

indicate an increase in the pool of qualified females. According to the study (Tara Research & Equity Consultants and Feedback, 2005:21), this is evidenced by the fact that women who emerge as leaders do so in typically male-dominated environment, isolated from other females, and go on to act as the face of the organisation, as part of a public relations exercise. Respondents explained that, generally, there were very limited examples of preferential funding and professional development interventions targeted specifically at women; most activities cover the wider category of “previously-disadvantaged” individuals. Moreover, most initiatives are targeted at high school and tertiary institution learners, while in academia, programmes made little, if any, gender differentiation. The report argues that, while “gender rights may have benefited from being defined as a cross-cutting issue in policy formulation...the dearth of gender specific interventions begs the question of whether it has also not suffered as a result...Gender representativity in SET is a critical issue, requiring focused rather than incidental redress” (Tara Research & Equity Consultants and Feedback, 2005:20).

The study proposed several interventions, each comprising specific actions (Tara Research & Equity Consultants and Feedback, 2005:31-36):

- Implement a communications plan to sensitise the SET community to gender issues;
- Mainstream consideration of potential gender impacts in research projects and programmes;
- Compel meaningful female representation on large-scale research projects;
- Devise a comprehensive strategy to address science anxiety;
- Mobilise the positive influence of parents and educators;
- Target young women learners;
- Incentivise science;
- Investigate and implement best practice in accommodating women’s lifestyle imperatives;
- Attend to employee retention strategies;
- Design and implement professional support and development programmes;
- Implement and engage women in systematic career path planning processes;
- Provide more preferential bursaries and scholarships for women, research grants favouring representation of women and research grants favouring projects with outcomes for women;
- Publicise the availability of preferential funding;
- Mandate the consideration of gender impacts as a basic funding condition;
- Determine SET transformation priorities;

- Conduct policy impact assessments; and
- Develop transformation targets, monitor and publish progress, and sanction deficits.

The 2005 study and other research in this area³ form the fundamental building blocks of the South African DST's Gender and Race Equity policy, currently being developed under the auspices of the South African Reference Group (SARG) on Women in SET. SARG was established in 2003 as a subcommittee of the National Advisory Council for Innovation.

A comprehensive analysis of this and other SA government structures, policies and education strategies addressing gender specifically, or as an aspect of empowerment, has already been completed by James et al (2006) and consequently is not repeated in this report. The 2006 study effectively highlights all the different organisations (public and private) promoting and advocating the participation, position and representation of women in ICT and in many cases the wider SET community. It outlines the South African gender machinery, national policies and frameworks addressing gender, national R&D policies and strategies, and implementation at the national and provincial government level. The report walks the reader through gender and equality in the South African education system from early childhood development through to university and various initiatives targeted at both students and teachers to develop SET skills amongst learners. Workplace interventions are also addressed as are support systems for women (mostly in ICT) including, for example, the work of Women in IT (WIIT), the Association of South African Women in Science and Engineering (SA WISE), the NRF, the Council for Scientific and Industrial Research (CSIR), the aforementioned SARG and not-for-profit organisations such as South African Women in Dialogue. The study successfully identifies gaps in these approaches and makes a strong case for a WRC type of intervention - amongst others - in South Africa: "The contents of this report should provide another step forward in terms of consolidating available...data and information on what has been done...to this end...a manual of possible interventions [has been developed], as a separate document, which outlines six possible programmes⁴. Some have already been initiated by a variety of players. What is missing, though, is a more

³ DST and SARG, 2004. Synthesis report: Women's Participation in Science, Engineering and Technology. http://www.sarg.org.za/docs/pdf/womens_part_set_2004.pdf

Looking at SET through Women's Eyes, an unpublished consolidation of the outcomes of a series of national consultations for women in SET (James et al., 2006: 23)

A Monitoring and Evaluation Framework to benchmark the Performance of Women in the National System of Innovation. http://www.naci.org.za/OECD/Vol1MainReport_13Dec05CREST.pdf

⁴ 1) Establishing a South African Resource Centre for Women in ICTs; 2) Strengthening the research capacity in women and ICTs; 3) Developing a workable and integrated system for measuring ICT in working life and the education system; 4) training programmes for school teachers; 5) training programmes for girls and young women and 6) dissemination and awareness raising activities

coordinated approach to ensure maximum impact of these diverse, and laudable, efforts” (James et al., 2006:97).

Although South Africa currently does not have a national or regional resource centre focused on women in SET, discussions are currently ongoing in the South African Department of Trade and Industry (DTI) about the establishment of a WRC although not specifically targeted at women in science and technology. At the time of writing, little detail was available on the progress of this development.

While South Africa is advanced in its assessment of the challenge the country faces with respect to women’s lower participation rates and unequal position in SET disciplines and the impact this has on the nation’s innovation and growth objectives, the solutions are – as yet – not implemented and, in some cases, remain undefined. However, this is not necessarily a problem, as South Africa has a wealth of international experiences from which to draw, analyse and assess the potential for local application. Some of these initiatives are highlighted in the following section. An emphasis is placed on resource centres as one effective mechanism which brings the benefits of the aforementioned initiatives under one roof.

2.8 International initiatives

Many international, regional and national organisations have attempted to identify the numerous policies and programmes in place in order to increase the participation and position of women in SET. The EU has several sharing of “best practice” approaches in place (see following section), while the OECD has brought together experts to assess the root causes behind this problem and examine models for the attraction, recruitment and retention of women in SET careers, in both public and private research.

The number and diversity of interventions is overwhelming. Without endorsing any one intervention, the OECD (2005:5) identified several important steps to be undertaken in efforts to improve the participation and advancement of women in SET. These include, for example, promoting role models, creating formal and informal networks, using scholarship/research grants to draw more women into non-traditional SET fields, linking female entrepreneurship initiatives with those targeted at women in science, evaluating public programmes promoting women in science to ensure results are fed back into the system’s design and improving the creation of sex-disaggregated data.

2.8.1 European Union (EU)

The EU has a long history of promoting gender equality. Its agenda for promoting European growth and competitiveness to 2010 (the so-called Lisbon Strategy) officially recognised the need to boost women's employment and accelerate gender mainstreaming in order to meet labour market challenges and meet Europe's innovation goals (Haataja, Leinonen and Tervonen, 2006:34). Table 1 highlights the activities of the EU's 25 Member States in promoting gender equality in science. Many countries have established Women in Science coordination units within government departments and WRCs have opened up across Europe as a result of EU funding under various project lines (WENNET, 2005:5)⁵. The emergence of WRCs *focusing on the SET agenda* is a relatively new phenomenon and exists only in a limited number of EU member states. Some countries, such as the Netherlands and Germany, rank their universities according to the number of women in decision-making positions overall and in SET domains specifically (DG Research, 2005c:10).

Table 1: Member State Policies to Promote Gender Equality in Science, 2004

Equality measures in Science	EU Member States (25)																									
	BE	CY	CZ	DK	DE	EE	EL	ES	FR	IE	IT	LV	LT	LU	HU	MT	NL	AT	PL	PT	SI	SK	FI	SE	UK	
Equal treatment legislation	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Commitment to gender mainstreaming	X	X	X	X	X		X	X	X	X	X		X	X			X	X	X	X	X		X	X	X	
National women & science cttee.	X	X	X	xx	X	X	xx	X	X	X	X		X		X	X		X	X	X	X	X	X	X	X	
Women & science unit in Research Ministry					X		X5	X	X		X							X	X						X	
Sex-disagg. Stats	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X3
Gender equality indicators	X4			X	X		X		X	X	X	X			X	X		X		X	X		X	X	X	
Public cttee. gender balance targets	X2			X	X		X		X	X													X	X	X	
University cttee. gender balance targets		X		X	X				X								X4	X					X	X	X4	
Gender equality plans in university & research	X4			X	X				X	X	X			xx			X4	X					X	X		
University gender studies/research	X	X	x	X	X	X	X	X	X	X	X	X	X	xx	X	X	X	X	X	X	X	X	X	X	X	X
Programme on women and science, funding available					X		X		X	xx	X	xx	xx			X	X	X				X			X	
Nationwide women & science centre			X		X																				X	

Source: Information provided by the members of the Helsinki Group & EOWIN, summer 2004, DG RTD, Unit C4
 x – yes
 xx – in preparation x1 – French speaking x2 – Dutch speaking x3 – not for industrial R&D x4 – by certain universities x5 – person only responsible for women and science blank cell – no

(DG Research, 2005c:11)

⁵ Many WRCs have their roots in EU funding initiatives such as NOW, NOW I, NOW II, Employment/NOW, INTERREG, INTERREG II, ECOS-OUVERTURE, RECITE II

A significant amount of EU funding is available for gender-specific projects in the form of Community grants. Traditionally the remit of the European Commission's Directorate-General (DG) for Employment, Social Affairs and Equal Opportunities⁶, initiatives targeted at addressing gender gaps are spread across the Commission services. Following are some notable European interventions targeted at women in SET.

2.8.1.1 DG Research

According to DG Research's website (DG Research, 2005c), recognising the relationship between women, research and innovation, the European Commission has pledged to:

- encourage women's participation in scientific research (as researchers and within the evaluation, consultation and implementation process);
- strengthen the role female SET professionals play in the wider context of innovation and knowledge transfer;
- ensure research addresses women's needs as much as men's; and
- carry out research that contributes to an enhanced understanding of gender issues.

To this end, the Commission's 1999 Action Plan on Women and Science set out a strategy to promote research by, for and about women. One of the outcomes was the creation of the Helsinki Group on Women in Science⁷ which brings together national experts from EU Member States to network and discuss good practice at the national level. These national initiatives have been compiled into a single resource⁸. In addition, a key output of the Helsinki Group is sex-disaggregated statistics and gender-sensitive indicators⁹. Published in 2002, DG Research's Science and Society Action Plan set out several gender-specific initiatives which have resulted in concrete actions at the EU level (DG Research, 2002:18-19). These include:

- the newly-formed European Platform for Women Scientists (EPWS), a lobbying body representing the interests of women scientists from all disciplines in the research policy debate and promoting the understanding of the gender issue in science (EPWS, 2007);
- the Women in Research (WIR) initiative (DG Research, 2006a). WIR has conducted an assessment of women in industrial research, analysed statistical data, provided a benchmark of good corporate practices to enhance the role and participation of

⁶ http://ec.europa.eu/employment_social/gender_equality/index_en.html

⁷ http://ec.europa.eu/research/science-society/page_en.cfm?id=2906

⁸ http://europa.eu.int/comm/research/science-society/documents_en.html#eurepor

⁹ http://ec.europa.eu/research/science-society/women/wssi/index_en.html

female industrial researchers and, more recently, conducted research into the business case for diversity in industrial research; and

- the Enlarge Women in Science to East (ENWISE) expert group who examined the situation of women scientists in ten Central and East European countries in an effort to promote women in science in the new EU Member States (DG Research, 2005a).

The Research Framework Programme (FP) is the EU's main mechanism for funding research. In existence since 1984, the FP runs for five years before a new round is introduced. The Seventh Framework Programme (FP7) is currently active and covers women specifically under the theme *Improving Human Resource Potential and the Socio-Economic Knowledge Base* (CORDIS, 2006).

A follow-up to the work of ENWISE, the Central European Centre for Women and Youth in Science (CEC-WYS) is one of many initiatives funded under FP6. The Centre aimed to raise the visibility of female scientists using an interdisciplinary database to build skills and capacity through the development of such tools as a Project Management Sourcebook, a Manual on the Inclusion of the Gender Dimension in Research Questions and Methodology and a career resource website, among others (CEC-WYS, 2004).

2.8.1.2 DG Enterprise

Considering the relationship between SET, innovation and job creation, another interesting EU initiative is in the area of women and entrepreneurship (DG Enterprise, 2005b). In addition to the funding it provides to European projects targeted at women and small and medium-sized business, DG Enterprise has established an entrepreneurial portal which provides links to the websites of female entrepreneurs' representative organisations, networks, projects and events (DG Enterprise, 2007a). Although static in nature, the portal provides a wealth of information on female entrepreneurship resources at national and international level. Some interesting SET-related initiatives (mostly EU-funded projects) include:

- FemStart – hosts debates at European universities addressing specific measures to encourage women in science to choose entrepreneurship (FemStart, 2007).
- ProWomEn – involves 16 European regions which aim to share good practice in helping women to create innovative ideas and starting up a business (ProWomEn, 2002)

- WENETT – works with local support networks to inform businesswomen and women scientists about the benefits of establishing European and international partnerships (WENETT, 2007)
- WISE – identifies and supports the needs of women entrepreneurs in ICT and develops tools and measurements to improve the overall performance of women entrepreneurs (WISE, 2007).

DG Enterprise has also funded a project which aimed to identify and evaluate national measures related to start-ups, information/advice, funding, training, mentoring and networks concerning the promotion of female entrepreneurship (DG Enterprise, 2005c). The results were published in 2003 including examples from the EU and other OECD countries. These were accompanied by a handbook entitled *Evaluating Actions and Measures Promoting Female Entrepreneurship – a Guide*, and a female entrepreneurship database providing details information on funding opportunities.

2.8.1.3 DG Regio

A final interesting initiative with roots in EU interregional funding is the pan-European Network of Women Resource Centres (WINNET Europe). WINNET Europe is based on the Swedish model of WRCs, a bottom-up initiative founded on the empowerment of women (see following pages). With its primary mission to increase the number of women participating in economic life on a regional and local level, WINNET Europe's members comprise many of the 600 national, regional and local WRCs across Europe.

In supporting the efforts of a wide variety of WRCs, the European Association advocates that women claim their share of society's resources; that their competences be utilised in society; and that female efforts are valued equally with that of men (WINNET, 2007). In addition to strengthening the role of WRCs as key actors in economic growth, WINNET aims, among others, to increase the empowerment of women by enhancing their use of ICT and create stable employment by supporting female entrepreneurship and women's ideas relating to the production of goods and services.

WINNET Europe spreads information about the association through a new type of innovative network portal (www.winneteurope.eu) where information is available based on a geographic information solution, including quality indicators and modelling of resource centres which essentially allow for the benchmarking of good practice at the European level. WINNET Europe also takes a leading role in initiating new joint actions for ensuring sustainable results

in increasing women's participation in the Information Society, including the start-up of a European Centre for Women and ICT.

The pan-European association offers a multitude of services, including support for establishment of resource centres, lobbying, awareness-raising campaigns, stakeholder dialogue, quality certification of resource centres and coordination of EU projects. An overwhelming amount of information is available from WINNET. Following, are two examples of European initiatives taken from the WINNET databank.

Austria

The University of Vienna provides an interesting model of an initiative in academia. Despite an increase in the number of female enrolments and highly qualified graduates, as well as female academics and scientists, the university acknowledges that female scientists and academics remain underrepresented in various academic job positions (University of Vienna, 2004). To address these inequalities, the university has integrated gender mainstreaming across all disciplines supplemented by women's promotional measures. In 2004, a Centre for Gender Equality was established as a service facility with the main task of initiating and implementing individual affirmative action and promotional measures for women, while acting as a specific, equality-oriented advice service (University of Vienna, 2004). The Centre has four main areas of activities:

- Promotion of women and gender equality measures including a mentoring programme and curriculum for career planning for female academics and scientists, and a coaching programme for undergraduates, graduates and PhD students;
- Counselling and information for women, but also for the university management and decision-makers in relation to the advancement of women and gender parity/equality;
- Cooperation and networking; and
- Public relations and awareness-raising.

The Centre is probably one of the most developed members of the Austrian-wide Platform for the Advancement of Women and Gender Studies Institutions at Austrian Universities¹⁰.

In the private sector and a more regional initiative, an organization called Women and Work (Frauen und Arbeit, 2007) was established to facilitate women's return to work and help women with career development. Although similar initiatives exist in other parts of Austria, Women and Work is interesting because it collaborates with numerous organisations, from

¹⁰ <http://www.genderplattform.at/>

government to business and civil society, in order to be able to offer its extensive consulting services to women free of charge. The centre offers support to jobseekers and has a special focus on entrepreneurs looking to set up their own businesses.

Sweden

Female entrepreneurship is relatively strong in Sweden. According to NUTEK (2006:9), women owned and operated one quarter of all business in the country, while about 30% of all new businesses were started by females. Despite their growing numbers, female entrepreneurs remain invisible to the public eye and often even to each other. NUTEK's aim, therefore, is to raise awareness about the increase in female entrepreneurship, highlighting how multifaceted it is and to demonstrate how valuable female-run businesses are to the growth of the Swedish economy (NUTEK, 2003:5). Among other initiatives, in 62 municipalities, NUTEK finances female business advisers to assist women in starting up a business. These advisors are more than just mentors and role models, as many run their own businesses on a part-time basis. They facilitate the process providing assistance, training and consultancy through their network.

NUTEK also provides funding for Swedish WRCs which fall under the umbrella organisation of the NRC. A pioneer in the establishment of WRCs, Sweden is home to a network of 160 centres, 20 of which are regional, working to "implement and accelerate the inclusion of women in the labour market and in the local socio-economic development process" (WINNET, 2007). While promoting a bottom-up approach, the establishment of WRCs was a top-down initiative by government which regulated that such centres are effective tools for the integration of gender equality in local and regional development. In 1994, NUTEK was assigned the task – and supporting budget – to roll out the WRC concept with the support of country administrative boards, each of which had a legally-required gender-equality expert. Within five years, NUTEK handed over administration of the WRC network to a newly-founded coordinating body, the NRC. Today this national federation, in cooperation with NUTEK, provides financial and public policy support to its members, training (especially communications and IT), as well as mentoring and networking services. NRC is a lead partner in the WINNET Europe project and much of its work is used as a basis for good practice in WINNET's model.

These two country examples form only a small part of WINNET Europe's network which has members in 21 of the EU's 27 member states. There are several other interesting European initiatives which did not [at the time of writing] form part of WINNET's network.

2.8.1.4 Finland

Like its nordic neighbours, Finland is viewed by many outsiders as a model for equality between the sexes, but according to experts with a long history in gender mainstreaming, many areas of concern still persist. In the workplace, the gender gap is particularly wide as “women are usually lower paid, enjoy a lower professional status and have weaker career prospects” (Haataja et al., 2006:2). Sectors continue to be gender segregated with the high-tech industry being no exception. According to Haataja et al. (2006:2), women represent less than 20% of students and employees in technology sectors in contrast to 90% in social welfare and healthcare. The problem, like elsewhere in the world, is not that females underperform in mathematics or natural sciences, but rather that they are socialised to pursue more traditional studies and sidelined in management and entrepreneurship opportunities.

Although Finland is ahead of most nations in its efforts to reconcile work and family life due to the strong tradition of female labour market participation, Haataja et al. (2006:3) argue that the Nordic nation “still needs sustained and determined equality policies”. Focusing specifically on the high-tech sector, WomenIT was one pan-European project which aimed to reduce labour market gender segregation by encouraging and supporting females to pursue education and careers in technology-related domains¹¹.

Taking a holistic or life-cycle approach of targeting the education-employment pipeline at the earliest possible stage of intervention, the project was implemented in daycare facilities, schools, institutions of upper secondary level education, polytechnics, universities, enterprises and labour unions (Haataja et al., 2006:9). In terms of higher education, WomenIT interventions focused on development initiatives and research into teacher training, physical science and chemistry, informational processing science, technology programmes and support for technology entrepreneurship. One initiative was a year-long entrepreneurship training course offered through Lappeenranta University of Technology which provided support to selected learners (entrepreneurs, wage earners, students and unemployed individuals) in starting and developing a technology company. The programme aimed at highlighting, in particular, the success some women entrepreneurs have had in non-traditional female fields. Another example was research conducted for the University of Oulu’s Department of Information Processing Science which aimed to understand factors limiting greater female participation in the degree programme. The results were welcomed by

¹¹ A complete report on the WomenIT project is available at http://women-in-ict.meraka.csir.co.za/images/5/54/International_lowres.pdf

the Department and will be incorporated in the revision of teaching methods, possible structural changes to the programme and instruction content.

At the working-life stage of the WomenIT life cycle approach, great emphasis was placed on equality of workplace practices and mentorship. On the latter theme, a series of interesting initiatives were implemented on three levels, namely peer mentoring between technology undergraduates and upper secondary school students, virtual mentoring where “online mentors provided an opportunity to learn about the highly encouraging jobs and life stories of women in the field” and adult mentoring where younger female professionals “gained support in managing their work and advancing their careers while older mentors obtained new and fresh insights from their mentorees” (Haataja et al., 2006:28).

WomenIT was considered a remarkable success particularly in the teaching and educational changes which resulted in participating universities, schools and daycare facilities. Girls and women involved in the project improved their technology skills and gained confidence and enthusiasm for technology. According to Haataja et al. (2006:10), in addition to the contributions made by participants, tangible results included “new courses, educational content and models, teaching materials and practices”.

2.8.1.5 Germany

Based in Germany, but also working on an international basis, the Centre of Excellence for Women and Science (CEWS) is a knowledge and research-based service institute which implements projects and supports a network of good practices on the achievement of equal opportunities for women and men in the area of science and research in Germany. Established in 2000, CEWS is hosted by the University of Bonn and financed by the 16 Federal States and the Federal Ministry of Education and Research. It has also received funding from the EU. It is open to scientists, universities, research groups, scientific organisations and political panels, and offers the following services (CEWS, 2007):

- Transfer of knowledge – including the *cews.informationpool* (news, studies research and statistics), the *Equal Opportunities* portal (opportunities for WIR and teaching) and the women scientist database *FemConsult*. CEWS is working on a feasibility study to develop a meta-database for Europe.
- Advice and training – career strategy training for women scientists, researchers and professors and peer-mentoring programmes.
- Networking – in Germany and abroad.

- Strategy and policy development targeted at German, European and international policy makers.
- Evaluation and benchmarking of measures aimed at the advancement of women scientists – CEWS developed the first university ranking system on the basis of gender equality indicators and is responsible for managing the *Total E-Quality Deutschland* award given to universities and scientific institutions whose HR-management and institutional policies are designed to achieve equal opportunities.

CEWS – along with other consortium partners – has received funding from the EU to conduct training seminars for women scientists to encourage mobility and supranational careers in research and higher education. It has a staff of nine permanent employees and additional staff (usually scientists and researchers) for fixed term projects.

2.8.1.6 Spain

As illustrated in Figure 18, Spain experiences the same phenomenon as other countries with respect to women's predominance of the social science and humanities field at university level. Following the implementation of a scheme to increase the number of female students at one of Spain's leading polytechnical colleges which showed no noticeable results despite a significant investment, government recognised a once-off intervention is not enough and that the problem should be seen as a political one, requiring attention at all levels of Spain's education authorities.

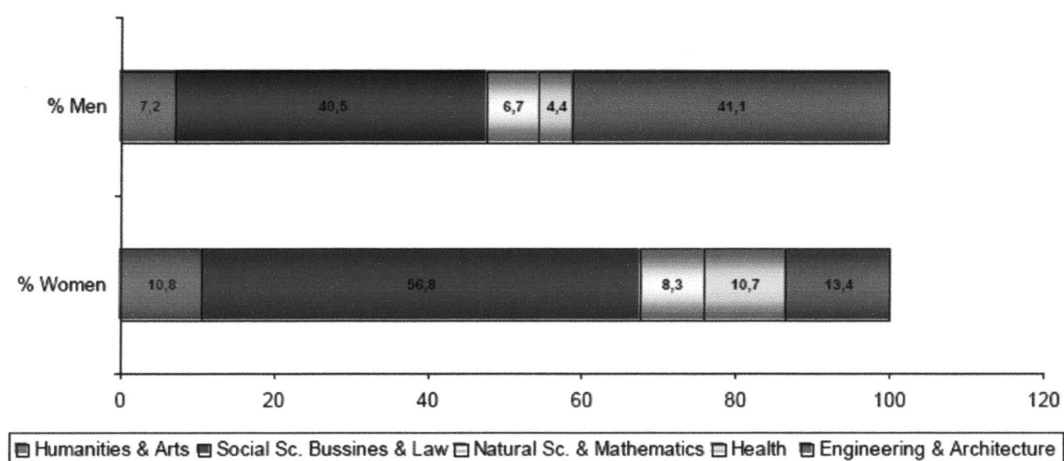


Figure 18: Gender distribution of university degrees in Spain, 2004

(UMYC, 2006a)

In 2006, the Spanish Ministry of Education and Science established the Women and Science Unit (*Unidad de Mujeres y Ciencia* or UMYC) to implement positive action measures addressing the discrimination of women in academic, scientific and technological domains (UMYC, 2006b). UYMC is essentially developing a network among universities, industry, government bodies, community centres and research institutes to promote gender equality. The organisation is currently understaffed and still in the early development stage, but its objectives include the following:

- Support for qualified women in achieving their rightful position in the education, science and technology sectors;
- Compilation of disaggregated statistics on scientific, educational and technological activity by gender;
- Promotion of research into progress made and obstacles faced by women in pursuit of professional advancement;
- Achievement of mean European participation levels of women in management and decision-making positions;
- Collaboration with other institutions on achieving better work-life balance for women in scientific professions;
- Adaptation of the scientific, education and technological community mindset to take into consideration women's perspectives, experiences and needs; and
- Raising awareness among young women about the opportunities of a career in science and technology fields.

2.8.1.7 The UK

In the context of this report, probably one of the more developed and well-known WRCs is the UKRC for Women in SET which is led by a partnership of Bradford College, Sheffield Hallam University, Open University and Cambridge University. Established only three years ago, the UKRC has its roots in a broader governmental strategy to improve the situation of women's participation, retention and progression in SET education and work, and is funded nationally by the Department of Trade and Industry, the EU Social Fund and a limited number of sponsors. The organisation is monitored by an independent implementation group which oversees progress with respect to the government's strategy.

Contracted to run until 2008, the Centre aims to "provide a lead and focal point for both supply and demand side actions to support women's participation, retention and progression in learning and work in key areas of SET and to concentrate on assisting women to senior

levels to influence organisational culture and practice and provide greater visibility and encouragement to young women then entering their fields” (Butcher, 2006:204). Its framework for action is illustrated in Figure 19. The UKRC has nine core objectives against which it is being measured, including to:

- review and develop a recognition scheme for “good” SET employers;
- share good employment practice for women in SET;
- disseminate and share information;
- set up and maintain a database of expert women in SET;
- maintain and disseminate UK gender statistics;
- raise the profile of women in SET;
- pump prime innovation and disburse travel bursaries;
- support SET women returners; and
- coordinate the work of women in SET organisations.

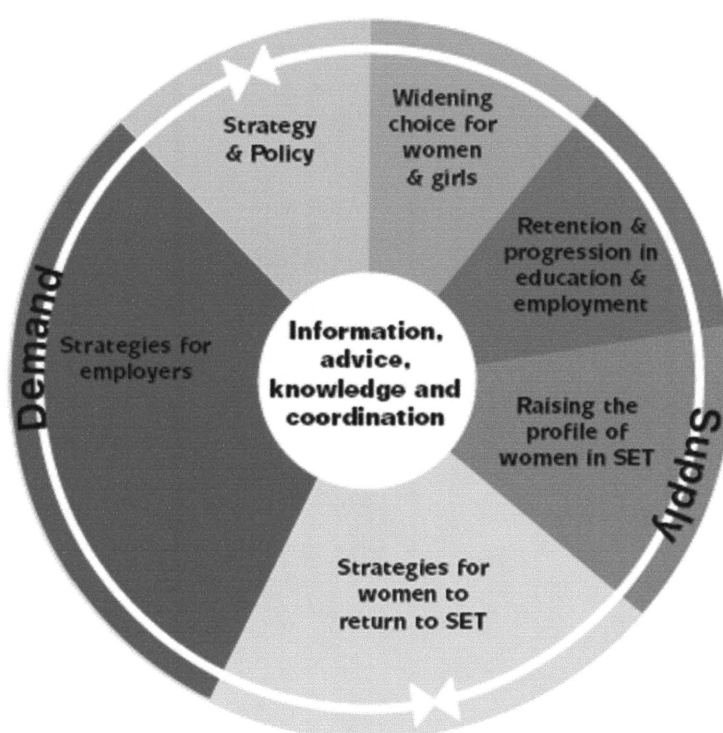


Figure 19: UKRC Framework for Action

(UKRC, 2007)

Undoubtedly central to its success, the UKRC is significant in terms of size, with 23 funded partners, a centre in Bradford with 16 staff members, a London Office, Scottish and Welsh satellite centres and regional hubs in Yorkshire and Humber, the North West and the South East. It aims to take a holistic approach in tackling the system which has erected barriers for

women in SET and consequently offers extensive services falling under the framework for action indicated above. In addition to acting as an advisor to government, business and various other parties, the UKRC provides a resource bank on research, role models, funding, career and academic opportunities. It has significant networking initiatives and a comprehensive mentoring programme. Some of its more innovative approaches include:

- a *free* ten-week online course for women wishing to return to SET careers offered in conjunction with the Open University;
- a *Culture Analysis Tool* (questionnaire) which organisations can use to determine the more intangible factors underlying workplace cultures which may act as barriers to women (the UKRC analyses the responses and issues recommendations accompanied by practical tools to aid improvement – such as training, mentoring and best practice human resource policies);
- funding of *PAWS* (Public Awareness of Science and Engineering) scriptwriting grant scheme for ideas featuring women scientists and engineers in leading TV roles; and
- the UKRC *Quality Mark* based on gender equality and diversity performance to identify employers of choice for women in SET.

Like other resource centres, the UKRC has recognised the importance of reaching out to a broader group, but it appears to have widened the net in terms of what it defines as important stakeholders. In addition to the usual suspects of government, industry and higher/further education, the Centre targets the media, research councils, professional institutes, career professionals and teachers, ensuring a broader take-up of its agenda.

2.8.1.8 Czech Republic

A partner in the European-funded CEC-WYS and EPWS projects, the National Contact Centre for Women in Science (NKC), was established in 2001 under the auspices of the Institute of Sociology, Academy of Sciences, as a grant project funded by the Czech Ministry of Education, Youth and Sports. The Centre's main objective is to improve the situation of female researchers and increase the proportion of women in executive positions in R&D. Acting as an advice and resource centre, the Centre provides, among others, networking facilities for women in SET, information on funding and grant opportunities and legal advice on pay discrimination and sexual harassment (NKC, 2007).

As with other WRCs, the Centre is involved in public policy work both in the Czech Republic, on the European level, and internationally. Its database of female experts is integrated with the CEC-WYS database and facilitates the search of women scientists for participation in

projects, advisory committees, boards and expert panels. Similar to the UKRC's *GetSETWomen* databank (see page 69), it offers "highly qualified women a platform to make themselves more visible" (NKC, 2007). Other awareness-raising projects include:

- the *INFOMAT* portal, a virtual space for university study, science and research which provides information about study opportunities, grants and fellowships, access to professional literature resources, and the ability to create "a place for reflection on one's study and scientific work";
- *Woman of the Month* role modeling featuring successful female scientists; and
- Publication of *Context*, a journal dedicated to the issue of gender and science.

The Centre also organises regular seminars and workshops on gender issues in R&D, and conducts research on a variety of issues, such as the work-life balance, both in the Czech Republic and at the EU level, as part of project consortiums.

2.8.2 Asia

2.8.2.1 South Korea

With its roots in Korean law and funded by the Ministry for Science and Technology, NIS-WIST was established in early 2005. NIS-WIST was set up in response to the declining number of women enrolling and working in the science and technology domain. Although Korea ranks relatively high among OECD countries in terms of the level of women's education, female participation in the SET labour market remains at less than 12% of the workforce. The Korean government believes that, if it can raise this number to one quarter of the total population, Korea's per capita income would be directly impacted, rising to R143,000 (\$20,000USD) (NIS-WIST, 2007). The goal is thus to reach 30% employment rate of women in SET by 2013.

Closely following the work of the UKRC, NIS-WIST's vision is set out in Figure 20. Its ultimate goal is to boost Korean competitiveness by developing and supporting women scientists to enter SET careers – an undertaking which can only be attained by removing the barriers that deter female participation and increasing the number of women in the sector. Under the pillars of public policy, human resources development and information management, NIS-WIST is working to create an environment where women can play a leading role, proposing policy aimed at recruiting and supporting women, centralising female skills in SET and providing world class training and education.

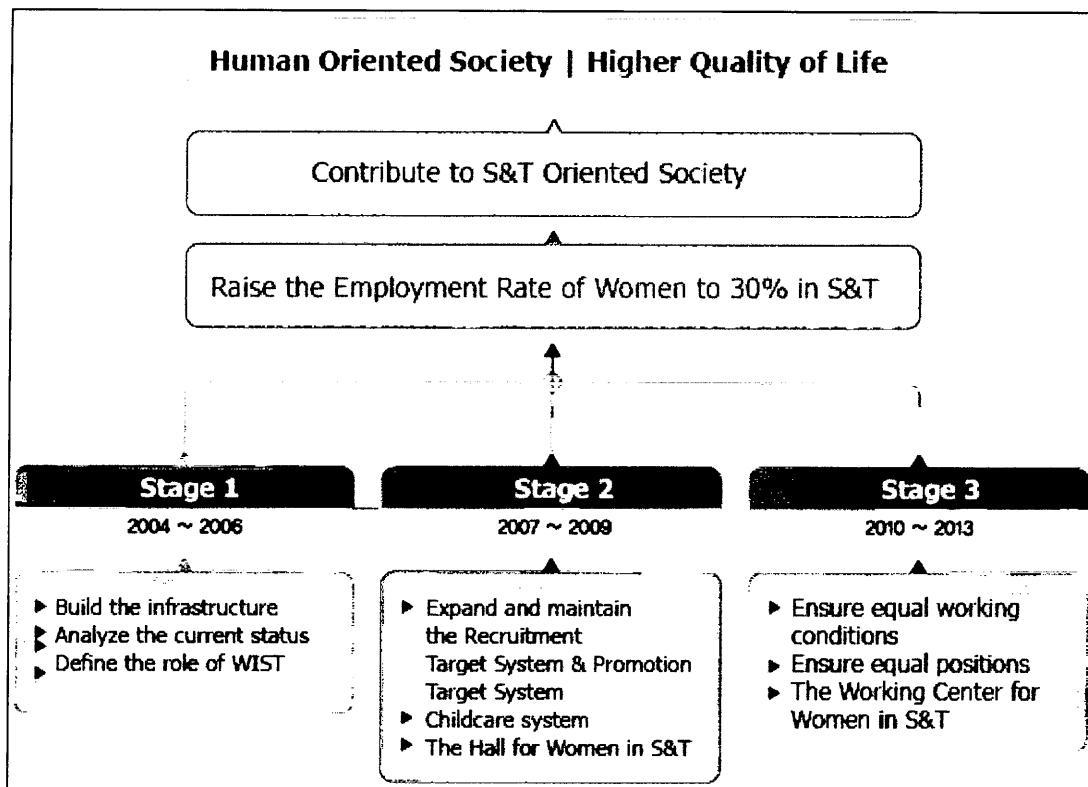


Figure 20: NIS-WIST Vision Statement

(NIS-WIST website)

The Institute's objectives are broken into the short- and long-term comprising the following specific actions for women in SET:

- establishment of an online registration centre;
- provision of innovation funds for organisations promoting female employment in SET sectors;
- development of a tailored employment model;
- provision of courses and training for women returning to SET;
- collection of latest trends in research worldwide;
- promotion of exchanges at international level; and
- development of programmes focusing on leadership, creativity and globalisation.

More long-term objectives include the implementation of a quota to grow female employment and expand women's share of decision-making and governmental roles. NIS-WIST also aims to become financially-independent at some point. NIS-WIST's objectives fall under three core framework areas as outlined in Figure 21. The Institute has implemented extensive projects under each programme. For example, in the area of policy evaluation, NIS-WIST awards organisations with excellent recruitment target system performance results and will analyze existing policies concerning 1) the hiring, employment and promotion of women in SET, 2) an

employment target system for female professors, and 3) representation of women in committees. Under competency development, the Institute offers training on science and technology management, leadership, technical communication and writing, and statistics amongst others. The online registration centre, which NIS-WIST has implemented as part of its information management programme, is also interesting as it aims to build an information management system for women in SET, linking individual “career cards” with a job information system.

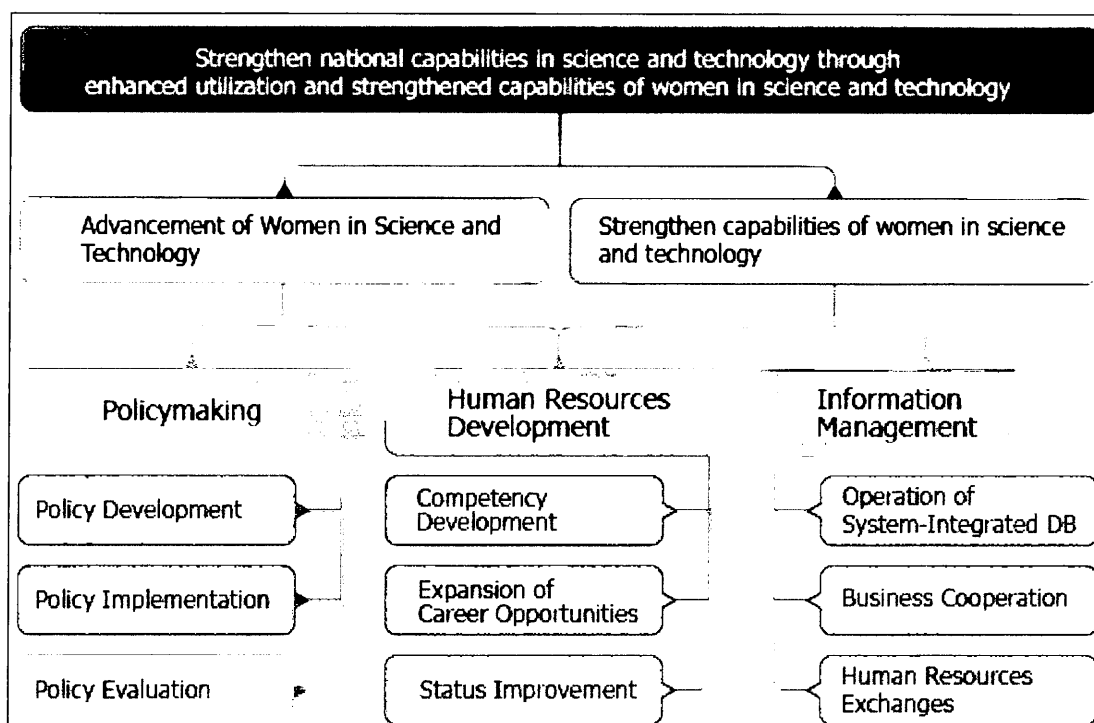


Figure 21: NIS-WIST Framework Programme
(NIS-WIST, 2007)

Like other resource centres, NIS-WIST has an extensive network base and is heavily involved in policy development. Its network extends beyond government to industry, academia, the media and individual women in the SET community. Members of the Institute’s Steering Committee, and Planning and Coordination Committee represent a variety of interests including four government ministries, R&D bodies such as the Korea Institute of Science and Technology and several universities and corporations. The Secretariat is well staffed with approximately 15 employees.

2.8.2.2 India

In the developing country context, India is an interesting example as science and technology has always been an integral part of Indian culture. According to the Indian Department of Sciences and Technology (DST, 2005a), following independence in 1947, the country invested heavily in the modernisation of science and technology capabilities. India's first Prime Minister Pandit Jawaharlal Nehru understood the vital role SET played in enhancing social equity and economic development. This is reflected in his government's Scientific Policy Resolution, over half a century old, which aimed "to foster, promote and sustain the cultivation of sciences and scientific research in the country and to secure for the people all the benefits that can accrue from the acquisition and application of scientific knowledge" (DST, 2005a). The government has recognised, however, that women – while comprising a significant portion of the labour market – have been excluded from SET opportunities.

The DST has established a Women Scientists Scheme targeted at qualified professionals wishing to return to the job market. The scheme, which is basically in the form of scholarships with research grants, encourages female scientists to take up research in so-called "frontier areas" and to participate in SET-based internships leading to self-employment (DST, 2005b). Although there is an Indian Association of Women in IT, an Indian Association of Women Scientists and Engineers, and a Women in Technology Research Forum, little information was readily available on these organisations.

2.8.3 United States of America

Female participation in SET is equally underrepresented in the United States. According to the US National Science Foundation (NSF), women represent half the workforce and more than 50% of all undergraduates, but only 18% of employed scientists and engineers and 20% or less of graduates majoring in engineering, physics, computer science and similar fields (ABI, 2007). Consequently there are numerous initiatives underway to address this anomaly, including work done by the Association for Women in Science¹², the National Research Council's Committee on Women in Science and Engineering¹³, Women in Engineering Programs and Advocates Network¹⁴ and the Society of Women Engineers¹⁵, to name just a few.

¹² www.awis.org

¹³ www7.nationalacademies.org/cwse/

¹⁴ www.wepan.org/

¹⁵ www.swe.org

The picture is depressingly similar for information technology where, although an increasing number of women are using the internet, they are considerably less involved in the development of IT products and services. Two interesting American initiatives, which work to enhance women's participation in technology and have done significant work outside of the US, are CWIT and the Anita Borg Institute (ABI).

Founded in 1998 and the brainchild of the University of Maryland Baltimore County (UMBC), CWIT has a large external advisory board comprising members from industry, academia and government. According to its website (CWIT, 2007b) the Centre has three main objectives:

- 1) to encourage more women and girls to prepare for careers and become leaders in IT;
- 2) to communicate information related to the richness and breadth of women's lives, concerns, and possibilities using technology; and
- 3) to foster research concerning gender and IT.

Despite its small staff of five, CWIT is well-connected globally and conducts a number of impressive national initiatives targeted at young school children, post-secondary learners and women in the workforce, all of which are sponsored by external players such as industry or government agencies. For example, open to both men and women, the *CWIT Scholars* programme provides four years of financial and programmatic support to pursue a bachelor's degree at UMBC in an IT-related field. Another intervention, *ACTIVATE* is a year-long entrepreneurial training programme for women with significant technical or business experience. The programme enables women to use cutting-edge technologies to start up companies; provides coaching by experienced entrepreneurs and access to a network of technical experts, professional service providers and investors; and offers support in the establishment of new businesses. Like other resource centres, CWIT offers a mentoring scheme; hosts events to raise awareness among young learners about the opportunities of an education and career in SET, including IT; and more generally highlights – through external speakers, seminar and other mechanisms – gender issues in IT. The Centre's website has been recognised for its wealth of information on women and technology.

Another not-for profit initiative with global reach is the ABI which provides resources and programmes to help industry, academia and government recruit, retain and develop women leaders in high technology careers (ABI, 2007). Sponsored by high-tech industry, the Institute aims to increase women's impact on technology and vice versa by:

- developing leadership and technical skills through workshops, publications and information;

- celebrating women who are changing the face of technology through an award system (including non-US residents);
- providing programmes that change the way in which technology is created, learned and taught; and
- cooperating with industry to recruit, retain and develop high-tech skilled females.

According to its website (ABI, 2007), the Institute's two advisory Boards are a veritable mix of governmental, academic, civil society, trade association and business players including venture capitalists, entrepreneurs and authors. A staff of 12 manages their main projects: *Systems Online Community*, *TechLeaders*, and various award programmes including: *Grace Hopper Celebration of Women in Computing*, *Women of Vision* and the *Anita Borg Awards*. *Systems'* is a forum of 2,300 members for all women involved in the technical aspects of computing in at least 35 countries around the world. *TechLeaders* is a regular networking forum bringing together women from industry, academia and government. An interesting initiative, although no longer active, the *Virtual Development Center (VDC)*, was a partnership with universities, high-tech companies and community groups which has developed teaching and learning methods to "engage women's perspectives and priorities in the generation of new technologies and applications" (ABI, 2007).

2.9 Summary

Women's experience in SET domains has been broadly negative regardless of career stage or sector in both South Africa and abroad. At university, women tend to enrol mostly in the less-valued disciplines of humanities, arts and education, followed by social sciences and natural sciences (including computing and engineering) as the least popular fields. Moreover, although women hold the majority of undergraduate degrees in South Africa and most OECD countries and there has been a positive change in the number of women graduating with postgraduate diplomas, their numbers decrease significantly as the level of study advances. In the academic and industrial research community, the trend is much the same with women being less qualified than men and clustered in social and health sciences and humanities. In general, women leave science and engineering professions at twice the rate of men.

This so-called "leaky pipeline" between education and employment and throughout a woman's SET career is the result of much-researched barriers such as stereotyping, female and male perceptions of a woman's science ability, work-life imbalance, the male-oriented SET culture and standards of excellence, lack of networks and role models, and unappealing

image of SET as a career choice for young women. While South Africa is in the early stages of investigating possible initiatives to overcome these barriers, many international interventions exist which South Africa can analyse, and assess the potential for local application. These include, but are not limited to role model promotion, the use of formal and informal networks, mentoring, advice and training, scholarships, the creation of sex-disaggregated data, and nationwide centres for women in SET, the so-called WRC organisational model.

CHAPTER 3. RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

WRCs were selected as the preferred organisational model to foster the participation and position of women in SET as they typically address the entire life cycle from education through to employment and career advancement. They consolidate internationally-applied interventions which on their own tend to be less effective but when combined with each other have delivered sustainable results.

This study surveyed six women involved in varying degrees with WRCs in Finland, South Korea, Sweden, the UK and the US. Four of the respondents are either Directors of, or senior managers at, Centres focused specifically on addressing the needs of women in SET (one leans more towards information technology-related aspects), while two respondents head up non-sector specific WRCs. All the respondents have extensive experience in women in science and technology and equality issues more generally.

The study aimed to highlight the context in which each initiative was developed and whether this influences (negatively or positively) the way the Centre operates. It also intended to identify which key stakeholders need to be targeted, the minimum services which should be offered and overall the critical factors necessary for the sustainability of any WRC, namely core competencies, operational resources, leadership, and evaluation and control mechanisms. By sharing their personal experience and knowledge, each woman has contributed to a greater understanding of what is involved in establishing a WRC, the challenges to expect and possible pitfalls to avoid.

3.2 Subjects

Six individuals representing four national and one regional (state) examples were approached to participate in this research. There are a limited number of WRCs which focus specifically on advancing women in SET. While not all existing options were analysed, those selected are repeatedly highlighted in literature; were recommended by those knowledgeable of the subject area; and, most importantly, make publicly available a wealth of information on their organisations. Two non-sector specific examples (Finland and Sweden) were chosen to

supplement the research as their country of origin has a long history in the promotion of equality between the sexes while the individuals themselves have a great deal of experience in the area of WRCs, the interplay of gender, science and technology, and both have cooperated with South African counterparts and government officials on gender-specific projects.

3.3 The research instrument

Research in this report is based on case studies. Although limiting, due to the fact that they are context-bound and based on a small number of examples, case studies provide the opportunity to “describe, understand, and explain”, fulfilling the three tenets of the qualitative method (Tellis, 1997). The case study approach was selected for this research essentially because it was the most comprehensive way to investigate the WRC phenomenon, as an effective intervention to raise the participation and position of women in SET. As WRCs are a relatively recent development, literature offers limited information and, therefore, examining individual experiences and perceptions as they relate to each resource centre is believed to produce the most valuable information.

The technique employed was a questionnaire (see Appendix A) consisting of six sections:

- Establishment phase;
- Stakeholder involvement;
- Services;
- Critical success factors;
- Evaluation and control;
- Other (emerging issues, advice, etc).

Each section included questions encouraging expression of the respondent’s point of view.

This approach was chosen for three reasons. Firstly, half the respondents are not native English speakers and it was suggested that it would perhaps be easier to have some time to reflect before noting the answers. Secondly, as the questionnaire required substantive responses and research was being conducted over the US and European holiday period (June-August), arranging minimum one-hour interviews for approximately 15 individuals was logistically difficult. Finally, the samples were from around the world, making face-to-face interviews impossible. While telephone interviews were an acceptable solution, there might have been poor sound quality, especially where translators, in some cases, had to be

involved. A questionnaire would appear to be an effective means of gathering data, especially as all respondents agreed to be contacted by phone to clarify any open issues.

3.4 Data collection

The questionnaire was sent to five individuals at Directorship level of each WRC. In one case, the Executive Director of CWIT shared the questionnaire with a senior staff member. The questionnaires were e-mailed in early May 2007 and responses received during July, August and September 2007 via e-mail. NIS-WIST opted to translate the questionnaire, answer in Korean and then translate back to English. In the case of the UKRC, a telephone interview was arranged in *lieu* of completing the questionnaire manually. In some cases, follow-up e-mails and telephone calls were made to clarify responses. In all cases, each respondent received a copy of the findings prior to publication and was given the opportunity to comment or edit for accuracy purposes. Respondents were given the opportunity to keep responses confidential but all chose to be quoted directly or indirectly in the report.

3.5 Data reliability and validity

Literature states that ensuring the reliability and validity of case studies is difficult. Nevertheless, using multiple sources of data can help to determine the stability and quality of the data obtained (Tellis, 2007; Riege, 2003). Information about each WRC was obtained directly from the respondents via the questionnaire, but supplemented by annual reports and other communication materials, in addition to presentations made at international conferences and as part of international reports¹⁶. Previously gathered information appearing in the literature serves to corroborate the responses in the questionnaire. All the organisations have well-developed websites, many of which include testimonies from members and network affiliates about the work of the WRC. In the case of the UKRC and NIS-WIST, both organisations are independently monitored by government, the results of which are publicly available.

In addition, pattern-matching is used to analyse the responses in the questionnaire, comparing each WRC's approach against the predicted outcome of what constitutes good

¹⁶ In 2005, the OECD held a conference on Women in Scientific Careers: Unleashing the Potential, in response to a 2004 ministerial request to examine the growing gap of women in high education and the low share of women in the SET workforce. As part of the outcome, a report was issued on good policy practice for the attraction, recruitment and retention of women in scientific careers.

practice in terms of internationally-agreed initiatives to address women's under-representation in SET (see following chapter for more detail). Where the patterns match, the internal reliability of the study is enhanced.

3.6 Data analysis

The data gathered from the questionnaires and follow-up interviews were manually analysed and quotes from each respondent were included to qualify interpretations. As stated previously, pattern-matching was the main approach to interpret whether a model of good practice exists. Possible comparative tables were drawn up to highlight any commonalities and gaps between the observed WRCs. This was possible in terms of stakeholder base, board composition, services offered and cost drivers. For the most part, the analysis was highly interpretative.

3.7 Summary

Although there are a significant number of WRCs which are sector-specific, oriented towards developing women in business, or supportive of unemployed, inactive, immigrant or minority group women, there are only a few examples of Centres which focus on women in SET. Five overseas case studies were examined in an effort to assess the WRC model as an effective intervention to raise the participation and position of women in SET. Six individuals representing four national states (Finland, Sweden, South Korea and the UK) and one US state were approached to participate in this research, based on their prominence in the literature and recommendations by experts in the field. Each respondent at directorship or senior management level completed a questionnaire centred around the following topics: establishment phase, stakeholder involvement, services, critical success factors, evaluation and control, and other (emerging issues, advice, etc). The personal experiences communicated in the questionnaire were supplemented by annual reports and other communication materials, and compared against internationally-agreed criteria for initiatives addressing women's poor participation rate in SET sectors. Although the analysis was highly interpretative, commonalities emerged in terms of how a WRC acquires legitimacy, its stakeholder base, services offered and important elements such as core competencies, partnerships, leadership and the control process.

CHAPTER 4. RESULTS AND DISCUSSION

4.1 Introduction

Literature identifies good practice from around the world on the participation, retention and advancement of women in SET careers. Table 2 below lists mechanisms which consistently reappear across borders at various levels and within different types of organisations. These mechanisms have been endorsed by institutions such as the OECD and the European Commission and such approaches can, therefore, be identified as internationally-agreed standards which, if implemented effectively, could contribute to an improvement in the participation and advancement of women in SET.

Table 2: Instruments for change

Mechanism	Country examples (not comprehensive)
Coaching and mentoring	Germany, Norway, UK
Partnerships with employees	Canada, S. Korea, UK, US
Work-life balance initiatives	UK, Sweden, Finland
Support for returners to workforce	Japan, UK
Funding (e.g. scholarships, bursaries, faculty chairs)	Canada, France, Norway, UK, US
Training, courses and seminars	UK, S. Korea
Recognition awards	UK, US
Awareness-raising	Japan, US, UK
Networking (formal and informal)	UK, Sweden
Disaggregated statistics	Across the EU, US
Promotion of role models	Japan, UK
Strategic policy development	Finland, France, Norway, S. Korea, Spain, UK
Exchange of best practice	UK, US
Career advice	Japan, UK

(Adapted from OECD, 2006:14)

While many of these initiatives are carried out in conjunction with each other, literature shows WRCs are exceptional in their ability to bring most, if not all, of these actions under one roof.

Taking a holistic approach is essential, as tackling only one part in the chain of obstacles would have little impact. The focus must, therefore, be on the entire pipeline from education through to employment and both supply and demand-side. For example, focusing on career advice is useless unless employers are bought into the equation and hiring/promotion policies and procedures are addressed.

Looking more closely at the experiences of individuals involved in the establishment and operation of WRCs (in the US, UK, South Korea, Finland and Sweden) this research report reveals commonalities in terms of legitimacy, stakeholder involvement, services offered, resources required, core competencies and operation, and/or structural design which lend to the success of the Centres and can be replicated as a model for action in other countries.

While only three of the five models (UKRC, NIS-WIST and CWIT) are specifically focused on SET domains, the experiences of the Swedish and Finnish National Associations of WRCs offer valuable insight into efforts to increase the number of women participating in policy-making, business and society more generally. As explained previously, the Swedish model has received a lot of attention, particularly in terms of local and regional development.

4.2 Political context of establishment

Regardless of where the initiative began, the key driving force in the establishment of each resource centre was recognition of the fact that women's participation either in SET fields or policy-making and industry, more generally, was stagnant and in some cases declining. In three of the cases studied, government took the prerogative to launch the centre, while others were initiated by committed individuals (mostly from academia) who sought the support of business and government agencies.

In South Korea, NIS-WIST has its basis in a 2001 framework act on science and technology which spurred a study one year later on developing and supporting women scientists for a knowledge-based society. This study resulted in a 2002 *Act on Fostering and Supporting Women in SET*, driven by the Ministry for Science and Technology. The legislation aimed to increase the professionalism and social adaptiveness of women in SET and develop policy alternatives, while assessing progress regularly. Similarly, following a UK Department for Trade and Industry-commissioned study on the difficulties women face in SET domains, government drew up a strategy for women in SET which included – as one of its key initiatives – the establishment of the UKRC. In the case of Sweden, acknowledging the role

WRCs can play in the integration of gender equality in local and regional development, the government established a coordinating body (the NRC) and annual public funding to support the growing network of centres.

In the US, Dr Joan Korenman, Chair of the Women's Studies Department at the UMBC, an honours research university in Maryland, encouraged the university to fund the opening of CWIT, which soon reached out to other educational institutions, government agencies and industry for support. While in Finland, female academics from Kajaani University Consortium and the University of Oulu have played a central role in the establishment of regional organisations such as the WRC of Kajaani (Woimala) and the Northern Ostrobothnia Resource and Empowerment Centre for Women and Girls (SINNI Centre) and, on the national level, the National Association of Finnish Women's Resource Centres (SNRK).

The context in which a centre is established can have an impact on its operations and success. The South Korean experience of government intervention has been positive, as the legal basis of the *Act on Fostering and Supporting Women in SET* has, according to NIS-WIST Director General Gil-Ja Jhon, "systematically resulted in measures to foster and utilise female resources". She adds that stereotypes about and prejudices against women in SET domains are changing, as more women enter the system and participate in areas where they have not been active previously. Annette Williams, Director of the UKRC, notes that government involvement is highly beneficial, as it sends a message to women, business and other stakeholders that the issue of equality is "centre stage" for government. Having a foundation in governmental action is also advantageous to the extent in which the centre aims to influence strategy, regulations and policy. The UKRC, for example, has the "ear of policy-makers" and has been effective in providing advice on emerging issues and the mainstreaming of gender issues into government strategy. "Regular dialogue allows a two-way of information between the Department for Trade and Industry and UKRC, enabling the Centre to capitalise on existing and forthcoming opportunities to further the 'women in SET' agenda" (UKRC, 2006:20).

Britt-Marie Torstensson, President of the NRC, concurs, as the experience in Sweden shows how government endorsement of WRCs' role in regional development led to a legitimisation of the centres' work and their increased involvement at policy level. In 2004, for example, government determined that the centres' activities fell within the framework of the Swedish national plan for employment. "This provided an opportunity to increase the cooperation between regional employment services within the women's labour market, entrepreneurship and the running of enterprises, health, women and technology and young women's

conditions and possibilities” (NUTEK and NRC, 2005:5). Like the UKRC, thanks to its governmental roots, the NRC has been effective in influencing political authorities, but it certainly does not hurt, as Torstensson points out, that almost 50% of Swedish parliamentarians are female and have lent strong support to NRC efforts. From her perspective, having women in positions of power – particularly on the political level – is critical to the success of WRCs.

However, being part of a large governmental organisation can have its drawbacks, as one respondent noted: “there are challenges in the speed and execution of goals and objectives ... shared resources, space confinements, procurement, requisitions and other daily tasks, and functions are followed using strictly enforced guidelines, standard operating procedures and request for services”. Another problem emerges when too many departments have their fingers in the “equality pie” leading to duplication of effort, competition for resources and the “not invented here” syndrome which diminishes the effectiveness of a WRC’s efforts. Moreover, if the initiative is driven by one government department – for example the Ministry of Education – it can find itself separated from other units which clearly have an impact, such as Industry, Science and Technology or Gender Equality where this might exist. A WRC insider explains: “Just because government has funded a WRC does not mean that all aspects of government machinery will support the Centre ... reducing fragmentation between various government initiatives can often be a political minefield.”

For those centres with strong academic roots, the university network has been very advantageous. Pamela Ezzat, a Programme Director at CWIT, explains:

“There is a great benefit to being part of a large university system inasmuch as access to and partnership with a well-known and skilled academic community affords and supports quality research efforts that, under normal business protocols, may not be as readily accessible.”

Nevertheless, there can be risks where a centre has been established by one driving force and remains under its auspices for the most part. When UMBC was the sole funder of CWIT, Executive Director Claudia Morrell notes the programme’s existence was threatened as soon as there were budget cuts. Moreover, when one funding source dominates other smaller sources, there can be a conflict in direction-setting: “The challenge is to stay focused on the Centre’s primary mission and not to get redirected by funders with narrowed interests. In other words, the mission should drive the funding, not the funding the mission.”

The Finnish experience shows the importance of “being in the middle of the political context”. Marja-Leena Haataja, Chairwoman of Woimola and SNRK, points out that she and her colleagues established the centres almost as “a trade association”, because they were continuously fighting to be heard. All Finnish resource centres are funded by EU monies and consequently find themselves in a permanent “on-off” situation, depending on the availability of funding. According to Butcher (2006:204) the weakness of many initiatives targeted at women in SET is that they are “run for women by women”, voluntary in nature and at the edge of mainstreaming further and higher education institutions. While such interventions may achieve success in delivery, awareness-raising and sharing of good practice, they are limited by their status, size and funding: “the need to address mainstreaming and sustainability of initiatives is usually seen as a key criteria of funding approval, but is not adequately resourced or supported by the sponsoring organisations and difficult to achieve for small projects alone” (Butcher, 2006:204). The key, therefore, is not to work in isolation but reach out to stakeholders and develop relationships with a wide variety of partners, not only in terms of funding, but also engagement with and commitment to the centre’s mission and objectives.

Looking back at their own experiences in establishing a WRC, respondents offered some insight into the main challenges they faced. In the case of the UKRC, government tendered a contract for the establishment of a centre which Williams and her team won. For her, the challenge was to manage government expectations against what her experience told her was necessary to make an impact:

“Timescale was a big issue for us. Government wanted it done as soon as possible, but the project needed a lot of lead-in time – preferably one year – to develop strategies, bring in the right people, create communication and support tools ... this all takes time. You could start small with a website and a two-person staff, but in our case this was not feasible. We didn’t start from scratch as we already had a team of people in place working on other projects. However, this created challenges in terms of refocusing. Moreover, government gave us nine objectives, but we felt this was not the whole picture. In order to achieve long-lasting change, we firmly believed we needed to take a more holistic approach which extended our remit beyond the original nine goals. A final challenge for us was to find people knowledgeable of the issues with experience and the ability to take them forward to employers and other stakeholders. Skills shortage is definitely a key challenge in setting up a Centre.”

Ezzat echoes this focus on skills and experience when she says:

“The hiring and administration of individuals and processes that are familiar and apt at understanding and using state policies and procedures benefits the ability [of CWIT] to achieve work goals and objectives. Additionally, developing and maintaining relationships outside of the State system are important to facilitate mechanisms that benefit both the University and business and industrial relations. Therefore, the hiring of a skilled workforce, utilisation of approved policies and procedures and creating and maintaining relationships as partners with the University all assist in addressing challenges and issues.”

4.3 Stakeholder involvement

Stakeholder involvement varies depending on the size of the Centre but typical key stakeholders are listed in Table 3:

Table 3: Key stakeholders identified

• Industry/business	• Media
• Government (e.g. Ministry of Science & Technology; Labour; Commerce & Industry; Education)	• Professional organisations/trade associations/trade unions (e.g. Institution of Electrical Engineers)
• Higher and further education	• Teachers
• Research councils/institutes	• Women and girls ¹⁷
• International institutions (e.g. OECD, UN bodies)	• Career professionals (e.g. head hunters)

(Based on questionnaire responses)

Stakeholders can be divided into two primary groups: those who partner with the Centre to provide a service and those who are beneficiaries or targets of a particular service. Obviously there is an overlap between the two. For example, UMBC is a primary partner for CWIT as a source of scholarships and host of functions and events but UMBC is also a beneficiary of CWIT's work, as the latter “helps the university achieve its regional and national mission by identifying those areas in science, technology and engineering where women are significantly underrepresented and attracting well-qualified students to UMBC ...”. Likewise,

¹⁷ In order to address the education-employment pipeline, many of the Centres also target young school children and secondary school learners in their campaigns, but this falls outside the remit of this report. The UKRC focuses mostly on post-19 year olds due to the scope of the government's contract, but gives pump-priming funds to organisations which target a younger audience. Additionally CWIT services/scholarships are also open to men, although the main target is women.

for most centres, business provides professional guidance and mentorship, funding and internships, but it is also one of the main beneficiaries of any centre's work, as it gains access to a pool of highly skilled females, networking events, sharing of good practice, recognition and, in the case of the UKRC, specific services aimed at aiding companies recruit and retain female employees. Even women who turn to WRCs – to facilitate their return to work, get a start in the job market, find a mentor or get access to scholarships or bursaries – can often be an excellent resource for the centre as they become role models in publicity campaigns or even mentors for other women and young girls.

In identifying the UKRC's stakeholders, Williams explains that the Centre undertook a stakeholder analysis exercise. Twenty stakeholder interviews were conducted with relevant individuals (such as leading men and women in SET) in order to understand what they hoped to see happen, given the shortage of money and time, in other words what they felt was realistically achievable. Williams explains: "The analysis was important, because it was the initiation of a dialogue with key individuals we felt were stakeholders in the success of the UKRC. In turn, we introduced ourselves to them and the relationship evolved from there."

From her experience at CWIT, Ezzat advises:

To create a Centre for the benefit or purpose or cause that may be determined as needed, it must be created for the good of the cause and not for the benefit of its members. All members must have a specific benefit to the creation of the Centre and the cause must be well-defined and the mission, goals and objectives must be explicitly stated. The number of players will vary depending on the cause, however, the number of players should be varied, diverse, as well as represents a number of schools of thought and should be willing to work as a team for the benefit of the greater good. Ensuring that the players also represent an appropriate level of professional recognition within a given company or governmental agency, as well as an ability to work well with the other elected representatives to reduce redundancy and conflict, but promote healthy competition and respect for others, should also play a significant role in the recruitment of players.

Most of the centres acknowledged the role of a high level or Board of Directors group which, in the words of Morrell, "is critical to our success." By looking at the three centres which are focused specifically on SET domains (UKRC, CWIT and NIS-WIST), Figure 22 illustrates the breakdown in membership of the various high level boards or committees. With 12 members, the UKRC's Implementation Group acts as an "independent watchdog" to evaluate progress

towards the government’s strategy for women in SET. Williams explains that, initially, the Group largely comprised of female academics and “didn’t reflect the range of stakeholders to whom we needed to talk”. As a result, a National Advisory Group was established to offer strategic advice and influence to the UKRC. This Group has 15 members, excluding those from the Centre itself. Membership in both groups is diverse and even within a single category, such as Professional Organisation, a variety of interests are represented (e.g. Engineering and Technology Board, Women’s Engineering Society, the Science Council, the British Computer Society, the Institution of Electrical Engineers and Prospect, a cross-sector professional trade union).

While having different remits, the two advisory groups to NIS-WIST “jointly review the operation and management of the Institute as a whole” (NIS-WIST, 2005:29). In total, excluding NIS-WIST Director General Jhon who sits on both the Steering Committee and the Planning & Coordination Committee, the groups’ membership totals 26 individuals from a wide base of universities, government ministries, research institutes (such as the Korea Institute of Science and Technology and the Electronics and Telecommunications Research Institute) and the Korea Science and Engineering Foundation.

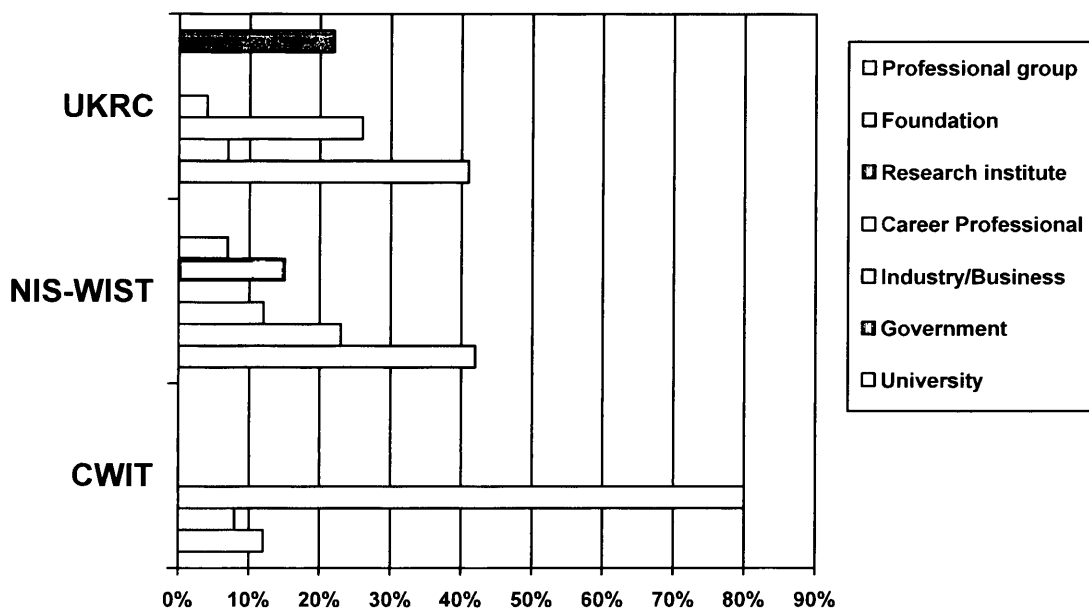


Figure 22: Membership breakdown of WRC high level boards¹⁸

¹⁸ The UKRC’s Implementation Group and National Advisory Group are bundled together as are NIS-WIST’s Steering and Planning & Coordination Committees.

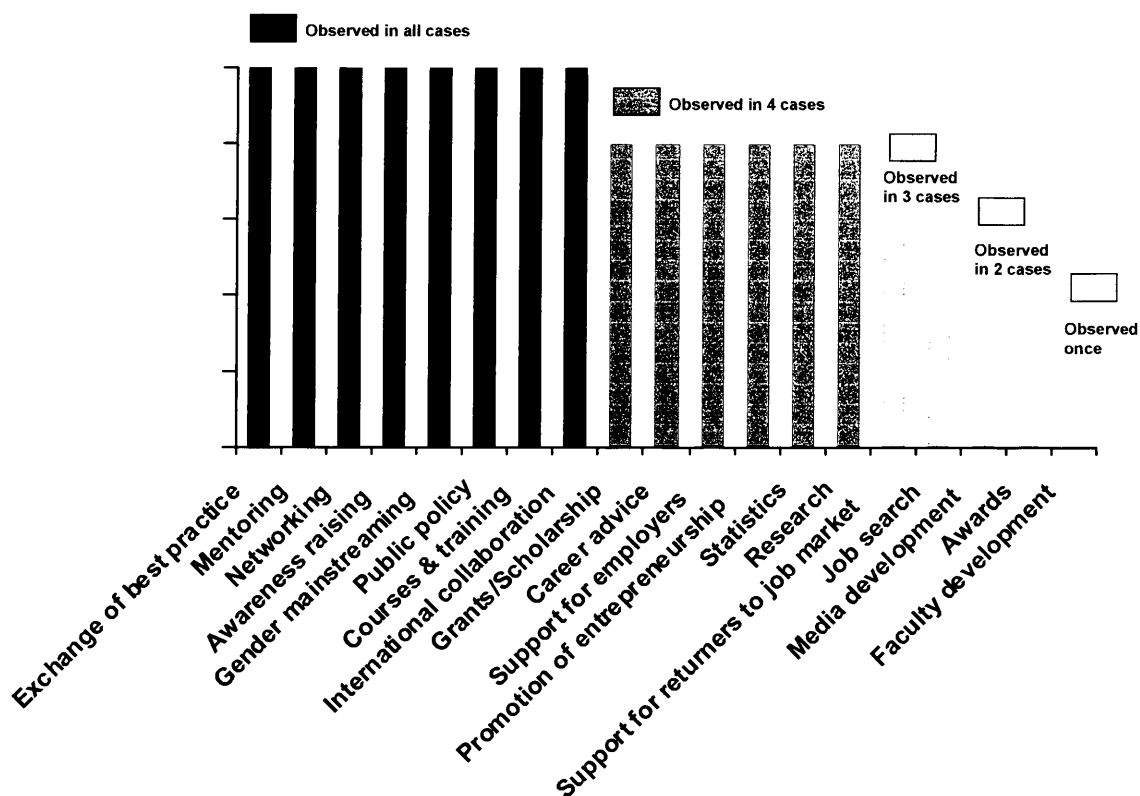
CWIT's External Board provides not just professional guidance, but also funding and programme support and acts as the main point of contact to the IT industry. Members are drawn heavily from industry, but again the category covers a broad spectrum of skills including IT consultants, software developers, representatives of large corporations (such as Xerox, Dell and Cisco) and even a production company to assist in public relations. Morrell notes:

"I think it is critical that you have community leaders on the advisory board and stay away from just friends and peers. Centres need to be run like businesses because at the end of the day they are. Without funding, there is no Centre. So having a clear mission, vision, and objectives will help draw the funding and related support. To get this vision, you need many people involved and be open to all the input to get 'buy-in'. Our Centre hosts business, government and education leaders. From chairing a committee to supporting the mentoring program, to opening doors to other leaders, to taking a group of students out to play golf, our community members are heavily engaged."

Haataja emphasises that it is important to include local players as part of your stakeholder focus as they would "act as mothers and fathers" of the Centre, embracing efforts which address community needs and providing the necessary drive and commitment to attract others partners on board. Torstensson adds that the involvement of, and partnerships between, regional stakeholders is also central to a WRC's success.

4.4 Services

The size and funding of the WRC has implications for the amount and type of service it is able to offer. Nevertheless, by looking at the examined cases, commonalities emerge which are represented in Figure 23 below. Broadly speaking, the services can be divided into four main categories: education and training, policy, employment and career development, and awareness-raising. Services most commonly observed, regardless of the size of the WRC, tended to focus on raising the profile of women (in SET and broader fields), retention and advancement in academia and employment, and overall improving options for women.



**Figure 23: Types of WRC services
(from most to least observed)**

Following are some examples of services offered by the *three* WRCs focused specifically on SET.

4.4.1 Education and training

This is a broad category and covers learners still at university and women who are either employed, unemployed or experiencing an interruption in their careers and seeking further training. NIS-WIST's *Science Communicators' Training Course* is targeted mostly at the unemployed, returners and "even retired professors and senior researchers". The aim is to train high quality science communication experts who find jobs as "science lecturers, commentators, curators and coordinators in primary education, private institutes, business and science museum or parks" (NIS-WIST, 2005:11). The South Korean Centre also offers leadership, financial engineering, and patents and statistics courses, among others. For example, more general courses are available in developing critical thinking and technical journalism. In offering this training, NIS-WIST partners with various universities such as Ewha Women's University, Chungbuk National University and Daegu University.

In promoting training and education, the UKRC also collaborates with network partners. In addition to its own free online SET course offered through the Open University, the UKRC provides access to a wide range of programmes across the UK, Europe and even on the international level. A search function is available on its website which highlights “a range of courses that provide additional encouragement and support for girls and women seeking to enter or to further their career in SET” (UKRC, 2007). This includes courses on business advice, leadership, assertiveness (more generally) and specific programmes such as *Women-Only Introductory Engineering* or *Free Taster Course for Young Women on Computer-Aided Design and Electronics*. Although its funding is limited to projects and initiatives, the UKRC offers advice on the availability of funding and bursaries for postgraduate and degree programmes.

Unsurprisingly with its roots in academia, education and training is a core component of CWIT's work. The Centre has multiple programmes which aim to encourage more women and girls to prepare for careers and become leaders in ICT and engineering. The *CWIT Scholars* programme is a four-year scholarship awarded to high-achieving high school graduates to pursue a graduate degree at UMBC in computer engineering, computer science, information systems, mechanical engineering or a related degrees. Partnering with the NSF, CWIT administers *SITE* (Scholarships in IT and Engineering) which targets women and minorities. Its *ACTiVATE* course provides free training to support female entrepreneurs in their efforts to build successful technology transfer businesses. Moreover, the Centre has designed a course for UMBC entitled *Women, Gender and IT* to aid the understanding of issues relating to the interaction of gender and technology at work. Like the UKRC, CWIT's website offers a wealth of information on fellowships, financial aid and training, among others. Although not a focus of this paper, it is worth mentioning that the Centre does a lot of work targeted at younger students. While also falling under the category of awareness raising category, CWIT's *ESTEEM* (Enhancing Science and Technology Education and Exploration Mentoring) after-school and summer camp, and *Computer Mania Day* programmes are recognised examples of efforts to educate young people on SET and future career prospects.

4.4.2 Policy

Just as CWIT's focus tends to be more education-oriented as a result of its university foundations, the governmental context of NIS-WIST and the UKRC has clearly influenced both organisations' extensive efforts in the area of policy, research, strategy development and consultation. An important objective is to advise decision-makers on public policy and

ensure gender mainstreaming through the provision of gender-based research, women in SET statistics, policy forms and debates, reports, case studies and identification of good practice. As Butcher (UKRC, 2006) notes:

“The Women and Work Commission’s recommendations and focus on gender segregation, the gender pay gap and the barriers for professional women returning to SET careers has direct relevance to the objectives of the UKRC. These are issues that impact at professional levels of SET employment. The UKRC is utilising opportunities to feed our expertise and experience into the government response to develop a more integrated approach to emerging employment and policy actions.”

Consequently, the UKRC has a regular dialogue with the DTI and provides draft responses to Parliamentary questions. The Centre has been involved in numerous governmental consultations and – like NIS-WIST and CWIT – many governmental bodies are represented in its board membership base (see Figure 20).

Research is a particularly important area for WRCs as “ensuring there is sufficient evidence to enable greater understanding is vital to progressing the participation and position of women in SET and the built environment” (UKRC, 2006:22). CWIT also values the promulgation of information concerning women and technology, and its website won the *ABCnews.com* accolade “best resource on women and technology on the web”. It is currently developing an international web portal for research on this subject and five faculty affiliates work through the Centre on NSF, state and corporate-funded projects. Statistics, specifically, are a fundamental pillar of any WRC’s public policy remit. However, beyond a superficial level, statistics are often too expensive to gather. All three SET-related Centres in this study provide statistics as a basic service either on their own (e.g. NIS-WIST’s *Survey on the Utilisation of Women in SET*) or in partnership with others (e.g. the UKRC works with the Institute for Employment Studies). According to Gidlöf-Regnier (2006:53) and Schacherl (2006:113), sex disaggregated statistics are important because they describe and make visible social progress from the perspective of gender equality. Without them, there is little awareness of the situation and, as a result, political action cannot be taken. While many countries have statistics on female researchers by sector, there is little information on qualifications, fields of science, age, economic activity and business enterprise activity. Data measurement of vertical segregation, research funding, pay gaps and participation on research boards, among others, is also missing from most official stats. “Despite the improvements made so far, a significant effort is still needed in data collection at the national level to provide the comprehensive information requested” (Gidlöf-Regnier, 2006:54).

4.4.3 Employment and career development

Like education and training, services falling under this category cover a broad spectrum of activities. As the title would indicate, such services are targeted not only at women seeking jobs for the first time, a return to the workplace or career advancements, but also those who hire them.

In all cases, whether they be in the public or private sector, employers are a key partner for and beneficiary of WRCs. In some cases, the benefit is less direct as business or government partners may – through their involvement in networking events, mentorship or intern programmes – have access to a qualified pool of potential employees. All the observed WRCs share good practice (some even have a recognition scheme for good employers). Therefore, employers can, formally or informally for example, have access to others' experiences with equality and/or family-friendly practices. However, in the case of the UKRC specifically, some of the services are directly targeted at employers. These include, but are not limited to, an information and advice service, workplace cultural audits, best practice / "how to" guides, recruitment and pay gap reviews, and diversity training.

Clearly the most important stakeholder of all WRCs are the women themselves and the main focus in this category of services is on overcoming barriers to entering, progressing in, or returning to SET careers. An effective means "to introduce role models, provide support at times of pressure and facilitate networking", mentoring is a facility offered by all WRCs (UKRC, 2006:10). Mentoring is a core component of many of CWIT's activities such as the *ACTIVATE* programme targeted at female entrepreneurs and *CWIT Scholars* where the latter "have the opportunity to both mentor new UMBC students and to be mentored by UMBC faculty and area business executives." Likewise, the UKRC runs and facilitates mentoring and networking programmes targeted at women with different needs and carried out in partnership with third parties. For example, the *SET for Work* scheme in 12 universities across England aims to retain and support SET students and "inspire them to choose employment or further study in these areas" (UKRC, 2006:10). Other organisations with which the UKRC partners on mentoring and networking, include the British Pharmacology Society, the Institution of Civil Engineers, Lend Lease (a real estate funds management and services business), and the Women's Engineering Society, to name just a few. In Finland, networks and mentorship programmes have been effectively used to promote female entrepreneurship.

In addition to network-building and mentorship, well-resourced WRCs are often able to offer one-on-one career advice and some host job banks or offer referral services where jobseekers can be matched with employers. A good example of this is NIS-WIST's *e-System for Recruitment and Career Management: WIST Career Centre*, where women post their experience online and NIS-WIST consultants and operators provide customer-oriented services (NIS-WIST, 2005:9). Also falling under the education and training category, internships or work-placement programmes are effective tools to help women (e.g. students or those returning to the job market) secure permanent employment.

4.4.4 Awareness-raising

While services in the areas of education and training, public policy, and employment and career development are central to a WRC's goal of empowering women, a core competency must be raising the profile of women in SET (or in the case of Finland and Sweden, more generally in the labour market and society as a whole). If the education-employment pipeline is to be replenished beyond current levels, young women must be inspired to enter and pursue SET disciplines.

Just as mentoring plays an effective role in supporting women in SET, role models are a great way to raise the visibility of women in SET careers and attract young women along similar paths. A simple example is the CWIT *You Can Be Anything* music video or NIS-WIST's campaign to include Dr Esther Park, the first female scientist in modern Korean history, in the national Science Hall of Fame. The UKRC has established a database, *GetSETWomen*, to provide the media and other organisations access to thousands of women at various stages in their SET careers. Members of the database have registered their details and can be approached for promotional and work-related opportunities (e.g. speaking events, providing comment in scientific news coverage, or sitting on public boards and committees). As one database member commented: "If you want to get ahead, visibility is so important these days. Get your science and brilliance out into the open and all else will follow. The database is one way of making sure that the relevant people know exactly how good you are, no matter where you are in your career journey" (UKRC, 2006:14).

Awareness-raising also comes in the form of fund-raising events, workshops and speakers' series such as CWIT's efforts to bring distinguished speakers to UMBC to address gender and IT issues with students. CWIT's Morrell has also been highly effective in reaching out to international organisations to share good practice and raise the profile of women in ICT on the global level. Likewise, recognising the importance of international collaboration in

successfully fostering women in SET, Jhon has established NIS-WIST relationships with the UKRC, the International Conference of Women Engineers and Scientists and other international players. All the WRCs target the media in their marketing and communication campaigns and use the internet as a key tool in disseminating information, resources and links.

When asked if there were additional services which – should resources be available – might be offered, Williams highlighted an important stakeholder who she believes is currently under-serviced by the UKRC:

“Because of the importance of the entire education-employment pipeline, we would like to place a greater emphasis on addressing people who affect career choices for women. This is core to what we do, but within this area there are things we cannot afford. We would very much like to implement a whole strategy to shake up the career advice sector. We also would hope to deepen incentives for employers to embrace part-time and flexi-work for female SET professionals, and establish a national forum for female students in SET domains to network undergrads or post-grads to address the attrition that occurs at every level.”

Haataja would be eager to see the extension of services in Finland to women with young children at home, women who would like to start their own business and older women who would benefit from networking and training. Jhon also has several plans on the horizon including the establishment of a Women Scientists Hall, the extension of recruitment and promotion target systems (see page 77), and new initiatives to provide childcare support for scholars and improve equality of working conditions.

4.5 Critical success factors

4.5.1 Core competencies

In trying to identify critical success factors for a WRC, it is useful to start with core competencies. As in business, good strategy execution would only result when the necessary competencies and capabilities are developed, upgraded and modified as the market evolves (Thompson, Strickland and Gamble, 2007:368). In order to be successful, a WRC must therefore identify what bundles of skills and know-how it can exploit to make a difference.

Williams states that the UKRC's core competence is "having a deep knowledge and experience of what works in practice ... engineers, scientists and educationalists comprise a fundamental part of our work base, and collaborate with other organisations to increase skills and resources ... we have a high level of awareness around gender-equality issues". Ezzat, Torstensson and Haataja affirm the value of being specialists of gender issues and gender impact assessment, but the latter two add that, in a developing country context, having a strong understanding of rural area issues (including rural business development and logistics) and experience in training, mentoring should also be a key competence. Morrell highlights CWIT's ability to "target new projects, filling gaps and moving forward with targeted goals to support women in the IT pipeline ... our competencies relate to all aspects of developing strategies to achieve our goal from fundraising to friend-raising, building programmes, evaluating them and disseminating them. We also promote the good works of others." In the case of NIS-WIST, Jhon identifies two key competences, namely the ability to leverage its relationship with the government and the university network to provide extensive professional training at a low cost, and its public relations machinery which has drawn considerable attention from the Korean SET community and the media. In the case of Sweden, Torstensson adds that WRCs are viewed as innovative systems focussing on different skills, including women and technology, entrepreneurship and business development. Because NRC is a network organisation, it has built up a competence bank in these areas and more generally WRC models and their role in regional and local development, for growth which it shares on an extensive basis both inside and outside Sweden. Torstensson notes: "The WRC model from Sweden can always be implemented in other countries because it is an open model that can be adjusted and used from different countries' perspectives and legislation." South Africa is one country which has benefited from the NRC's experience.

4.5.2 Partnerships

Thompson, Strickland and Gamble (2007:369] argue that core competencies and competitive capabilities in business emerge from collaborative efforts. They note the importance of thinking about which activities of which groups need to be linked and made mutually reinforcing, and identifying where necessary collaboration should be forged – both internally and with outside resource providers. Like a company which aims to build an organisation capable of good strategy implementation, each WRC observed has either had its roots in partnership or has reached out and built relationships with other stakeholders to help the Centre deliver on its objectives.

An actual partnership of several universities itself, the UKRC makes extensive use of external organisations and subcontractors to deliver services and enhance the work of the Centre. For example, its collaboration with WISE ensures that girls of school age (not a direct target of UKRC's own services) are encouraged to take up SET-related courses in school or university and move on into related careers. "Creating cohesion, avoiding duplication and maximising effectiveness is at the heart of the work of the UKRC as we take this important agenda forward," observes Williams (UKRC, 2006:4). Likewise, in addition to the university network, CWIT works closely with many government agencies (e.g. the NSF) and relies heavily on its business partners and over 300 volunteers who are essential to the Centre's strategy execution. In advising those who might wish to establish a WRC, Morrell emphasises "partnership, partnership, partnership ...", words echoed by Haataja and Torstensson who urge finding collaborators at all levels – locally, nationally and internationally. Equally, Jhon acknowledges in NIS-WIST's annual review (2005:2) "a key to the organisation's success within such a short period was generated from the partnership shared in terms of policy, finance, facility and administration support from the Ministry of Science and Technology, Korea Science and Engineering Foundation, Ewha Woman's University and members of SET government boards and committees."

4.5.3 Resources

Due to the different level of resources observed in each WRC, relating directly to sources of funding and national versus regional or local focus, it is not useful to compare one against the other. Typically the government-initiated Centres appear to have significantly greater resources in terms of staff and budget. For example, the UKRC (a national initiative) – as part of the effort to respond to regional priorities and thanks to European Social Fund support – has opened multiple resource centres across the country, including Wales, Scotland, the South East, North West, Yorkshire and Humber regions. NIS-WIST's secretariat has at least 13 staff members while the "very trim" CWIT only has five full-time employees "with part-time staff ranging from one to five depending on services needed, with an additional five to six people needed on a part-time basis", according to Ezzat. As previously mentioned, a weakness of many peripheral initiatives targeted at women in SET is that centres are limited by their status, size and funding. Haataja concurs, as her experience of struggling to secure funding shows, that "very often we underestimate the need for resources". Partnership is one means to overcome this but then, as Morrell advises, it is necessary to sign memorandums of understanding (MOUs).

All UKRC financial support comes from national government or EU funds. Although its budget is more than £6.7M (R98M or €9.8M)¹⁹, Williams felt that a *national-level* WRC could achieve a great deal with a minimum of £2.5M (R36.5M or €3.7M). She also mentioned the opportunity of seeking to commercialise UKRC products and services (e.g. consultancy services) in order to become more self-sufficient.

Torstensson emphasises the necessity of securing basic funding of WRCs on the national level as “a pre-condition for legitimacy as political support also means money”. The NRC estimates that – at a very basic level – *regional* resource centres should receive SEK1M (R1.1M or €108,000) in government funding. The NRC itself requires SEK2M (R2.2M or €216,000) for horizontal coordination alone (NUTEK and NRC, 2005:5). Swedish WRCs are well financed with SEK51M (R55M or €5.5M) set aside in 2006 for funding of administrative and project needs.

Having shifted its funding away from the university (about \$62,000, R443,000 or €43,000) and with more than 90% currently coming from non-state coffers (about \$863,000, R6M or €621,000)²⁰, Ezzat notes the difficulty CWIT faces in terms of developing and maintaining resources (human, programmatic and financial): “Efforts to identify, use and outsource business services when needed while working to develop and maintain a competent and secure staff are always a balancing act with priorities changing from year to year.” No information was available on NIS-WIST’s budget.

As the observed WRCs vary considerably in terms of their size and budget structure, it is also not useful to give a breakdown of resource usage. However, Figure 22 gives a simple indication of where a majority of the available budget goes. In all cases, staffing, infrastructure and marketing/communications (including awareness raising activities) are the biggest cost drivers. Depending on how the budget is structured, individual programmes or projects might be financed under their own budget lines or form part of an overall category. For this reason, Figure 24 provides only a simplistic overview.

¹⁹ According to the UKRC website: <http://www.setwomenresource.org.uk/en/home/about>

²⁰ According to the 2007 CWIT Annual Report, as received from C. Morrell

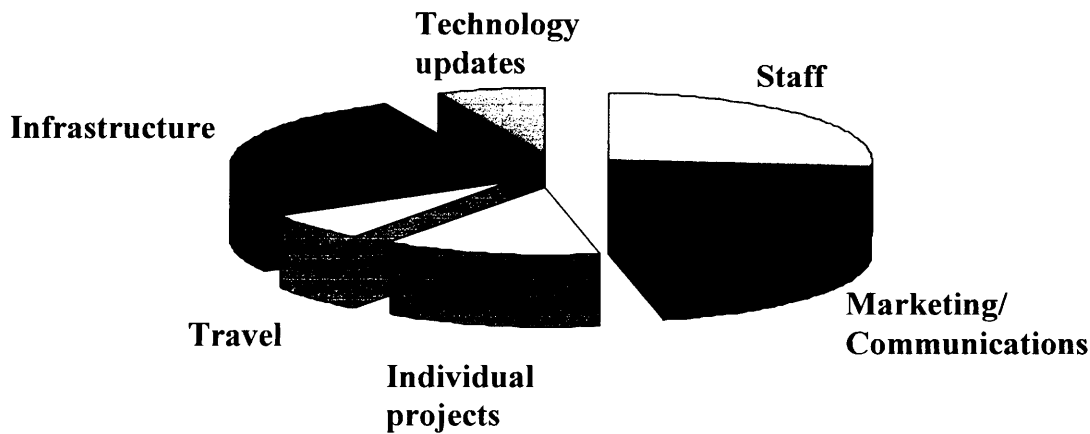


Figure 24: WRC main cost drivers

4.5.4 Other

When asked to identify other factors which should be taken into consideration when establishing a WRC, some interesting commonalities emerged. All respondents cautioned about the importance of pragmatic goal-setting and strategic focus. In the words of Williams: “Be clear on your objectives and what can be achieved realistically; be clear about what your stakeholders hope to see emerge ...”. This goes hand-in-hand with her advice to “always take account of grassroots action where great solutions emerge ... it’s important that it not be a top-down approach”. A similar message is given by Ezzat who says:

“As with all things, setting up centres requires funding. In efforts to begin the process, it may be important for those at the beginning to not only think creatively, but to make sure that their efforts are grass-root and not so robust that they cannot obtain reasonable goals and objectives. Taking more time in the forefront to plan for the success of the Centre is as important, if not more important, than the beginning stages ... Look for partners to share the finances as well as the planning for the centre. Look to augment what already exists and don’t waste time reinventing the wheel.”

Ensuring strong leadership of the organisation either in terms of the individual driving the process, or advisory board members, was also highlighted as a key to success. Leadership must set the vision and drive it forward. As with any corporate leader, there must be passion and determination and strong support from an effective management team. On a more personal note, Morrell adds:

"There are two unexpected elements I have learned in my job that surprised me, but by talking to others I realise are 'part of the job', yet they are areas seldom mentioned. First is that building a Centre can be a fearful endeavour. Sleepless nights and anxious days are part of the job. Second, as a woman, I find I am sometimes disliked for doing things that men do and that no one would question. As a 'business owner', I need to do what is best to achieve the goals of the Centre and this can mean tough decisions For leadership, understand what it is. It does not always emerge from people in power. Women and men have different leadership styles; none is better than the other. Avoid stereotypes. There are more differences among women than between men and women. Be open to sharing and be careful of those who are not willing to let others benefit. Be careful of judgements. We are all part of the same culture – equally influenced by it and equally able to change it. And remember the words of Margaret Mead – 'Never doubt that a small group of thoughtful, committed individuals can change the world. Indeed it is the only thing that ever has'."

Finally, it is important that the Centre has an empowerment perspective, as Torstensson argues, "the WRC is a democratic tool for women's participation". In the guidelines NRC issues to describe the working methods of WRCs, it emphasises that:

"The mobilisation of women's own resources shall be an important base for the work of the centre. To take responsibility over one's own life and work is a fundamental idea. Women who seek support from the centre shall not be 'taken care of' but rather get guidance towards self-help." (NRC, 2006b:3)

4.6 Evaluation and control

As was clear from the "words of wisdom" offered to those who might seek to establish a WRC, the emphasis on strategic focus, realistic goal-setting, collaboration, leadership and empowerment would indicate that these non-for-profit centres stand to benefit from many strategic management concepts employed by business. While it is important that not-for-profit organisations have a clear idea about their vision and how it would be achieved, it is equally critical that they put an evaluation and control process in place to measure success. According to Ehlers and Lazenby (2007:276), strategic control forms the backbone of continuous improvement. It incorporates the feedback function to both strategy formulation and implementation and enables the organisation to better align itself with its environment in order to improve the effectiveness. It evaluates whether the results produced by the strategy

are in fact those that were intended for and focussed on long-term outcomes. Ezzat qualifies that “a good evaluation plan should be incorporated as part of the initial planning process – not after implementation – to chart how well you are doing”.

According to Butcher (2006:204), “some of the issues for the performance and impact of the UKRC relate to the lack of comprehensive baseline data and the disaggregated statistics for the private sector in particular”. This is a problem common to all WRCs. As previously stated, most countries do not have extensive data on female qualifications, fields of science, age, economic activity and business enterprise activity in SET fields. In the interim, until such statistics are available, the observed WRCs have employed various approaches to measure their effectiveness. At CWIT, “every project has an evaluation component to measure the impact of activities on overall success in achieving its mission” (CWIT, 2007a:9). This is conducted via an independent evaluator. Overall, Morrell confirms that the balanced scorecard approach is used to evaluate all aspects of the Centre and its work on an annual basis. Some recommended measures of whether CWIT is meeting its strategic objectives vis-à-vis its mission include:

- the number of UMBC women who designate an IT course of study, including mechanical engineering;
- the percentage of women in UMBC IT-related graduating classes, as compared to other institutions;
- the number of students who participate in CWIT-sponsored activities;
- the number of partnerships with external organisations.

CWIT also measures financial and human resource goals, and internal business processes using a balanced scorecard.

Morrell and Ezzat are happy to report progress in terms of programmes targeted at young learners. For example, an evaluation of the *ESTEEM* programme has shown an increased interest from middle school girls (and boys) in SET and IT-related subjects “with eight of the 16 indicators of success statistically significant and all 18 are positive”, while “data collected as part of the *ACTiVATE* program indicates that there has been an increase of almost 50% of new technology start-up companies per year in Maryland, all run by women. The university has also seen an increase in female enrolment in its freshman class: from 23% in 2006 to 41% in 2007”. Overall, Ezzat notes: “the events and programs supported by the CWIT office have had and continue to have outstanding attendance and self-promote further opportunities via a viral network of participants ready and able to spread the word about the Centre and the event topics as timely, informative and innovative”.

The UKRC has two separate evaluations. One is to be carried out through the government-nominated Implementation Group while a second internal evaluation, conducted through an independent evaluator, examines processes and considers outputs and impact. It is near completion and expected by the end of 2007. Williams believes these evaluations would reveal that the Centre has had a significant impact:

"We are moving women into jobs. The Return Campaign infrastructure, for example, has directly helped 300 women by moving them into further training or employment. This is easy to measure because they came to us as unemployed. Our objective is to build on that momentum and refine our support to these women. We want to add a further 400 women to this group."

She adds that it is much harder to measure the progress being made in business. While the Centre has more than 270 links with major employers and the *Quality Mark* recognition scheme has "taken off", it is typically difficult to quantify UKRC's impact on workplace practices and other qualitative issues.

As NIS-WIST has its basis in legislation, namely the *Act on Fostering and Supporting Women in Science and Technology*, a target system was established along with the Act to measure progress in the public sector. Implemented by the Ministry of Science and Technology since 2001, the *Recruitment Target System (RTS)* applies to national, public and government-supported research institutes. In clarifying the status of women in SET sectors, the RTS shows employment figures for 99 government-supported SET research centres, public and private academia, and public and private industries. It also indicates the number of women with SET bachelor, Master's and doctoral degrees and their share of total degrees awarded. The Ministry of Education and Human Resources has introduced a similar RTS for female faculties in 46 Korean universities which has been in place since 2003 (NIS-WIST, 2005:6).

Although there is no legally-binding obligation on Korean business to improve the recruitment, retention and progression of women, as of 2005, firms are required to "report the status of hiring male and female employees based on occupational categories and positions" (NIS-WIST, 2005:8). Like for most WRCs, it is difficult to access comprehensive data in this regard. The Institute has taken a leaf out of the UKRC book and opted for a recognition scheme which raises the profile of corporate good practice. It also introduced an internship pilot which it can measure in terms of on-the-job and NIS-WIST-provided training. Finally, as a key component of its strategic control process, the Institute carries out an annual survey on the *Utilisation of Women in Science and Technology* as part of its research agenda. The

survey, first conducted in 2005, examined workplace practices including the recruitment, employment and promotion of women in national, public, government-affiliated and government-invested research institutes, national and public universities and 200 private organisations. The survey is an important feedback mechanism because the results "... will be reflected in guidelines for establishing yearly municipal, provincial and government policy plans for fostering and supporting women in science and technology" (NIS-WIST, 2005:27).

4.7 Summary

International institutions such as the OECD have recognised and approved many national mechanisms to improve the participation, retention and advancement of women in SET careers. WRCs are unique in their ability to bring together many, if not all, of these interventions and to leverage their synergies in breaking the chain of barriers facing women in science and technology. In examining five WRCs from Europe, the US and South Korea, important commonalities emerged. The context in which a centre is established can have an impact on its operations and success. Government endorsement and involvement often legitimises the Centre's work and facilitates its ability to influence policy, while having strong roots in academia provides easy access to highly-qualified trainers and research.

Although there are drawbacks to government-driven and academic-driven approaches, a WRC with no foundation in, or partnerships with, these communities is unsustainable in the long run. By looking at a Centre's stakeholders, universal actors were identified in all cases, with an overlap existing between those who partner with the Centre to provide a service and those who are beneficiaries or targets of a particular service. There were also a lot of parallels in the type of services offered which fell mostly into four broad categories, namely education and training, policy, employment and career development, and awareness-raising.

Finally, every WRC examined highlighted the importance of developing core competencies, employing partnerships, securing sufficient and renewable resources, setting achievable goals, having strong leadership and implementing effective evaluation and control mechanisms to ensure the Centre's outcomes are aligned with its strategy.

CHAPTER 5. CONCLUSION

5.1 Introduction

In today's knowledge-based economy, SET is pivotal to economic growth. As in many places across the globe, the shortage of qualified individuals, paralleled with the growing demand for skills in SET-related domains, is also a threat to South Africa's productivity, level of innovativeness and competitiveness. Untapped female potential can fill this gap. And yet literature shows the extent to which South Africa follows the world's example with respect to the participation and position of women in SET domains in both public and private spheres. Although women represent a significant proportion of South African researchers, as indicated in the recent National Survey of Research and Experimental Development, this does not provide a complete or totally accurate picture of women's progress in SET (DST 2006b). They are horizontally segregated into more traditional, less valued and less R&D-funded disciplines, such as biological or health sciences; vertically segregated in terms of the level of position they tend to dominate in the academic world or in management more generally; and contractually segregated in that they are less likely to receive tenure and more likely to be on short-term or part-time contracts.

If the South African government wishes to achieve its goal of a NSI which "brings about maximum human capital, sustainable economic growth and improved quality of life"²¹ it must address the country's poor record in the recruitment and retention of women in SET careers. The recent success of achieving a rate of innovation well above the European average of 42% will certainly be difficult to maintain in future years (DST, 2006a). There are simply not enough candidates in the country's "traditional talent pool" to meet South Africa's human resource needs.

5.2 Conclusions on the research proposition

This research aimed to identify initiatives outside of South Africa's borders which promote women's participation and position in SET sectors. Focusing mainly on WRCs as the preferred organisational model as it brings together many forms of intervention under one roof, the primary objective of the study was to analyse the critical success factors of a limited number of Centres and to suggest a possible model of good practice for South Africa.

²¹ DST mission at <http://updated.dst.gov.za/about-us/vision-mission/vision-mission-and-corporate-values>

There are many initiatives which support women entering, staying and excelling in SET environments, such as:

- promoting role models;
- creating formal and informal networks;
- using scholarship/research grants to draw more women into non-traditional SET fields;
- linking female entrepreneurship initiatives with those targeted at women in science;
- evaluating public programmes that promote women in science to ensure results are fed back into the system's design; and
- improving the creation of sex-disaggregated data.

While the OECD and other international and governmental organisations recognise these and other initiatives as important and effective features of any effort to improve the situation of women in SET, *on their own*, these initiatives are not sustainable. They neither take the entire lifecycle approach of addressing education through employment and career management, nor do they consider supply and demand side-needs. Often, they are merely efforts to “patch up” the leaky pipeline. This report argues that one approach, namely the establishment of resource centres for women in SET, is more effective as it brings many of these internationally tried, tested and approved initiatives together and takes a more holistic view in dismantling the barriers and filters that control and impede progress of women in scientific, engineering or ICT careers.

While the WRC concept has been around for well over a decade in many countries, particularly in Northern Europe, the idea to establish resources centres, focused specifically on women in SET, is a relatively recent phenomenon. This report has examined three specific examples, namely the UKRC, NIS-WIST in South Korea and CWIT in the US, along with the more general experiences of non-sector specific WRCs in Finland and Sweden, in an effort to develop an understanding of the WRC model. While the approaches are all very different, varying in terms of focus, resources and reach, commonalities have emerged in terms of legitimacy drivers, stakeholder involvement, services offered, required resources and other critical success factors.

For starters, the political context in which the WRC for women in SET evolves is a key factor. The initiative has to be mainstreamed and, although centred around the principle of empowerment, has to avoid the “run for women by women” trap. The need for the centre must be recognised at a very high level, as serious commitment is needed to change the

status quo. The WRC requires political support and a broad stakeholder base, including – but wider than – industry, to ensure legitimacy and, while it need not necessarily be a government prerogative, the state has to be involved and sponsor the initiative beyond just providing financial support.

Government involvement is beneficial because it places the issue centre stage and sends a message to women and the entire SET community that this is a serious issue of national concern. Having government on board also facilitates efforts to influence policy and develop new education and employment strategies. However, there can be shortcomings in government participation which should be acknowledged and addressed up front. Bureaucracy and governmental control can slow the process and dampen innovative and creative solutions. Moreover, if too many departments are involved, initiatives can become fragmented leading to duplication or lack of synergy. On the other hand, if key departments are left out, then the initiative may be sidelined or overlook useful experience and knowledge. Either way, the result is lack of effectiveness. Academically-rooted WRCs, or those with strong university affiliation, can also be advantageous in terms of access to qualified skills and resources which support research and training efforts. As educators and potential employers of women in SET domains, institutions of higher learning should play a critical role in WRCs. However, in the case of South Africa, it is important to bear in mind that universities and the research sector do not have as well-established functional links with government and the private sector as might be the case in more developed markets. The process of implementing sustainable partnerships for innovation is ongoing and, consequently, any academically-driven initiative to establish a WRC must take this into consideration to ensure a fully integrated and legitimate solution.

Whether driven by government, academia or other players, the crucial point is to find a balance and not get sidelined by a narrow focus or interests particularly in direction-setting. A good way to avoid this is to ensure a broad base of stakeholder involvement. While this also contributes to a good take-up of a WRC's agenda, a wide but relevant stakeholder base is beneficial particularly when consulted on strategy formulation (e.g. board level) and used as a source of guidance and advice for the Centre. As done in the case of the UKRC, conducting a stakeholder analysis can be helpful in understanding a WRC's target audience, but more importantly in defining objectives and managing expectations. The setting of realistically achievable goals, as defined by a well-managed strategic process involving multiple stakeholders, was a feature common to all observed WRCs.

When identifying stakeholders, it is important to create a win-win or give-and-take approach. Each stakeholder must stand to benefit from the Centre's work, but should also be a contributor to the effort. The most common stakeholders appear to be:

- industry/business;
- government (e.g. Ministry of Science & Technology; Labour; Commerce & Industry; Education);
- higher and further education;
- research councils/institutes;
- international institutions (e.g. OECD; UN bodies);
- media;
- professional organisations/trade associations/trade unions (e.g. Institution of Electrical Engineers);
- teachers;
- women and girls; and
- career advisors and professionals (e.g. head hunters).

It should be emphasised, at this stage, that this report was limited in its original remit. It focussed mostly on initiatives targeted at women already at a certain level in their career (i.e. graduates or women with previous job histories). However, young girls are clearly an important stakeholder and interventions targeted at early childhood education are necessary if a WRC is to take a holistic approach in tackling the entire education to the employment pipeline. The problem is that this in itself is "a whole other story", as one respondent noted. A way around this would be to collaborate with partners who have expertise in this area and the necessary resources to take on the issue. Strategic alliances and partnerships are in fact a critical success factor of any WRC, as tackling barriers to women in SET is not something a Centre can take on in isolation.

In terms of core competencies needed to ensure strategy execution, while most WRCs appear to have a high level of expertise in gender equality and mainstreaming issues, what is most important is to understand how the institutional advantage can be gained and sustained and to invest in this. It could be done by providing the best training or mentoring programme or simply being highly effective in leveraging alliances or other networks in business, government or academia. Clearly, competencies and capabilities can only be developed with the right people on board. Therefore, a crucial driver of any WRC's success is skills. The Centre's staff must be familiar with the issues, preferably have a background in SET domains, be educationalists and strong communicators capable of building up partnerships

and retaining stakeholder support. As in business, strong leadership at board level, and of the Centre itself, is also important in terms of strategy implementation and effectiveness.

With respect to services, a lot depends on available resources. While each of the observed WRCs had varying levels of assets depending on their national, regional or local focus, it is clear that – in order to be effective and considered legitimate – a Centre should be sufficiently resourced. Like having insufficient political support, if a WRC constantly has to seek out funds it is an indication that the initiative is not mainstream enough and therefore, unsustainable. A figure of R36.5M was touted as more than adequate for a *nation-wide* programme and, in collaboration with other partners, enough to cover the main cost drivers of a Centre, namely staff, infrastructure, marketing and projects falling under the following areas:

- promotion and exchange of good practice;
- networking events / conferences;
- gender mainstreaming;
- courses and training;
- promotion of entrepreneurship;
- career advice and job banks;
- recognition awards;
- awareness-raising (including role models);
- mentoring and coaching;
- lobbying/public policy support;
- grants and scholarships;
- collaboration with the media;
- international collaboration; and
- research and statistics.

While often expensive, statistics are a fundamental tool in directly monitoring the impact a WRC's initiatives have on gender equality, for one cannot control and change what one does not evaluate. As a professor observed: "if you wish to have policy, you have to have competent statistics. No statistics, no problem, no policy. You just get gestures" (UKRC, 2005:1). Therefore, developing comprehensive baseline data on female qualifications, fields of science, age, economic activity and business activity in SET is essential. Although all the WRCs focused on women in SET are in "early days" of development, they each have measures in place to monitor their effectiveness. Clearly, having the right measurement criteria and indicators in place *before one begins the process* is fundamental to continuous

improvement. This is particularly difficult in the private sector, as many firms are wary of gender-monitoring beyond a superficial level, but nevertheless it is not an impossibility. While there is a limited amount of information available on women in SET in South Africa, the research commissioned by DST and SARG, and ongoing research at CREST at the University of Stellenbosch²², is an excellent foundation.

5.3 Implications of the study

Although commonalities are evident in the various WRC models other nations and regions have developed to address the under-representation of women in the scientific education and careers, there is no exact, off-the-shelf blueprint of what constitutes an effective resource centre for women in SET. But this is not a bad thing. It is important to understand the context in which SET is applied in developing countries. While there are numerous examples where South African research is at the technological frontier (e.g., solar energy, nano-technology, optical astronomy), in many cases it is more about adapting existing innovations to enhance growth and development. Consequently, any initiative to establish a South African WRC for women in SET must also be imbedded into development programmes at the national, provincial and local level. As cited in this report, gender issues are firmly in place on the South African agenda and the political will is present to act. In fact, there are a number of public and private groups, organisations and government bodies which look at the different elements of the women in SET life cycle, but so far these “many small efforts do not seem to be resulting in the impacts needed to make a large difference in the country” (James et al, 2006:96). Particularly as no current example exists in the developing country context, South Africa consequently has the opportunity to create its own customised approach, based on the country’s unique needs and situation, integrating experiences and advice from those who have gone before.

5.4 Limitations of the study

As previously stated, this report did not examine, in any great detail, interventions targeted at pre-university education or those with developmental objectives (e.g. using technology to empower disadvantaged women). In the South African environment, both aspects would be fundamental to the work of a WRC, due to government focus on education and skills and the

²² CREST is in the process of developing a monitoring and evaluation framework to benchmark the performance of women in the National System of Innovation. For further details, see pages 23-24 of James et al.'s report at <http://women-in-ict.meraka.csir.co.za> [accessed 12 December 2006].

fact that a large majority of the population lives in poverty. In South Africa, the discussion about and analysis around a WRC would have to be disaggregated on a racial basis – given the unique history of the country. Moreover, this study was limited to only five national initiatives – all in developed markets – and based on qualitative questionnaires. The research is therefore context-bound and needs modification and further analysis in order to be applicable to the South African experience.

5.5 Suggestions for further research

This research uncovered some interesting common factors lending to the effectiveness of various WRCs for women in SET. However, as these findings are based on the input of those working in each Centre, it would be important to conduct a quantitative analysis of the impact of the observed WRCs' efforts to lend more credence to the effectiveness of such an organisational model. Additionally the results of this report should be tested against qualitative research targeted at key members of each WRC's stakeholder base (e.g. women who have used the services, employers, government, university or the media). Moreover, as there is only a limited number of SET-specific Centres in the world, the sample could be extended to the WRC model more generally. This could be done to understand whether these commonalities are shared on a broader basis by national, regional or local bodies aiming to improve women's participation in political, economic and social life. WRCs focusing on women and entrepreneurship, of which there are many, would be a useful case to examine from the South African perspective.

For the findings to be relevant in South Africa, further research could be conducted into other developing country models, whether they are WRCs or different approaches, India being a potentially good example. It would also be useful to see how other developing nations embed SET into development programmes and how gender issues are integrated in the process.

Finally, a thorough analysis of the status (baseline study) of South Africa's initiatives in addressing women's participation in SET against the critical success factors or attributes of a "successful" WRC would be useful. Moreover, the problem of available baseline data was mentioned in this report as a limiting factor to the evaluation of a WRC's success. The work being done by CREST on a monitoring and evaluation framework for benchmarking women's performance in NSI is crucial. Measurement criteria are fundamental to the identification of problems and barriers and the effectiveness of their proposed remedies. While CREST's framework covers nine constructs, it does not address possible (voluntary) indicators for SET

employers to assess whether their attraction, recruitment, promotion and retention practices are fair to both sexes and help identify possible shortcomings in the human resources process.

5.6 Summary

In conclusion, this research has achieved its purpose of identifying interventions outside of South Africa to promote the inclusion and progression of women in SET, focusing particularly on resource centres for women as the preferred model which consolidates internationally-endorsed interventions while addressing the entire life cycle. The main findings of this report relate to commonalities in terms of how each Centre has achieved legitimacy, the stakeholder base, services offered, required resources and other factors critical to each WRC's success. It is hoped these key learnings might provide a useful point of departure for an initiative to tap into the great female potential in South Africa's SET community, helping to alleviate the skills shortage and unleash creativity needed for the country's sustainable global competitiveness.

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APPENDIX A

Questionnaire

If you are unclear about the meaning of a specific question, please state so in your response. If the question is not relevant, please indicate N/A (not applicable). Where necessary, please attach supporting material.

As a first preference, please type in your answers and send via email to lisalindy@yahoo.com; alternatively you can fax your written response to: +30 2810 391 408, attention Mrs O'Donoghue-Lindy or send it via post (least preferred option) to:

Lisa O'Donoghue-Lindy
c/o ENISA
P.O. Box 1309
Vassilika, Vouton
Heraklion, Crete 71001
GREECE

ABOUT YOU:

NAME: _____

ORGANISATION: _____

RELATIONSHIP WITH CENTRE: _____

_____ Yes, I am willing to be quoted directly in the results of the research

_____ Yes, I am willing to be contacted for a telephone interview to follow up my answers

_____ No, please do not contact me for a telephone interview but if you have questions about a reply, please contact me on email

EMAIL: _____

TELEPHONE: + _____

_____ Please send me a copy of the final research report

