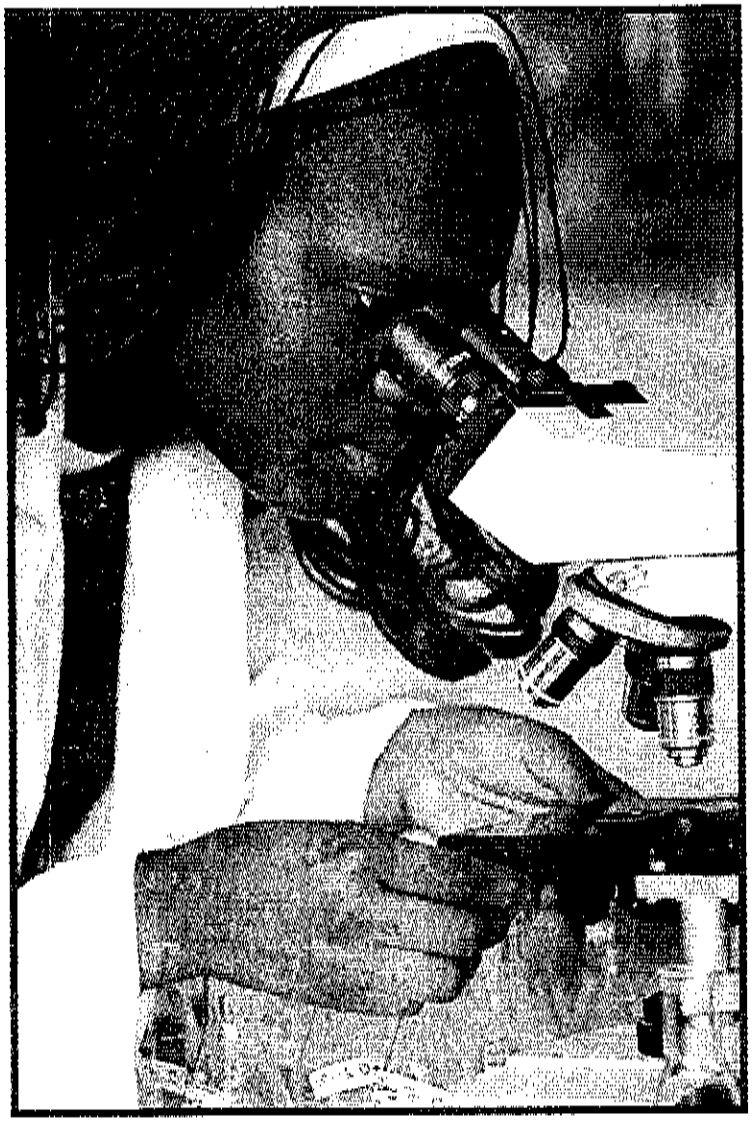
DRAFT REPORT 2 FOR WOMEN IN INDUSTRY PROJECT: 20 October 2006

An assessment of the participation of women in Industrial Science, Engineering and Technology in South Africa



Human Sciences Research Council
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EXECUTIVE SUMMARY

Context of the study

- Since 1994 the South African government has developed policy guidelines for women's empowerment in all spheres of life (e.g. *South Africa's National Framework for Women's Empowerment and Gender Equality*[1]) and legislation that seeks to promoted women's participation in the Science and Technology sector (e.g. the *White Paper on Science and Technology*). Also, the *Employment Equity Act* seeks to ensure to ensure that people from previously disadvantaged groups (e.g. women, blacks and people affected by disability) are given equal opportunities in terms of their participation in the labour market.

- The *Human Resource Development Strategy for South Africa*, the *National Research and Development (R&D) Strategy* and the *National Plan for Higher Education* are some of the key national instruments that were designed to drive the development of highly skilled personnel in various sectors of the South African economy.

- However, these broad efforts do not address specifically the issue of women's participation in the SET sector, nor do they focus on the need for both women and men to benefit equally from SET research, products and services. A number of studies commissioned by DST/NACI/SET4Women have highlighted several critical challenges that exist in South Africa which must be addressed at policy level in order for women to participate in and benefit equitably from the SET sector. These studies include in-depth interviews with university students and graduates in Science, Engineering and Technology disciplines, focus group discussions on the needs of women in the SET sector, consultative conferences on women in the SET sector and e-mail discussion forums. The findings from these studies will culminate in the development of a gender equity policy for the SET sector in South Africa.

- The HSRC (Gender and Development Unit) was responsible for the overall management and co-ordination of the some of the projects. The Gender and Development Unit was also tasked with the responsibility of using findings from the above studies to develop, together with the DST and other stakeholders, a gender equity policy for the SET sector in South Africa. It was in this context that the Gender and Development Unit undertook the quantitative and qualitative assessment of the participation of Women in Industry in the Industrial Science, Engineering and Technology sector on behalf of the South African Reference Group on Women in Science and Technology (SARG).

- The stated aim of the assessment was to "... determine factors contributing to or inhibiting [women's] participation" in the SET sector of South Africa. In particular, the project objectives were as follows:

  - Undertake an environmental scan to determine comparable research in South Africa and internationally in this area. This entailed conducting desk research on international best practices with respect to women's participation in the SET sector.

  - Quantify the number and status of women SET workers in companies with a sizeable technology base. Among other things, this quantitative component of the project provided information relating to issues such as the level of qualifications, fields of study, years in the industry, personal experiences and percentages of women within each of the aforementioned SET sectors.

  - Identify gaps in gender representivity in industry and the key workplace factors blocking progress. Questions relating to the first part of this objective (i.e. gaps in gender representivity) were included in the survey while the factors blocking progress were explored using a qualitative method.

[1] Published by the Office of the Status of Women (2001)

- Develop a best practice guideline document with regard to gender equity mainstreaming for the relevant technology intensive SOEs and private sector companies and produce a comprehensive report for submission to SARG including all the compiled databases. Using information on the international best practices on women in the SET sector as benchmarks, as well as findings from the quantitative and qualitative studies described above, a best practice guideline document and the report was submitted to SARG.

Section 1: Literature on women in industrial SET

- Research on the experiences of women in various SET workplaces in South African has revealed a number of poignant factors that must be addressed if these workplaces are to become more attractive for women with SET potential. It is important to point out from the outset that there is a considerable degree of diversity in terms of the specific experiences of individual women across SET workplaces, institutions, and SET disciplines. However, at a macro-level, similarities do exit with variations being more apparent in terms of magnitude, severity and impact on the women involved.

- Of particular interest is the need to address the existing gender imbalances in the SET sector of South Africa through a systematic process that ensures women's full participation in and benefit from the SET sector. Once a policy framework has been adopted and agreed on by all stakeholders, specific manifestations within each sector, institution or discipline can then be addressed at a micro level.

- Some of the challenges facing South Africa in terms of issues in the SET workplace include the following:

  - To put in place mechanisms and processes for dealing with the negative impact of recruitment practices and processes that currently favour male SET graduates as well as deal with the false perceptions prevailing across the SET sector regarding women's suitability for and competence in SET jobs and careers.

  - To ensure that discriminatory workplace practices are eliminated as they are a violation of women's human rights in the workplace.

  - To devise strategies that will ensure that women working in the public and private sectors of SET are not treated differently from their male counterparts in the allocation of work-related resources.

  - To ensure that the gender imbalances in terms of family roles and responsibilities are addressed so that they do not continue to impact negatively on SET women's ability to balance their time between family and work commitments.

  - To ensure that SET women's needs during pregnancy and maternity leave do not compromised their opportunities for professional growth and development.

  - To develop and implement specific strategies for ensuring that senior women and men in SET are equipped with gender-sensitive mentoring skills and serve as positive role models to young women scientists to enhance their professional growth and development.

  - To develop effective strategies for ensuring that women scientists, engineers and technologists are actively involved in decision-making bodies and processes, both at an organisational as well as national level.

  - To put in place a funding mechanism that targets women as specific beneficiaries both in terms of women's education in SET disciplines as well as their entry, retention and advancement in SET careers.

Section 2: Methodology

- The research question posed in this study: What are the factors that contribute to or inhibit women's participation in the SET industry of South Africa? was investigated with both quantitative and qualitative methodologies. Potential participant companies from private, JSE listed, SOEs or SMMEs were chosen and approached for permission to collect data about the topic of the research.

- In order to address the research question two objectives were identified. Objective 1 serves to examine the gaps in gender representivity in industry. A quantitative methodology, in the form of a balanced score-card questionnaire that required information about women's participation in each of the companies, was sent to an identified contact person in each company to complete. A statistical analysis was performed on the data. Due to the limitations of the information provided by participant companies and the fact that the weighting procedure for gender equity assessment within the SET sector of South Africa has not yet been formulated and agreed to at a policy level, a full balanced scorecard for each company could not be computed. A summary of the information gleaned from the data with respect to some of the key indicators that would form part a balanced scorecard is presented in the report.

- Objective 2 was to determine the factors contributing to or inhibiting women's participation in the SET sector of South Africa. Both quantitative and qualitative methodologies were employed. The latter used in-depth interviews and the former used a survey method (specifically questionnaires) to gather data. The in-depth interviews (qualitative) gathered comprehensive verbal – or textual - expressions of women's experiences and perspectives of their participation in the SET industry from the most senior woman in the industrial SET company as well as the company's CEO or his or her designate. The questionnaires (quantitative) captured numerical (mostly) ratings of women's (with a SET background) experiences in each company. A thematic analysis was performed on the data from the in-depth interviews and a statistical analysis was performed on the data from the questionnaires.

Section3: Presentation of findings

- The gender representivity survey demonstrates that women continue to be under-represented in the SET sector and specifically in the industrial context. Some of the main findings are as follows:

  - Only one company reported having a gender equity policy.

  - Women are better represented at the lower levels of the sixteen industrial SET companies that formed part of the survey.

    Only one of the companies has a female leader (CEO).

  - Women of colour are less well represented than white women in these companies at all levels, and especially at executive and management levels.

  - Shareholding by women is low in the companies who participated.

  - Although some of the companies are spending large amounts on social development and other strategies that encourage women's participation in industrial SET, information about women beneficiaries has not been recorded by all of the companies.

- The responses to the statements on the questionnaire are categorised into the following types of experiences: Feedback on work performance, Remuneration and promotion opportunities, Work environment, Gender relations in the workplace, Mentorship and career development, Race and gender in the work environment, Implications of a career on in SET for family life, Experiences in the SET industry.

- The findings show that although most of the women's experiences are universal, some individual differences are apparent across age groups (in terms of the life-cycle approach, type of industrial SET context and level of seniority in the organisation)

- The in-depth interviews focused specifically on the three categories essential to this study: recruitment, retention and advancement of women in industrial SET. The findings highlight that most factors (favourable and unfavourable) were raised in the context of retention (40) followed by recruitment (22) and then advancement (21). Interviewees thus focussed mostly on retention as being favourable or unfavourable towards women's participation in the SET industry. Also, 30 factors can be identified as favourable to women's participation while 51 factors can be identified as unfavourable to women's participation.

- Senior management was also asked about the policies and strategies at their companies. The interviewees did not commonly discuss policies specifically addressing gender issues. Both men and women did not regard them as important, especially at SMMEs. Furthermore, incorporating issues for women into a gender policy is constructed around women as child-bearers, i.e. what maternity leave benefits exist. Interviewees at SMMEs perceive having policies like sexual harassment policies to be linked to the size of a company and so because they see themselves as 'small' they do not see it as necessary to have these kinds of policies in place.

- Four types of strategies to support the implementation of policies are community-based strategies, workplace strategies, partnerships and bursaries and learnerships. Factors contributing to or inhibiting women's participation in specific organisational contexts (private, JSE listed, SMME or SOE) are presented as themes with direct quotations from the interview transcripts.

- The integration of the findings from the gender representivity survey, the questionnaires and the in-depth interviews presents the following themes about the data:

  - Discourses of difference between men and women
  - Women are not a homogenous groups
  - The masculine image of science
  - Women's increased participation in the SET industry must be a natural evolution
  - Inequality of men and women in industrial SET
  - Allocation of responsibility for increasing women's participation in industrial SET

Each of these themes is discussed critically with regards to the literature and best practice in increasing women's participation in industrial SET.

Section 4: Recommendations to increase the participation of women in industrial SET

- Recommendations to increase the participation of women in industrial SET are made for industry as well as national government, universities and funders of entrepreneurial projects.

- The major nodes of intervention according to the findings of this study are: Ensuring that funding reaches as many women as possible, creating an accommodating work environment for women, creating networking opportunities that do not rely on activities traditionally used by men to do business, debunking the masculine image of 'the scientist', conducting research and monitoring the progress of women in industrial SET. Finally, a policy needs to be formulated and implemented to address the issue of women's under-representation in the SET sector.

- It is therefore commendable in the light of the challenges that women face in the SET sector that government has taken the initiative to formulate a gender equity policy that addresses women's lack of participation across the SET sector, from school to the workplace. Furthermore, it is crucial to monitor and evaluate the policy's impact on women's participation. For example, although

SOEs have risen to the challenge of compliance with gender equity requirements, an important challenge remains for departments such as DST and DTI to bring private and JSE listed companies to comply.

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1 CONTEXT OF THE STUDY

For South Africa to remain globally and technologically competitive, positive steps must be taken to address existing gender imbalances in the SET sector in order to create a diverse, well-trained and innovative SET workforce that can spearhead economic growth, wealth creation and the improvement of quality of life for the people of South Africa. One of the major challenges confronting the new, post-apartheid South Africa is that of delivering increased economic growth, wealth creation and improved quality of life for all its citizens. Critical to addressing this challenge is the need to increase the rate and quality of innovation in Science, Engineering and Technology (SET).

A second and more potent factor contributing to the shortage of skilled personnel in the SET sector of South Africa is the failure to harness and utilize the SET potential of women who constitute over 50% of the national population. Studies commissioned by the Department of Science and Technology/NACI/SET4Women[2] have all clearly demonstrated the under-representation of women in the SET sector, particularly at senior levels and, in specific fields within the sector. For example, the CREST report[3] recounts that although in 2001 women represented 53% of all higher education enrolments, only 31% of Doctoral enrolments in the Natural Sciences and Engineering were female. Only 7% of Doctoral graduates in engineering were female. The study also showed that only 9% of instruction staff and 14% of research staff in engineering were female, while female scientists received only 21% of all research grants awarded by the National Research Foundation (NRF). Of particular concern is the fact that less than 6.4% of all publicly funded research projects were identified as having an explicit 'gender dimension'. It can be deduced from these statistics that, despite the marked increase in women's entry into the higher education system of South Africa during the past decade, women remain under-represented within the natural sciences and engineering. The bottleneck gets even smaller at higher degree levels, particularly in the field of engineering. This means that only a small proportion of South African women end up working in the SET sector.

The Women in Corporate Leadership Census Women (Business Women Association and Catalyst, 2004) shows that women who enter the SET industry are also under-represented at senior levels given that approximately 60% of all companies have no women board directors. The study measured the number of women on boards in executive management of every listed company on the Johannesburg Securities Exchange (JSE), as well as 17 of the largest state-owned enterprises for the first time in South Africa. The results revealed that of the 3125 directorship positions held, women hold only 221. Only 11 women hold chairs of boards out of a total of 364. In addition, there are only seven women CEOs and/or MDs in comparison to 357 men. The results also indicated that State-owned enterprises (SOEs) outperform JSE Securities Exchange–listed companies by a significant margin.

Globally, it is recognised that research and innovation within the various Science, Engineering and Technology (SET) fields can make significant strides towards improving the quality of life and wealth creation opportunities for women. The kind of research envisaged by this proposal would implement the sentiment of Kahn (2004) that "the stark imbalances in gender and racial representativeness in the science and technology system ... requires urgent attention". A point made by Mario Ramos, group chief executive of Transnet, in the Women in Corporate Leadership Census (2004) is also relevant in terms of why the current research needs to be conducted. She remarked: "Unless you measure, you do not know where you are going or how you are going to get there".

[2] See for example the Facing the Facts report published by the Department of Science and Technology/NACI (2004).

[3] Facing the facts: Women's participation in Science, Engineering and Technology (2004), published by the National Advisory Council on Innovation (NACI) and the Department of Science and Technology (DST).

Increasing the number of women in the national system of innovation is both a human right as well as a development issue. South Africa faces a range of challenges in the building of a social order, which speaks to the needs, and the development of all its citizens. Challenges such as gross disparities between rich and poor, high unemployment rate, the HIV/AIDS pandemic have in a sense "forced" the public and private sectors to create demand for innovation in an attempt to deal with the double challenges of economic competitiveness and social development (Abrahams & Galant, 2005). The latter authors argue that one way to address the issue is to grow a national knowledge base which is able to create and sustain levels of innovation which contributes to annual GDP per capita growth as well as ensure scientific and technological innovation is of benefit to the poor.

The stated goal of the Department of Science and Technology is " ... to establish a gender equity policy for the Science, Engineering and Technology sector within South Africa's National System of Innovation (NSI) which will inform the sector's initiatives with respect to gender equity mainstreaming". This goal is consistent with South Africa's National Policy Framework for Women's Empowerment and Gender Equality prepared by the Office of the Status of Women in 2000. This framework specifies the key institutional processes, role players, key partners, and mechanisms required to achieve gender equality in both the public and the private sectors of the South African economy. A gender equity policy for the SET sector is an essential element for realisation of the goals enunciated in the national policy framework for the empowerment of women and achieving gender equality in the workplace.

The National R&D strategy recognises the critical importance of nurturing human capital necessary for a robust NSI, and also articulates the numerous challenges confronting South Africa in this regard, including the fact that the South African scientific population is aging and shrinking, while our proportion of 1.9 researchers per thousand workers is comparatively low (NACI, 2005). The consequence of aging and shrinkage is a shortage of highly skilled workers in the fields of Science, Engineering and Technology (see for example Lawless, 2005). Another of the factors contributing to the shortage is that of outward mobility of R&D workers (see Kahn et al., 2004).

The Department of Science and Technology (DST) is currently involved in a series of studies on issues affecting the effective recruitment, advancement and retention of women in the SET sector in South Africa. These studies include in-depth interviews with university students and graduates in Science, Engineering and Technology disciplines, focus group discussions on the needs of women in the SET sector, consultative conferences on women in the SET sector and e-mail discussion forums. The findings from these studies will culminate in the development of a gender equity policy for the SET sector in South Africa.

The HSRC (Gender and Development Unit) was responsible for the overall management and co-ordination of the projects. The Gender and Development Unit was also tasked with the responsibility of using findings from the above studies to develop, together with the DST and other stakeholders, a gender equity policy for the SET sector in South Africa. It was in this context that the Gender and Development Unit undertook the quantitative and qualitative assessment of the participation of Women in Industry in the Industrial Science, Engineering and Technology sector on behalf of the South African Reference Group on Women in Science and Technology (SARG).

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4. Develop a best practice guideline document with regard to gender equity mainstreaming for the relevant technology intensive SOEs and private sector companies and produce a comprehensive report for submission to SARG including all the compiled databases. Using information on the international best practices on women in the SET sector as benchmarks, as well as findings from the quantitative and qualitative studies described above, a best practice guideline document and the report was submitted to SARG.

The report is divided into four sections. In Section 1 a review of the literature on the participation of women in Industrial Science, Engineering and Technology is presented. It briefly examines two theoretical perspectives on the lack of women's participation in SET before turning to a discussion of the gender of engineering and information technology respectively. Some specific barriers experienced by women, such as sexual harassment, working time constraints and family commitments, are highlighted. The section is concluded with a reflection on best practice that would increase women's participation in SET as well as how gender policies could achieve this. Section 2 contains a description of the research design of the project. The design is presented first followed by an explanation of the sampling techniques that were used to identify potential companies and individuals to participate in the research. Then each of the quantitative and qualitative methods with their attendant data gathering instruments is outlined. The analysis techniques that were used on the data are also discussed. Some challenges encountered during the research conclude this section. In Section 3 the findings from the analyses are presented which include the results of the gender representivity survey (in the form of a balanced score-card), the questionnaire survey and in-depth interviews. Section 4 contains recommendations, based on the findings and literature, to increase the participation of women in the SET industry. These suggestions relate to universities, government, funders and the industry itself.

2 SECTION 1: LITERATURE REVIEW: The Participation of Women in Industrial Science, Engineering and Technology

2.1 Introduction

This review examines literature on women's participation in Industrial Science, Engineering and Technology (SET) both internationally and locally. In particular, this review looks at the specific issues that affect the recruitment, advancement and retention of women in the SET sector. While there is considerable literature on women in SET available from the United States and the United Kingdom, there is a paucity of literature on the South African SET sector.

Although women have made strides and are continuing to grow in number, women still remain under-represented in the SET sector. Research conducted by the European Commission (2003) reflects that despite the increase in women's educational attainment in the EU member states during the last 20 years, the number of women in industrial research is lower than in other sectors. In 8 of 10 EU countries, women constitute between 18% and 20% of all industrial researchers. Furthermore, it appears that women participate more substantially in industrial research areas which focus on health, social work and financial intermediation. Both international and local literature confirms that as a result of many factors, women in Industrial Science, Engineering and Technology are generally inhibited from participation in the SET sector. Constructions of gender differences appear to be one of the main factors highlighted in all the literature, with the European Commission (2003) highlighting that women frequently are forced to choose between family and children, and a professional career. As a result of this forced choice and most employers' traditional perceptions of 'mothers' as limited in their performance capabilities, SET loses out on the potential of talented female scientists, engineers and technologists. Similarly, research conducted in SET industries in Australia (1995) highlights that SET is consistently constructed as a masculine arena which excludes, marginalises, alienates and isolates women within the industry.

In order to understand the inhibiting factors experienced by women in SET, a discussion of theoretical perspectives is necessary.

2.2 *Statistics of Women in SET*

Women remain underrepresented in SET globally. Careers in Science, Engineering and Technology have been chosen by more women today and account for half of the Bachelor Degrees conferred. In the United Kingdom, of the 44% of Masters degrees and 37% of PhDs conferred in SET, women only comprise a quarter of the Science and Engineering workforce. In 1997 in the USA, women received 18.7% of the Bachelor's degrees, 19% of the Masters degrees and 12.2% of the Doctoral degrees in Engineering (Engineering Workforce Commission, 1998). Most European countries have fewer women in Engineering - Denmark (6.4% female Engineers); Ireland (2% female Engineers) and France (5% female Engineers). In South Africa in 2001, the situation of women in SET compares quite favourably with the European Union: 35.7% of doctorates in Science are owned by women in South Africa while 30.5% of doctorates in Science in the European Union are owned by women (NACI & DST, 2004: 5).

Despite these successes, women still lag far behind. It appears that the more advanced the level of study in SET at universities and technikons, the fewer female enrolments. In comparison to 69% men enrolled for doctorates in the Natural Sciences and Engineering in 2001, women comprised only 31%. In terms of graduations in Engineering, the situation is similar, with 7% women graduating with doctoral degrees compared to 23% men (NACI & DST, 2004). In addition, although women's participation has increased in the public SET workforce over the past decade, they still occupy fewer spaces than males in the sector – this includes academic staff in universities as well as R&D staff in science councils. In 2001, the proportion of female academic staff was 40% in comparison to 60% male staff, while female R&D staff in the science council sector accounted for 42% compared to 58% male staff. While these are improvements since 1992, the majority of these women were white and located in the Social Sciences and Humanities, rather than the Natural Sciences and Engineering (NACI & DST, 2004).

From the above statistics it is evident that gender plays an important role in the (lack of) participation of women in SET.

2.3 *The Gender of Engineering*

According to Evetts (1998: 283) "engineering and management in Engineering are archetypically men's careers". This is the prevalent mindset in most facets of the engineering industry. The requisite qualification for employment in Engineering is a degree in Science, Mathematics or Engineering. Although there have been changes recently, women continue to be a minority (4.6%) in the Engineering industry (Evetts, 1998). Engineering is perceived as a masculine profession and consequently women entering the profession are regarded as intruders and cannot expect the same privileges afforded to their male counterparts. It is difficult to ascertain the impact of gender on SET in South Africa as a result of the dearth of literature on the subject. Some possible reasons for the under-representation of women in SET in South Africa are provided below.

2.3.1 Cultural Problems

Cultural norms around gender constructions result in gendered divisions of the public/private sphere. This often means that women's responsibilities revolve around the home while men are expected to go out to work (Serugamo & Kotze, 2004). Closely related to cultural problems is the "power position in the gender and technology debate which appeals to the understanding of the social context within which particular gender constructions and particular technologies appear" (Faulkner, 2000: 90). Faulkner (2000: 90) claims that "both technology and hegemonic masculinity are historically associated with industrial capitalism; they are linked culturally by themes of control and domination".

Noble (1991) explains that historically it has been man's quest to gain control and domination over nature (in Faulkner 2000), thus the "mastery of nature remains a powerful emblem of technology" both within Engineering and the wider culture (Faulkner, 2000: 90). Consequently technology is perceived as a "masculine culture" (Wajcman, 1991). Faulkner (2000) posits that it is essential to explore in-depth the relative links between gender structures (occupation and education), gender symbolism (cultural associations between masculinity and technology), and gender identity (how people see themselves as women and men) in the gender-technology association.

2.3.2 Hegemonic Masculinity

This notion of hegemonic masculinity is related to individually practised gender identity and the aggregated gender stereotypes (Connell, 1978). Hegemonic masculinity is the benchmark against which other men are measured and is used as a means of excluding women (Faulkner, 2000: 91). As a benchmark, hegemonic masculinity is counterpoised to "subjugated femininity" which is a suppression of women since the benchmark is specific. It is used to identify a certain type of manhood associated with men in power. In addition, hegemonic masculinity is associated with successful white heterosexual men (Faulkner, 2000). Most men in Kimmel's (1994) opinion do not meet the standards but perform within the confines of masculinity for the benefit of other men. According to Brod and Kaufman (1994) the individual does not feel powerful although men as a group hold and exercise power. Despite the wealth of literature available on Science and Technology, masculinity studies have been predominantly "gender blind" (Faulkner, 2000: 91) not taking cognisance of the role of women in SET. Although certain studies of women Engineers were conducted during the mid 1980s and early 1990s which focus on masculinity, these are not sufficient (Sorensen & Levold, 1992). It would be interesting to establish how 'hegemonic masculinity' operates in the South African context. Masculinity and technology is an area that requires considerable attention, specifically the notion of 'mismatches' in the role of femininity and technology, as discussed below.

2.3.3 Masculinity and Technology - Mismatches

Despite the numerous campaigns in developed countries to encourage the progress of women in Science and Engineering, women are not playing a significant role in design roles (Faulkner, 2000). Henwood (1996) claims that there is a misconception that women's socialisation has to be modified to match the role of an Engineer and not vice versa. It may thus be assumed that the reason for failure of the initiatives to get more women recognised in Science and Engineering stems from the strong operation of the symbolic association of masculinity and technology.

There are a series of highly gendered dichotomies that may be discerned within this association. Faulkner (2000) identifies three of these dichotomies. Initially there is a distinction between being people-focused and machine-focused: this is one version of the sociological distinction between masculine instrumentalism (machine-focused) and feminine expressiveness (people-focused). In this regard, it appears that if a woman chooses to work within the technology sector, she is potentially rejecting any meaningful engagement in the social world and thus faces 'gender inauthenticity' (Keller, 1985). Secondly, there is the distinction between hard technology and soft technology, the latter with which women are associated (domestic appliances).

Arising from this hard/soft dualism are styles of thought, since accompanying the association of Engineering with Science is the established gender dualism (Edwards, 1996). On the one hand, objectivist rationality connected to emotional detachment and abstract reductionist approaches to problem solving is claimed to be masculine. On the other, subjective reality is associated with emotional connectedness related to concrete, empirical, and holistic approaches to problem solving. Abstract thought and work is generally associated with masculinity, while concrete thought is associated with femininity. However, Faulkner (2000) argues that both sides of abstract and concrete dualism are requisites within Engineering. In science, these dualisms "are widely held as truths by technical and non-technical people, women and men..." (Faulkner, 2000: 94). Numerous studies tend to confirm the operation of the three sets of dualisms, namely; people versus technology focused, soft versus hard technology and concrete versus abstract. These dualisms are evidenced in schools and institutions of higher education where girls are perceived to be out of their depth in the male dominated Science and Engineering professions.

Many women are now working in jobs which were traditionally perceived as male and many men are technically incompetent. Thus Faulkner (2000: 95) sees a crucial point that is often missed: the "huge mismatches between the image and the practice of technology with respect to gender." The South African literature does not highlight this mismatch but Stephen (2000) states quite categorically that society's attitudes to women in Science in South Africa is not encouraging as society concurs with the global notion that scientific careers are incompatible with a woman's life. In this regard, it is necessary to examine what so effectively maintains this male dominated domain. Thus the necessity arises for the examination of the relationship between the continued male dominance in Engineering as well as the masculine images of technology and how they are sustained.

2.3.4 Contradictory Gendering in Engineering

Although there is considerable literature available on the participation of women in Science, Engineering and Technology, most research has been conducted outside of South Africa. There appears to be a dearth of literature in this area in South Africa. Although there is an abundance of literature available globally, in the UK there is still the belief that there is a desperate need for empirical studies in gender to be conducted, since gendering that exists at this level is both more complex than assumed and highly contradictory (Faulkner, 2000). Studies of women in Science have been conducted almost entirely in the developed countries of the north, while Science in what was known as the 'third world' has been neglected (Campion & Shrum, 2004).

A look at the dichotomous ways in which Engineering work is categorised will help to understand the complexity. The distinction between manual labour and the professional graduate Engineer is the most obvious of those dichotomous ways: "These two versions of masculinity are essentially class based and embody the often gendered dualism of mind and body" (Wajcman, 1991: 95). Men are considered to be "natural" Technologists because they have the suitable rationality and mechanical skills required by the profession. Until recently higher status and credit was attached to the more mathematical and abstract analytical work and less to hands-on concrete work within Engineering education in the USA. In addition, sociologists of technology have argued that Engineers should adopt a holistic view and "integrate heterogeneous technical and non technical elements if artefacts are to work and meet a real need" (Faulkner, 2000: 98). However, the reality for most Engineers today is that they are defined by their technical specialism and their participation in holistic projects is dependent on their organisation into multi-skilled endeavours. It is purported that men and women differ in the field of Engineering with regard to sex and gender.

2.3.5 Sex and Gender in Engineering

This section explores a contested aspect of Engineering, that of whether gender differences exist in how Engineering is conducted and whether men and women might bring different styles or perspectives to Engineering. It is a fact that there are no inborn differences in the technical ability of males and female and the way that males and females engage in technical tasks (Faulkner, 2000). However, there is evidence to suggest that there are some differences in particular settings as found by Turkle and Papert (1990) in their study. Women and girls tend to adopt an interactive approach while men and boys approach was linear formal and comprised hierarchical planning. In IT a number of female programmers favour abstract approaches but the conclusion that Turkle and Papert (1990: 132) arrived at is that "the computer supports epistemological pluralism but the computer culture does not." In both design and programming there are dominant gendered assumptions that males have an innate aptitude and value nominally masculine styles. These assumptions are sustained despite the counterevidence. Consequently aspiring women Technologists are excluded.

This notion begs the questions "Could Engineering support different epistemological styles of work? Should such a powerful occupation as Engineering be predominantly shaped by a singular set of values and styles" (Faulkner, 2000)? Campaigning for equal opportunities has stressed the benefits that male dominated areas would receive by including both women and ethnic minorities. The diversity position purports that women contribute different approaches and priorities. This assumption however, may be interpreted as essentialist because it fails to challenge stereotypical constructions such as femininity being associated with subordinate and masculinity as the controlling force in society. If the representation of women in Science and Technology improves then it contributes to the transformation of technological products as well as the procedures used (Arnold & Faulkner, 1985).

Rose (1983) argues that women are more likely to bring a caring rationality to technical work. However, the evidence is limited and inconclusive. The exclusion of women based on these assumptions may possibly be identified as one of the reasons that inhibit the participation of women in SET. The South African literature has touched on this aspect in a limited way. For example, Mabandla (UNESCO, 1998) states that "we should not continue to waste our human resources by excluding women since very few women in Africa were employed in Science and Technology occupations". Thus far various aspects relating to women's exclusion from SET were discussed. What follows is a discussion of the subjective reality of Engineers.

2.3.6 Subjective Reality of Engineers

What are the subjective experiences of Engineer? There are three subjectivities that require discussion: "the pleasure Engineers so palpably take in technology, the exclusion of women based on these assumptions may possibly be identified as one of the reasons that inhibits the participation of women in SET, their ambivalent relationships with power and the identity work they do" (Faulkner, 2000: 104). Faulkner (2000) argues that Engineers' pleasure in technology and their close identification with technology are fundamental to the individual identity and shared culture of Engineers. A fraternity is cemented among Engineers which inevitably excludes women Engineers from significant internal networks.

Engineers are no longer held in high esteem as was the case previously. However, engineering still provides Engineers with great pleasure as nature creates a yearning within Engineers to produce feats of immensity, which Florman (1976: 122, 126) refers to as "an existential impulse for the vanity of *pyramids or dams* – constructions that inevitably invoke thoughts of the divine". Part of the pleasure of Engineering according to Hacker (1989) is a pleasure derived from domination and control over staff and the natural world. In addition, she suggests that the fun that Engineers experience with technology may be seen as compensating for the contribution to larger systems of dominance and control. This pleasure may also be seen as a reward for the fragmented roles they play in the labour source as well as the limited job satisfaction they experience in other spheres (Hacker, 1989). Hacker's (1989) intention was to demonstrate how the power and pleasure of Engineering are linked. She claims that men in Engineering have their limited strength or potency symbolically extended through the power of technology. Men who relatively lack power are those who gain the most pleasure in technology. Henwood (1993: 41) explains: "Technology offers a symbolic promise of power as well as the potential to compensate materially for their relative lack of power by a strengthening of their gender power through the acquisition of technical expertise". Further, aptitude in mathematics and technology offers some Engineers certain compensation for a lack control in various areas: "Engineers routinely feel powerless themselves but are viewed as highly empowered by outsiders" (Downey & Lucena, 1995: 172).

Engineers have an ambivalent relationship with power and are rooted in their structural location within the capitalist industry. Due to the ambiguous location between capital, labour and the state, Engineers have identified themselves with technology since this self acknowledgment has provided them with apparent neutrality (Berner, 1992). A number of studies report that most Engineers are interested in gaining organisational power (McIlwee & Robinson, 1992). Engineering may thus be viewed as a fraternity constructed around this shared identity with, and pleasure and pride in technology.

According to Kimmel (1994) the Engineering fraternity is a homosocial performance that affirms a specific version of masculinity which is also a primary resource in advancing their positions and interests. Engineers enjoy high status in certain organisations and disciplines and thus they benefit from the "power to create a work style comfortable to them as men" (McIlwee & Robinson, 1992: 138). There will be evidence of the domination of an Engineering culture when stress is placed on the centrality of technology and when competence is displayed aggressively. These are accepted means to secure top jobs and assignments in an organisation. Career progression for men in the Engineering field is based on involvement in successful projects and membership of networks of contacts and mentors (Melström, 1995). Most women who initially lack the hand-on experience and confidence, despite their competence, do not experience the thrill and obsession of their male counterparts (McIlwee & Robinson, 1992; Melström, 1995).

Based on these patterns of homosociality produced by Engineering, it is not surprising that many women Engineers opt to leave the profession. Alternately they lose out as far as their careers in Engineering is concerned since they do not belong to the 'club', and it is hardly surprising that the access of women into Engineering is greeted with hostility by many male Engineers. Murray (1993) believes that this challenges what it means to be a man or the entry of women might spoil their fun. Thus for women to compete in the Engineering field, where they are not held in high esteem as Engineers, their upward mobility is impeded by vertical segregation.

The previous section concentrated specifically on literature with regards to women in Engineering.

2.4 Key obstacles faced by women in SET

Liu and Wilson (2001) have identified four main obstacles that have restricted women from working in or pursuing a career in IT. These are gender stereotypes and attitudes, family responsibility, working time constraints and lack of confidence. According to Liu and Wilson (2001) the number of women in the IT field is declining. They also point out that male IT workers earn a higher salary than females. Other issues that were highlighted in their study were a lack of childcare facilities, lack of IT skills and lack of finance.

2.4.1 Gender Stereotypes and Attitudes

One of the major restrictions on women's development and career advancement in IT was the gender stereotypes and attitudes of male colleagues. Gender stereotypes and attitudes emanate from family values, societal and media influence as well as education. All these contribute to shaping beliefs and values. These forms of behavioural and mental conditioning underpin many assumptions and stereotypes that are carried into the workplace.

Traditionally, men are expected to hold senior positions while women are employed in lower positions despite the number of women who have entered the IT field. Empirical research has highlighted the fact that occasionally these misguided expectations lead to segregation of the sexes (Liu & Wilson, 2001) so that there is no even distribution of women across the various occupations and industries. In the UK, for example, many of the women worked in gender segregated jobs horizontally and vertically, confining them to low levels in the job hierarchy denying them a voice or the power to improve their positions (Steven, 2000).

Gender stereotypes include the notion that a woman's role is to serve. For example, as the only woman on the management team she would be expected to take the minutes at a senior managers' meeting, for example. Women managers who reject these expectations are labelled troublesome, unreasonable and aggressive. Comments made by male colleagues towards female colleagues are often derogatory and demeaning, particularly with reference to women not being technically minded and the possibility of falling pregnant on the job. In addition, Trauth (2002) found that men make also sexually explicit comments. These derogatory comments and skewed perceptions may impact negatively on a woman's career.

In Liu and Wilson's (2001) study they found that men's negative attitudes increased towards women who were promoted to managerial positions. Life for women in the workplace is made very difficult by these gender imbalances. Thus it is assumed that women suffer more hostilities in the profession than men, especially those women who hold positions of authority. Simpson and Holly (2000) assert that gender imbalance creates an organisational culture that is hostile or resistant to women. Further she points out that organisations with relatively few women in positions of authority are experienced as less welcoming to women and less accepting of women's values, attitudes and behaviours. Women in South Africa and Africa are being encouraged to pursue careers in Science. At a conference held in South Africa in September 1998, the issue of attracting and retaining women in science and technology was discussed. Governments of African countries were urged by leading women Scientists, academics and politicians from Southern Africa to increase opportunities and access for women's participation in Science and Technology in South Africa (UNESCO, 1998). In their study Lui and Wilson (2001) found that female managers identified gender stereotypes and men's attitudes as the second largest restriction on women's careers. In addition to stereotypes, sexual harassment in the workplace was identified as another problem that women face.

2.4.2 Sexual Harassment

According to Evetts (1998), sexual harassment in the workplace is not uncommon. She claims that some of the relational difficulties of being a woman in the field of Science, Engineering and Technology would be accurately described as sexual harassment. Many women in this field refrain from reporting such incidents for fear of victimisation and being ostracised. This male dominated world does not view such complaints empathically and instead women are made out to be responsible for invoking such behaviour by men.

Evetts (1998) tells of a young woman in an Engineering organisation who was touched, whistled at, leered at, insulted and patted on the head. Although she was with her manager who witnessed some of this behaviour, nothing was done about it. It is incumbent upon management to have a clear policy on sexual harassment and that all employees are made aware of the consequences of such acts. Sexual harassment may not be perceived as such by women who take unequal treatment for granted as they do not fully grasp the sexual harassment and challenges to their competence until it is pointed out to them (Trauth, 2002).

Although no literature could be found on sexual harassment in SET in South Africa, it does not mean that women in SET have not encountered sexual harassment. As more information becomes available in South Africa and Africa, there may be reports on sexual harassment in SET. Many women complained about working time constraints which was a further inhibiting factor in their careers and which will be discussed below.

2.4.3 Working Time Constraints

Another key obstacle that restricted women's development is working time constraints. In order for women to be both mother and employee, it is necessary for employers to deviate from the norm and allow more work time flexibility. The fixed working times make it difficult for mothers/working women. As a result many women leave permanent employment and opt for part-time employment. Apart from childcare women have domestic responsibilities. Inflexible working time can restrict women's development in technology. Time constraints in the workplace tend to have a restrictive impact on women's careers as well as their chances of fracturing the glass ceiling (Liu & Wilson, 2001).

2.4.4 Family Responsibilities

A major obstacle for women in the IT field as well as in SET in general, is family responsibilities, since the belief shared by employers is that women lose their ability to compete when they became mothers and are less likely to be flexible in the workplace. As a result of these distorted beliefs, 'glass ceilings' (see below) are created for women working in the IT profession. Earlier studies have indicated that employers obstruct the promotion of women in IT and provide less training. In addition, they are averse to accommodating women's home lives that involve children (Kavanagh, 1999). In their study, Lui and Wilson (2001) found that female managers identified gender stereotypes and men's attitudes as the second largest restriction on women's careers. Family responsibilities were cited as the largest restriction on women's careers in IT, according to Liu and Wilson's study (2001).

An interesting point from Campion and Shrum's (2004) study of Scientists in Ghana, Kenya and India, was that 95 per cent of the men were married compared to three quarters of the women. Women had fewer children, whereas men had more. Sixteen percent of the women were pursuing a professional career in Science with no children. Given the similar age structure of the men and women, this suggests that men and women handle their professional and family lives differently. The South African literature found unfortunately does not address this issue across race groups but Serumaga and Kotze (2004) found that marriage and children affect white women's participation in the South African labour force. Role stessors, which include role ambiguity and role conflict, are found to impact negatively on women.

2.4.4.1 Role Stressors (role ambiguity and role conflict)

Role conflict refers to incompatible expectations associated with a work role which often arises when two or more conflicting demands occur (Igbaria & Chidambaram, 1997). Schwartz-Cowan (1979: 67) argue that "men continue to perceive women as the rearers of their children, so they find it understandable, indeed appropriate, that women should renounce their careers to raise families." As a result, women may leave their jobs and concentrate on family responsibilities. In their study, Igbaria and Chidambaram (1997) examined gender differences in role stressors (role ambiguity and role conflict).

Role ambiguity is faced by many women in SET as they are unclear about their job duties, performance and standards or level of job performance Women are socialised to develop different job-related expectations in specific occupations than men and if they are unable to meet these expectations, it may cause role stress throughout their careers. Consequently, women may experience higher levels of role stress. Role theory is based on the premise that individuals have limited resources in terms of time and physical, mental and emotional energy (Igbaria & Chidambaram, 1997). The demands and requirements of women playing multiple roles with regards to family and career often create role conflict, role overload and role strain on women (Gallivan, 2004).

Because women have to juggle their roles within the organisation and at home they are invariably not given the opportunity to take on challenging assignments and as a result are overlooked for salary raises and promotion. Since men have fewer career interruptions they acquire more experience, education and human capital. As a result, family responsibilities impact seriously on women's career development as "withdrawal from the labour market influences wages through human capital depreciation and underinvestment in on-the-job-training" (Mincer & Polachek, 1974, in Chaung, 2003).

It has been argued that women often experience 'role overload' which occurs when they undertake paid employment, and have to concurrently maintain responsibility for domestic tasks, family responsibilities and child rearing. Women executives have reported that they carry a disproportionate share of the responsibilities for home chores (Schwartz, 1989). As a consequence, women may face a greater conflict between household and child rearing responsibilities and organisational duties than do men. The potential for stress and strain arising from work and family domains is heightened as women are required to balance the simultaneous demands of career with those of family where they are essentially responsible for household chores and childcare (Gallivan, 2004; Igbaria & Chidambaram, 1997). Another factor that causes role stress is the fact that women's salaries are lower than men's. It is argued that since wives only enter the workforce during periods of temporary economic need and leave thereafter, they earn the requisite (lower) salaries. The lower salaries and lack of recognition of their abilities and capacity in the field may lead to a lack of confidence in women in SET.

2.4.5 Lack of Confidence

Despite their educational qualifications, a number of women believe that they lack competence to execute their jobs effectively. Women in SET have inevitably suffered some form of low self-confidence at some point in their working career. This low self esteem and low self-confidence may be attributed to fears of failure and fears of being labelled incompetent (Lui & Wilson, 2001). Lack of confidence causes a barrier to development in SET, and low self-esteem can also be quite restrictive.

There is a tendency among men to see women as the 'weaker sex'. If women are assertive, they may be labelled by their male counterparts and this contributes towards women losing their self confidence. Recent research has highlighted the fact that a lack of confidence may lead to attrition as well as restricting the development of women in the profession. The numbers of women in Science and Engineering is declining at an alarming rate and this attrition may be attributed to the loss of self-esteem and self-confidence. Greater in-depth investigation has to be conducted into the reasons that underpin women's loss of self esteem and lack of confidence. Added to the lack of self esteem and lack of confidence, is age as an obstacle.

2.4.5.1 *Age as an Obstacle*

Age was found to be an obstacle in a number of studies that were conducted. The majority of women in SET are in the age group 25-29 and 30-35 (Igbaria & Chidambaram, 1997). It has been suggested that male and female managers differ in their success and this could be due to the average male manager being older and more experienced than the average female manager. Women are said to possess comparatively less life and work experience and fewer skills. Therefore it is suggested that women in the workplace are likely to be younger and hold lower qualifications (Igbaria & Chidambaram, 1997). Socio-cultural influences play an important role in SET as well as in IT.

2.4.6 Socio Cultural Influences

Recent studies emphasise an emerging theory of gender and IT as socially constructed (Trauth, 2002). Women experience a variety of socio-cultural influences which either encourage or discourage their participation in the IT profession. Every woman is an individual who possesses different technological talents and inclinations and responds to social shaping in a unique and individual way. The IT field is socially constructed as a male domain which prevents women's participation at a higher level. Whereas women from communist countries were encouraged to pursue a career in IT, others had to resist a cultural norm where working is unacceptable and in IT, even more unusual.

Cultural influences are experienced as a restraint in some countries where the private sphere is often understood to be women's domain and not in the IT workplace (Trauth, 2002). Schools have also been cited as promoting gender segregation in certain courses, specifically in mathematics and computer courses. Further, certain staff members favour gender segregation when they encourage males and discourage females from pursuing Science and Technology. Moreover women who have entered the male domain of Technology may be inhibited by the organisational culture.

2.4.7 Organisational Culture

Problems with gender and Technology in the organisation are found in the organisation itself rather than with women themselves. The gendered expectations and processes within the organisation contribute to the real dilemmas that women face in their careers in Technology (Evetts, 1998). Women are made to feel uncomfortable in the organisation – an intruder in a male domain. Women employees in Engineering and Technology cited examples of organisational culture that required them to be submissive. Managers had specific expectations of professional employees and these expectations were gender specific. If women were perceived as confrontational or too aggressive, it could be to their detriment with regards to promotion or other work-related opportunities.

Some women are resigned to organisational expectations and behave in a specific manner in order to satisfy the organisational culture where women are expected to be tolerant and accepting of gender challenges and not provoking confrontation (Evetts, 1998; Trauth, 2002). This behaviour is also believed to be problematic as women are perceived as too weak, submissive and passive to be promoted and are judged as unsuitable for career progress and development.

Organisations have taken on a more competitive and masculine culture which negates the presence of women especially in senior, decision-making management roles. Since only a third of women enter the IT field and gender imbalance in the workplace can make life difficult for the minority group, it may be assumed that women in IT encounter more hostilities than men. Gender imbalances in an organisation create an organisational culture that can be described as hostile or resistant to women. As a result women are overlooked for promotion and encouraged to steer away from the managerial route as a career path (Trauth, 2002).

Two career ladders were identified by Trauth (2002) - professional and managerial career ladders. In many organisations, women are encouraged to pursue the professional rather than the managerial route. Consequently, women were becoming highly skilled Technical Specialists in the profession but not managers, and they therefore did not have a voice in managerial decisions. The professional path was seen to be more appropriate for women with family commitments (Evetts, 1998).

Traditional beliefs hold that there are appropriate roles for men and women and these beliefs exert a major influence on employment opportunities and experiences for women. The traits and behaviours stereotypically viewed as appropriate and possessed by men, for example competitiveness, logical and initiating behaviour, persuasiveness and aggression are believed not to be attributes associated with women. Therefore, women are not suited for certain positions which require leadership, professional or technical skills (Worrel & Rener, 1996). In Nigeria, the United Nations declaration, 1976 – 1985, spurred the Federal Government on to implement affirmative action. Affirmative action accounts for much change with regard to the promotion of women (Chovwen, 2003). Similarly, South Africa has implemented the policy of affirmative action which saw many women in top managerial positions. However, these statistics still remain far below that of men in managerial positions. Since the perception that women should not pursue the managerial route persists, some organisations allow women to progress up the ladder but only as far as the 'glass ceiling' and no further.

2.4.7.1 Glass Ceiling

Can the glass ceiling be penetrated to allow upward mobility of women in SET? This is a question that is probably on the lips of many women in SET who have reached the glass ceiling, and for whom upward mobility is not possible due to an organisational culture that favours men in senior positions. A study conducted by Simpson and Holley (2000) investigates the impact of restructuring on the career progression of women in Transport and Logistics. The findings could have significance for women in SET who have encountered a 'glass ceiling' and are restricted by it.

This study looks specifically at organisational change and gender impact. Women are particularly vulnerable during times of organisational change as they are less likely to be seconded into other functional areas thus, limiting access to new skills and management expertise (Woodall, Edwards & Welchman, 1997). Further, as the major concentration of women is in junior or middle management, retrenchments and demotion at these levels suggest that the women managers are reduced, thus making the glass ceiling even more impenetrable with fewer women eligible for promotion to senior positions. Despite equal opportunity measures being in place, they are not likely to be considered favourably during times of organisational change.

With women having to juggle their roles of motherhood and employees, certain organisations planned to introduce family friendly policies (Simpson, 1998). However, considerable hostility was directed at these plans on the basis that some were gaining while others were losing their jobs. The transport sector has undergone major changes but not to the benefit of women since they are still underrepresented in the top echelons of management. This suggests that barriers do exist to managerial positions. Simpson (1998) argued for instance that token women in minority positions experience greater career barriers than in an environment where the gender balance is more equal. This could possibly be the situation in SET in South Africa where women do not appear to be penetrating the glass ceiling to top management positions.

Women in the USA indicated that they were negative about their career prospects since they believed that men's remuneration was higher and their progress was faster than their female counterparts (Simpson & Holley, 2000). Additionally, women were frustrated by the sexual discrimination and 'old boys' networks' that favoured males in hiring and promotion decisions (Simpson & Holley, 2000). Men in Logistics still hold senior posts although women Logisticians hold higher qualifications including a more participatory style better suited to the current competitive environment. A study of 300 transport managers established that 75 percent believe that their careers have been restricted by a glass ceiling and sexism in the Transport industry (Holley, 2000). Women in IT are invariably faced with sex bias which suggests that various mechanisms inhibit women from upward mobility irrespective of their qualifications and experience. Evidence of gender bias against women is prolific especially at higher corporate levels. Several papers are cited that suggest the existence of a glass ceiling that inhibits women from reaching the top (Bilimoria & Piderit, 1994). Globally few women and fewer still in Nigeria have managed to penetrate the glass ceiling (Chovwen, 2003). These sentiments can similarly be applied to SET as women are not rising to top management levels as they should be.

2.4.7.2 *Attrition in SET*

There has been widespread research over the past 20 years to understand what factors influence job satisfaction and the high attrition rate (Niederman & Moore, 2000). According to Moore (2000) job stress and burnout were leading causes of IT employees' high attrition rate. IT personnel research has sought to identify gender differences that may explain the low participation of women in the IT industry. Because of the socio-cultural influences, prejudice, gender segregation and other barriers, the attrition rate in SET is high (Igbaria & Chidambaram, 1997). Social and structural barriers impact on women's persistence, retention and advancement in IT and consequently women are offered fewer opportunities for promotion and professional development. In New Zealand, for example, a woman in IT was forced to resign from her job because there was no maternity leave available and the organisation could not accommodate her on a part-time basis (Trauth, 2002).

Chovwen (2003) found that women who persist with pursuing their careers in the face of opposition, experience extreme frustration and consequently leave the organisation. This can cost the organisation talented individuals. To add to these problems experienced by women in SET, many mentioned the lack of support and mentorship (Trauth, 2002).

2.4.7.3 *Support and Mentoring*

Most of the literature consulted mentioned mentoring as a problem faced by women in SET. Mentors are necessary as women invariably feel excluded in the SET sector (Igbaria & Chidambaram, 1997; Liu & Wilson, 2001; Trauth, 2002). Many organisations are averse to investing in women with regard to upgrading qualifications and reskilling. Organisations would rather invest in males as they are seen to have a good return (Igbaria & Chidambaram, 1997). Consequently there are fewer women in SET as they do not get the support or mentoring that men do. Allied to the lack of support and mentorship is the fact that there are very few role models in SET.

2.4.7.4 *Role Models*

Women in SET have very few role models as the majority of women who could rise to senior management level are restricted for the various reasons explained earlier. Men still occupy senior positions in management and if a woman is promoted there will be no female role model to support her. More positive female role models are needed as it would help to promote society's awareness of women's potential to excel in the highest ranks possible, while also empowering and encouraging other aspirant women. Many women in SET have experienced exclusion by their male counterparts and management.

2.4.7.5 *Exclusion*

In institutions, different ways of viewing or approaching problems, different priorities, professionalism and power factors such as competing for scarce resources, often contribute to hierarchical cultures in the workplace. Newcomers to an organisation can feel excluded as a result of the organisational culture and it may take a long time for that individual's contribution to be acknowledged. If old staff feel threatened by the newcomer, the situation worsens. Organisational level can also be divisive, as managers tend to exploit their power in the workplace. Gender inequality exists on all levels and particularly in management where important organisational decisions are made. This phenomenon has been identified in international literature and to a lesser degree in African and South African literature.

4.6 Gender inequality in management: globally and in South Africa

Recent studies have paid considerable attention to women in management positions worldwide and have reported on the demographic changes in top and senior management positions by debating the status and conditions of professional women. Despite these advances, women still occupy secondary positions worldwide and are also being underutilised (Mathur-Helm, 2005). Although the Civil Rights Act of 1964 increased the number of women in male dominated occupations, women's progress to top management is still slow (Nelson & Michie, 2004). In the UK and China for example, inequality is still evident in the labour force.

Only recently in South Africa, has attention been focused on problems faced by women in the workplace and management positions. Despite the voluminous documents on equality and women's rights, women employees are still found in the lowest ranks of organisations, experience difficulty with upward mobility to senior and executive management levels and are not benefiting from government policies and legislation to advance their careers. This is the case in spite of the tremendous advances that South Africa has made to promote and advance women in the workplace. According to Catalyst and Opportunity Now (2004), women are still underrepresented in corporate boardrooms with only 7.1 percent women directors in the country. South Africa still lags far behind the rest of the world whose statistics are also low (Mathur-Helm, 2005). Grant Thornton International reported in 2003 that 75 percent of businesses in South Africa employ women in management and senior management positions. This indicates that South African women are only allowed to advance as far as the 'glass ceiling' indicating that there are major barriers that South African women have to face as the environment of South African organisations are still not women-friendly (Mathur-Helm, 2005). This study looked at women in management across organisations and did not specify particular fields. However, it would be safe to assume that SET makes up a fair proportion of the statistics and that this would apply to SET as well.

4.7 Best Practice

To remain competitive in this global and technological world, institutions and organisations throughout the world need to move forward and create a well-trained, diverse and multicultural workforce. With the decrease of general interest in SET careers and an increase in the demand for Engineers and Scientists worldwide it is essential that organisations look beyond the traditional pool of talent (predominantly men) and target the other half of the population - women. But how will these organisations achieve this?

There needs to be a paradigm shift in traditional thinking towards women working in SET, to change the mind-set of those who believe in gender specific jobs. More female role models are required and women need to be given greater access to advanced, specialist training to management and technical skills. In order to boost self-confidence it would be necessary to train women in assertiveness. Salaries should be negotiated in accordance with women's achievements to pave the way for equality in SET. Those in power should influence change within the organisation. Attempts should be made by employers to eradicate gender stereotypes and attitudes and to play an active role in removing traditional concepts of a 'woman's place'. In addition,, it would be incumbent on the Government to have

2.4.7.6 Gender Policy

Numerous policies have been introduced over the past decade to make the workplace friendlier to women employees. With discrimination against women in the workplace because of family responsibilities and motherhood, one of the most far-reaching policies is that of the extension of parental and family leave. Despite human rights' discourse penetrating the world, this has not eliminated gender inequality. According to Gottfried and Reese (2004), there are no women-friendly policies promoting gender justice by breaking down gender-based hierarchies, enhancing women's independence and increasing their capacity to support and sustain an independent household

A consortium of eleven non-governmental organisations from Europe, Asia and North America is devoted to community based and gender sensitive poverty alleviation in Africa (Hadjipateras, 1997). Although Accord does not deal with gender in SET per se, valuable lessons can be learnt from them about policy formulation and best practice. They adopted an analytical framework comprising five steps along the path towards equality between men and women. These are improvement for women in terms of welfare (survival); access to resources (including opportunities for self realisation), conscientisation (an awareness of and will to alter gender inequalities); participation (including an equal role in decision making); and control (in both the personal and public domains) (Hadjipateras, 1997). Although these five steps were used to develop a policy for women in Africa, it could also be adapted for use in SET.

South Africa implemented equal opportunity and affirmative action legislation as a system of national strategy to redress the past imbalances that were created by the previous dispensation after the first democratic elections in 1994 (Mathur-Helm, 2005). Consequently women's issues were highlighted, such as their rights, equality, welfare and empowerment and attention was focused around these issues. Subsequently in 1996, the South African Government approved the International Convention on Elimination of All Forms of Discrimination (CEDAW) by passing the Gender Policy Framework (GPF) (Mathur-Helm, 2005). The main aim of the GPF was to integrate gender policies by taking into account that:

- Women's rights are perceived as human rights
- They have equality as active citizens
- Their economic empowerment is promoted
- Their social upliftment is given priority
- They are included in decision making
- They are beneficiaries in economic, social and cultural areas
- Affirmative action targeting women needs to be implemented.

The GPF guided the process of developing laws, policies and procedures to ensure equal rights and opportunities for South African women. According to the GPF, if South African women do not have equal opportunity, access to resource sharing, control and decision- making, the aim behind the GPF would not have been achieved (Mathur-Helm, 2005).

2.5 Conclusion

Women in SET are disadvantaged in numerous ways as evidenced in the reviewed literature. Furthermore, the literature revealed that in all the developed countries the numbers of women in SET is rapidly declining. This begs the question: why are women not entering the Science field and what prevents them from remaining and developing in the field? The European Society of Engineering Educators (SEF) assessed the low representation of women Engineers in all European countries and made a plea for national mobilisation of effort to reverse this trend.

Effective management of technology is required in the future including organisational competence and intellectual capital. South Africa has a difficult task as women irrespective of race have always held secondary status in society. Coming from a paternalistic history, women were defined as inferior to men and this emphasis the need for South African women in SET to advance, assert themselves and make their voices heard in male dominated sectors.

3 SECTION 2: METHODOLOGY

3.1 Research Design

Figure 1 illustrates the research design that begins with the research question posed in this study: What are the factors that contribute to or inhibit women's participation in the SET industry of South Africa? The research design entailed both quantitative and qualitative methodologies. This is commonly referred to as mixed methods research in academic circles and can be defined as follows: "the type of research in which a qualitative and quantitative data collection procedure ... or research method ... is used to answer the research questions"[4]. A literature review was undertaken to determine comparable research in South Africa and internationally in the area of women in industry. This entailed conducting desk research on international best practices with respect to women's participation in the SET sector. Literature on women's experiences in the SET industry was also examined. Potential participant companies were then chosen and approached for permission to collect data about the topic of the research.

In order to address the research question two objectives were identified. Objective 1 serves to examine the gaps in gender representivity in industry. A quantitative methodology was used, i.e. numerical data was collected about the representation of women in each of the participating companies using a survey method and a statistical analysis performed on the data. Objective 2 was to determine the factors contributing to or inhibiting participation in the SET sector of South Africa. Both quantitative and qualitative methodologies were employed. The latter used in-depth interviews and the former used a survey method (and specifically questionnaires) to gather data. The in-depth interviews (qualitative) gathered comprehensive verbal – or textual - expressions of women's experiences and perspectives of their participation in the SET industry whereas the questionnaires (quantitative) captured numerical (mostly) ratings of women's experiences. A thematic analysis was performed on the data from the in-depth interviews and a statistical analysis was performed on the data from the questionnaires. Each of these aspects of the research design is expanded on in the sections that follow.

[4] Tashakkori and Teddlie (2003, p. 62)

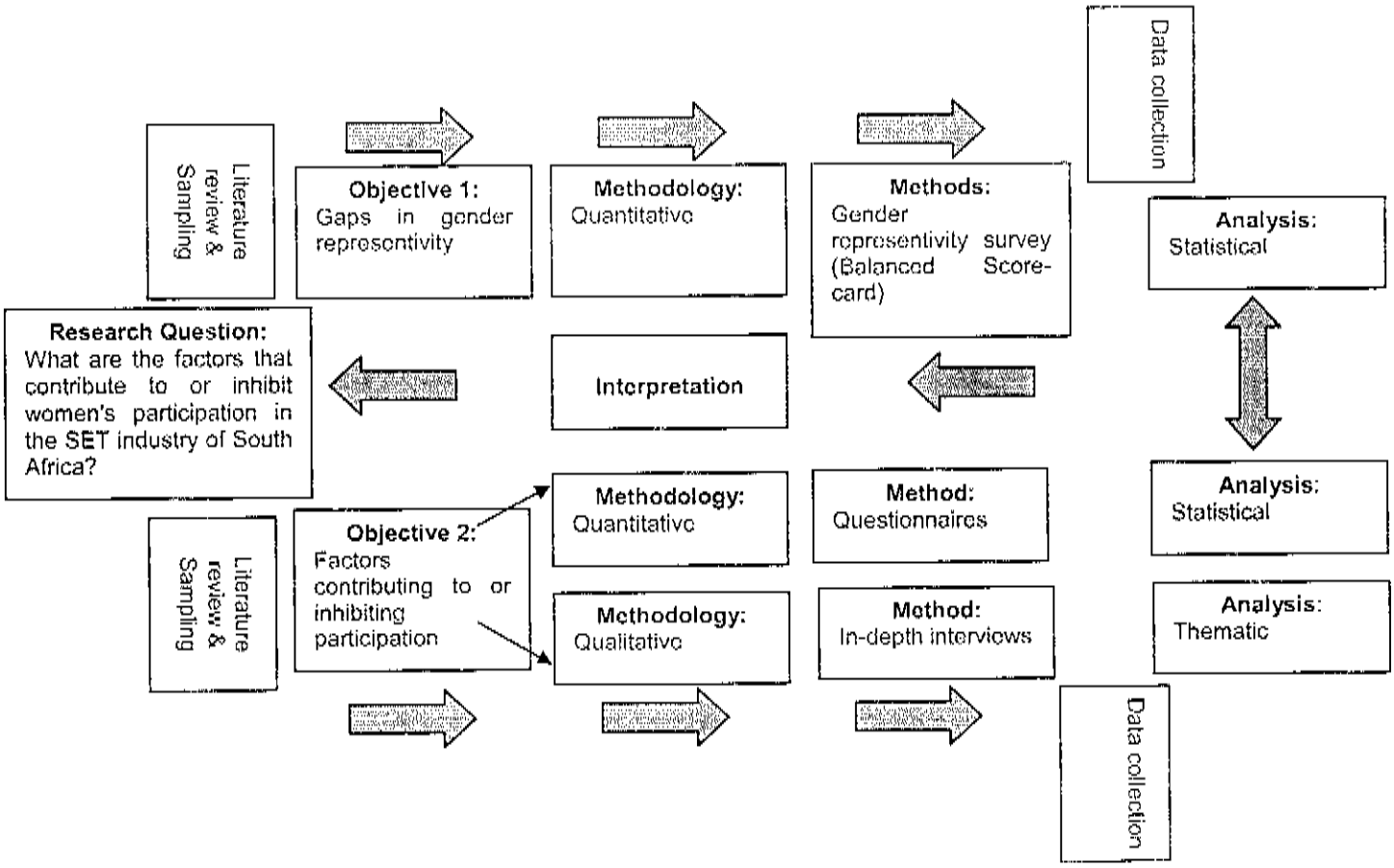

Figure 1 Diagram of research design

3.1.1 Sampling

Specific companies were identified by the Department of Science and Technology in consultation with the HSRC research team. Companies that were selected fell into one of the following categories: (1) listed on the JSE, (2) privately owned, (3) an SMME, or (4) a state-owned enterprise (SOE). Although the aim of the study is to explore factors blocking women's progress, and women were targeted as the majority of participants, DST requested that some men be included in the sample. Interviewees for the in-depth interviews were selected from the following two categories: (1) a senior women in the organisation with an SET qualification and/or experience, and (2) the CEO or his or her designate in the organisation.

This type of selection is known as purposive or judgemental sampling as the "units to be observed are selected on the basis of the researcher's judgment about which ones will be most useful or representative"[5]. It is categorised under non-probability sampling and therefore it cannot be assumed that the sample is representative of the population that it is drawn from, i.e. the population of all women (and men) in the SET industry in South Africa. Results can therefore not be generalised to all other such contexts. The purpose of this study was not, however, to generalise findings to all women in the SET industry in South Africa. Rather, it was important to understand a subset of women's experiences and identify the factors, according to these women (and some men), that block their progress in the industry.

[5] Babbie (2007, p. 184)

The gender representivity survey would be used as a balanced scorecard to evaluate the status of gender equity in selected organisations and represents only those in the sample. The sample for the questionnaire that was sent to SET women in these organisations is one of convenience as the respondents to the questionnaire are those who completed it and returned it to the research team, i.e. there was reliance on available subjects (Babbie, 2007).

Twenty-seven companies were selected as potential participants in the research. It was decided that companies in the private sector would be proportionately represented more in the sample and thus nine were needed from the private sector, six from JSE registered companies, six from SMMEs and six from SOEs. Although 27 companies were necessary for the sample the research team over-sampled by two or three in each category to allow for organisations who might turn down the request to be part of the study; subsequently 35 companies were contacted for permission to be included as research participants. Of these, 28 companies agreed to participate and 22 companies conceded within the timeframe set for gaining access and doing the fieldwork (approximately 12 months from August 2005 – August 2006). Table 1 contains details of the number and type of companies that were targeted versus those companies that were willing to participate in the study.

Table 1 Number and type of companies targeted versus companies who participated

Type of company	Companies targeted and contacted	Companies that agreed to participate	Companies that responded within fieldwork timeframe
JSE listed	9	4	4
Private	11	8	6
SMME	8	8	5
SOE	7	8	7
Total	**35**	**28**	**22**

3.1.2 Instruments

Both the literature review and the aim of the study were considered when the instruments were developed. Below is a brief description of the content and aim of each of the instruments.

3.1.2.1 Gender representivity survey

The aim of the gender representivity survey was to identify gaps in the representation of women at various levels within organisations with a sizeable technology base. This was accomplished by quantifying the number and status of women SET workers in companies. This instrument can be found in Appendix A. The survey also provided information relating to issues such as the level of qualifications, fields of study, years in the industry, personal experiences and percentages of women within each of the aforementioned SET sectors. This information was used to generate a Balanced Score-card.

3.1.2.2 Questionnaires

In order to explore the factors blocking progress of women in the SET industry (in companies targeted in this study) a questionnaire was developed that requested them to rate their agreement or disagreement with particular statements. The questionnaire can be found in Appendix B. Some open-ended questions were included to allow the respondents to express any additional perspectives that they may have on the topic.

3.1.2.3 *In-depth interviews*

In addition to the quantitative data from the questionnaires key workplace factors blocking progress were explored in in-depth interviews. A semi-structured interview guide was developed (see Appendix C) to direct the interviewer through an open conversation with an interviewee about his or her perspectives on women's participation in the SET industry.

3.1.3 Procedure of Data Collection

Once the sample was selected the research team worked on gaining access to each of the companies. A letter was composed by the DST as well as the HSRC explaining the purpose of the study and what would be required from participants. As soon as permission was granted by the organisation to proceed with the research data collection commenced.

3.1.3.1 *Gender representivity survey*

A member of the HSRC research team asked each organisation to identify the person who could assist with the completion of the survey. The instrument was sent to this individual to fill out and return to the HSRC.

3.1.3.2 *Questionnaires*

The questionnaire was e-mailed to each organisation so that respondents could complete it electronically or on paper. The completed questionnaires were returned via e-mail or collected by a member of the HSRC team.

3.1.3.3 *In-depth interviews*

Once both the senior SET woman and CEO or designate in the organisation had been identified a member of the HSRC research team made an appointment at the earliest convenience of the interviewee. Two interviewers (usually one male and one female) travelled to the organisation and conducted the interview either in the interviewee's office or in another suitable location like a boardroom.

The interview was initiated with an introduction to the study and an explanation of the ethical rights of the interviewee. The interviewer began by asking a general question about the interviewee's perspective on the under-representation of women in the SET sector and probed further for certain issues as the interview continued. Generally, interviews lasted between 45 minutes and an hour.

3.1.3.4 *Ethical considerations*

This study adhered to generally accepted ethical considerations for social science research. Organisations were initially contacted for permission to include them in the sample. For the questionnaires respondents did not have to include any personal information that would identify them. They therefore remained anonymous.

The participants in the in-depth interviews were provided with a Participant Information Sheet that explained the broad aim of the study and set out the ethical rights of the participant. This included, for example, that the interviewee could end the interview at any time without providing an explanation and that he or she needed to consent to the interview being tape-recorded. (Some of the participants did not consent to the recording and thus the interviewer made detailed notes during and after the interview.) The interviewees were asked to sign a Participant Consent Form that confirmed that they had read and understood their rights. Provision of personal information on the consent form was voluntary. Each form is stored on file at the HSRC Gender and Development Unit's offices. The perspectives provided during the interviews remain confidential; no statement can be attributed to a specific individual.

3.1.4 Data analysis

3.1.4.1 Gender representivity survey

Data obtained from the gender representivity survey were analysed in order to examine the nature and extent of women's involvement in the SET companies that participated in the study. A full balanced score card for each company could not be computed because of the following two reasons:

1. The weighting procedure[6] for gender equity assessment within the SET sector of South Africa has not yet been formulated and agreed to at policy level

2. Some of the companies did not provide the requested information (e.g. with respect to ownership, post-tax profits, etc).

3.1.4.2 Questionnaire

Descriptive statistics were calculated for the demographic characteristics of the respondents. Frequencies and percentages were generated for the statements in the questionnaire and cross-tabulations were performed according to the type of SET industry, age of respondents (recoded to match the life-cycle approach) and position in the company (recoded to management and non-management levels).

3.1.4.3 In-depth interviews

The cassettes from the interviews that were tape-recorded were sent to a transcriptionist for verbatim transcribing into an electronic format. Two researchers read through each of the transcripts and generated categories from the meaning units identified during the reading. These categories were captured onto an Excel spreadsheet where a frequency of one was allocated each time the category was raised by an interviewee.

The categories were then used to perform a thematic content analysis of the data. This method allows the analyst to group common categories under a theme, and describe the nuances of the themes, as well as calculate basic statistics on the data. The themes represent the perceptions of the interviewees about the participation of women in the SET industry. The perceptions reflect the beliefs of the women and men who were interviewed and do not necessarily reflect some universal truth. The description of themes includes direct quotations from the interviewees to illustrate some aspect of the theme either in the text or in a box with other similar quotations. As much detail as possible about the context (gender, position in company, type of company etc.) of the interviewee who made a specific comment is included without divulging the identity of participants. The themes are presented in a separate document (Appendix D) for the sake of keeping the report to a reasonable length.

4 SECTION 3: PRESENTATION OF FINDINGS

4.1 Gender representivity survey

4.1.1 Sample

Sixteen companies completed and returned the gender representivity survey. The results are presented below.

[6] See Appendix D for a short description of the methodological procedure that is followed when computing values of a balanced scorecard

4.1.2 Balanced scorecard

Given the limitations of the data provided by the participant companies a summary of the information gleaned from the data with respect to some of the key indicators that would form part a balanced scorecard is presented here. Table 2 shows the mean and standard deviation scores for the percentages of women who are employed in all the SET companies that responded to the gender representivity survey as a function of level of seniority and benefit from SET sector.

Table 2 Balanced score-card

LEVEL OF SENIORITY	Mean
% share of direct shareholding by women in the company (direct shareholding refers to employee share schemes	0%
% share of indirect shareholding by women in the company (ownership of women outside the organisation)	0%
% of women members of boards of directors	10.88%
% of Women in Executive Management	11.63%
% of women in Middle Management	26.10%
% of women supervisors	29.52%
% of highly skilled women who are not in management / supervisory positions	18.03%
% of women in the junior professional category	29.04%
BENEFIT FROM SET	**Mean**
% spent on skills development for women in past year	.001%
% spent on procurement from women empowerment companies in last year	13.27%

Some of the further insights from the survey include the following:

- Only one company reported having a gender equity policy.
- Women are better represented at the lower levels of the sixteen industrial SET companies that formed part of the survey.
- Only one of the companies has a female leader (CEO).
- Women of colour are less well represented than white women in these companies at all levels, and especially at executive and management levels.
- Shareholding by women is low in the companies who participated.
- Although some of the companies are spending large amounts on social development and other strategies that encourage women's participation in industrial SET, information about women beneficiaries has not been recorded by all of the companies.

4.2 Questionnaire

4.2.1 Sample

Ninety women returned the questionnaire rating their experiences in the SET industrial workplace. Table 3 contains the demographic details of the sample (Appendix E). Almost half (45.6%) of the respondents were from State-owned Enterprises, married (43.3%) and white (46.7%). A third (33.3%) of the respondents' home language is Afrikaans. Almost two-thirds (63.6%) of the women are in the age group of 25-34 years. Women mostly had either no child currently living at home (41.1%) or two to three children currently living at home (42.2%). Almost 60% of the respondents reported that their position in their company was skilled professional. Almost 40% of the women have a cost to company of between R100 001 and R 150 000. The cost to company of six of the respondents was less than R100 000 and only 1 woman reported that her cost to company is between R450 001 and R500 000. Sixty percent of the women reported that they had work interruptions due to maternity leave.

4.2.2 Results from questionnaire

Tables 4 to 7 (in Appendix E) present the findings from the questionnaire according to women's ratings of their experiences in the various companies. The data are represented in a 3 point scale (Disagree, Neutral and Agree) for all the women who responded to the questionnaire and are expressed as percentages. The responses are categorised into the following types of experiences: Feedback on work performance, Remuneration and promotion opportunities, Work environment, Gender relations in the workplace, Mentorship and career development, Race and gender in the work environment, Implications of a career on in SET for family life, Experiences in the SET industry.

Table 4 presents the ratings of all respondents to the questionnaires of their experiences in private or JSE listed companies, SMMEs and SOEs. Responses to the statements are generally in agreement with positive with positive statements and in disagreement with negative statements about their experience of women's participation. Exceptions to this are the statements about:

- Being sufficiently rewarded for efforts at work,
- Having a mentor in the organisation,
- Having excellent career opportunities in the organisation,
- Women find themselves without the necessary instruments to perform duties,
- Constantly have to prove myself because I am a woman,
- Feel marginalised as a women in the industry,
- Need to prove myself because I am a Black woman
- Feel marginalised in my industry as a Black woman
- Black women often have to deal with obstacles that others don't have to

Table 5 in Appendix E presents the ratings of women's experiences according to their position in the SET industrial company. Two categories were created from the original categories on the questionnaire: management or non-management. Women in management positions tend to rate statements similarly to women in non-management positions except for the following statements:

Management disagrees - non-management agrees	Management agrees - non-management disagrees
Working conditions taking into account that they are women	Being sufficiently rewarded for efforts at work
Men being more easily promoted	Having a coach in the organisation
Men being taken more seriously during meetings	Having a mentor in the organisation
Having to prove myself because I'm a woman	
Proving myself as a Black woman	
Not being taken seriously in the industry	
Success in the career should come before other considerations	

Table 6 in Appendix E presents the ratings of women's experiences according to their age group divided into categories that match the life-cycle approach: 20-24 years of age, 25-35 years of age or 35-55 years of age. Women across the age groups tended to rate statements similarly with the following exceptions:

25-55 disagrees	25-55 agrees	20-24 and 35-55 disagrees	20-24 and 25-34 disagrees	35-55 agrees
Being sufficiently rewarded for efforts at work	As Black women sometimes feel marginalised in industry	Often expected to work overtime	Other people more easily promoted than Black women	Have to prove themselves at work because they are women
Having a coach in the organisation	Male colleagues earn more than women at same level			
Having a mentor in the organisation	Men in SET sectors have more opportunities and advantages than women			
Excellent career advancement opportunities in their current company	As women they often have to deal with obstacles that men don't have to deal with			
	Women should be encouraged more to enter the science, engineering and technology			

	sector			

Table 7 in Appendix E presents the ratings of women's experiences according to the type of SET industrial company they were employed at when they completed the questionnaire. There are more noticeable differences between the ratings made by women across types of industrial SET companies than with the former groups.

Private	JSE listed	SMME	SOE
Disagree that working conditions take into account that they are women	Neutral about working conditions take into account that they are women	Same number of women disagreed as agreed that male colleagues earn more than female colleagues at the same level	Disagree that they are often expected to work overtime
Agree that they have adequate opportunities for professional development	Disagree that they are given regular feedback on their work	Agree that they are sufficiently rewarded for their efforts at work	Disagree that they have adequate opportunities for professional development
Neutral about being given the resources and training necessary to do their work	Disagree that they are given the resources and training necessary to do their work	Agree that they constantly need to prove themselves at work because they are Black	Agree that they constantly need to prove themselves at work because they are Black
Disagree that they are excellent career advancement opportunities at their current companies	Disagree that they have a coach at work who helps them address the technical issues of their work	Agree they experienced many difficulties, challenges entering SET sector	Disagree that they are excellent career advancement opportunities at their current companies
Agree that men are often more easily promoted than women at their company	Agree that men are often more easily promoted than women at their company	Agreed and disagreed to the same extent that working environment is more suitable for men than for women	Disagree that they sometimes feel marginalised in their industries
Disagree that they sometimes feel marginalised in their industries	Agree that other people are more easily promoted than Black women at their company		Disagree that they often have to deal with obstacles that men don't have to deal with
Disagree that they often find themselves without the necessary instruments to perform their duties	Both agree and disagree to the same extent that they often find themselves without the necessary instruments to perform their duties	Disagree that they often find themselves without the necessary instruments to perform their duties	Disagree that they often find themselves without the necessary instruments to perform their duties
Agree that black women should be encouraged more to	Agree that black women should be encouraged more to	Disagree that black women should be encouraged more to	Agree that black women should be encouraged more to

enter the SET sector	enter the SET sector	enter the SET sector	enter the SET sector
	Agree that they often feel that they are not taken seriously by male colleagues		
	Agree that men are taken more seriously during meetings held at their company		

4.3 In-depth interviews

4.3.1 Sample

The realised sample for the in-depth interviews was 38. The section that follows contains a summary discussion of the major findings from the interviews.

4.3.2 Senior management's perceptions of women's participation in industrial SET

The findings from the analysis of the in-depth interview data are presented in table format (Appendix E). Table 8 includes the three categories essential to this study: recruitment, retention and advancement of women in industrial SET. Within each category the factors (themes) that were identified as favourable or unfavourable to women's participation are listed. If there are factors that oppose each other they are listed in the same line. As mentioned earlier a detailed explication of the themes formulated from the data can be found in Appendix F.

Table 8 also highlights that most factors (favourable and unfavourable) were raised in the context of retention (40), followed by recruitment (22) and then advancement (21). Interviewees thus focussed mostly on retention as being favourable or unfavourable towards women's participation in the SET industry. Also, 30 factors can be identified as favourable to women's participation while 51 factors can be identified as unfavourable to women's participation.

Factors that received the highest endorsement (up to the 5 highest scores) by the interviewees are reflected in figure 2 below:

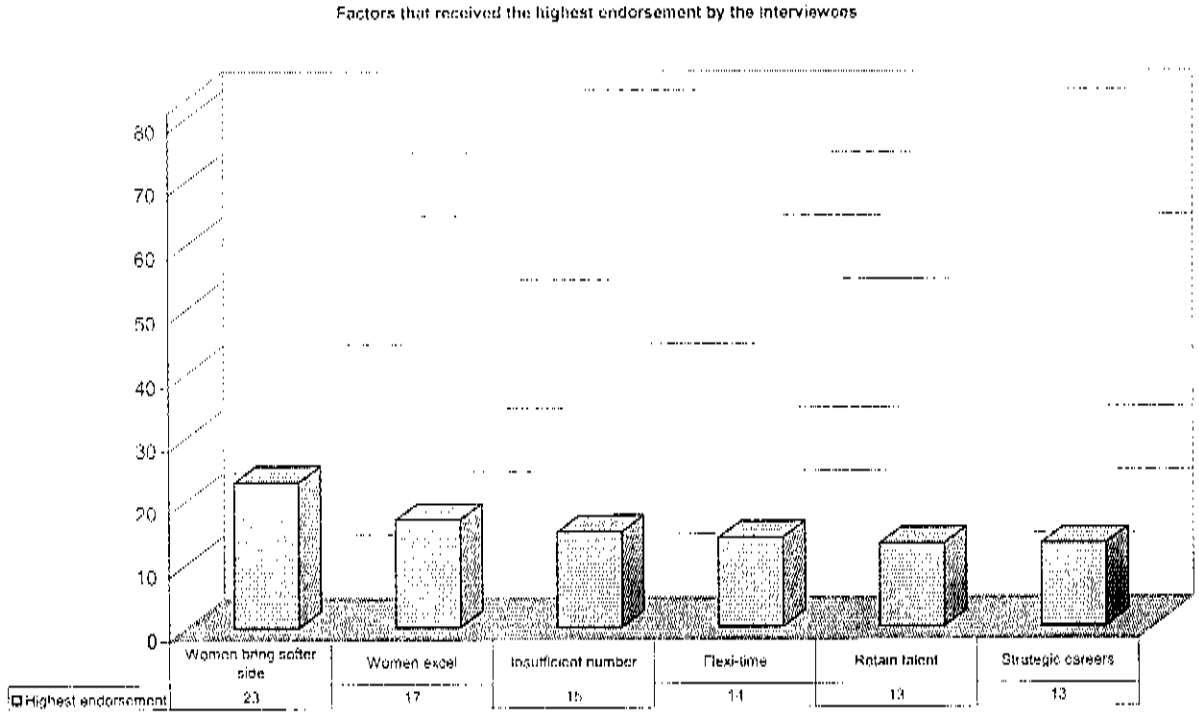

Figure 2 Factors that receive the highest endorsement by interviewees

Factors endorsed most by the interviewees (up to the five highest scores) that are favourable to women's participation are reflected in figure 3 below:

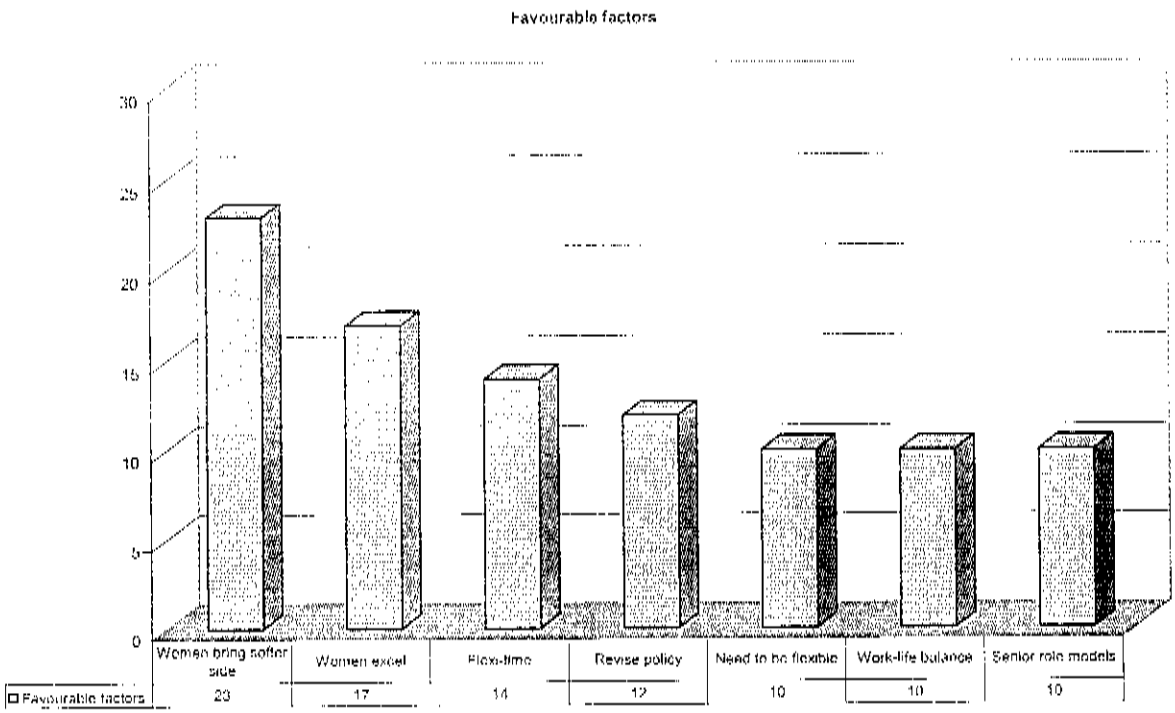

Figure 3 Factors that received the highest endorsement by interviewees that are favourable to women's participation

Factors that were endorsed most by the interviewees (up to the five highest scores) that are unfavourable to women's participation are:

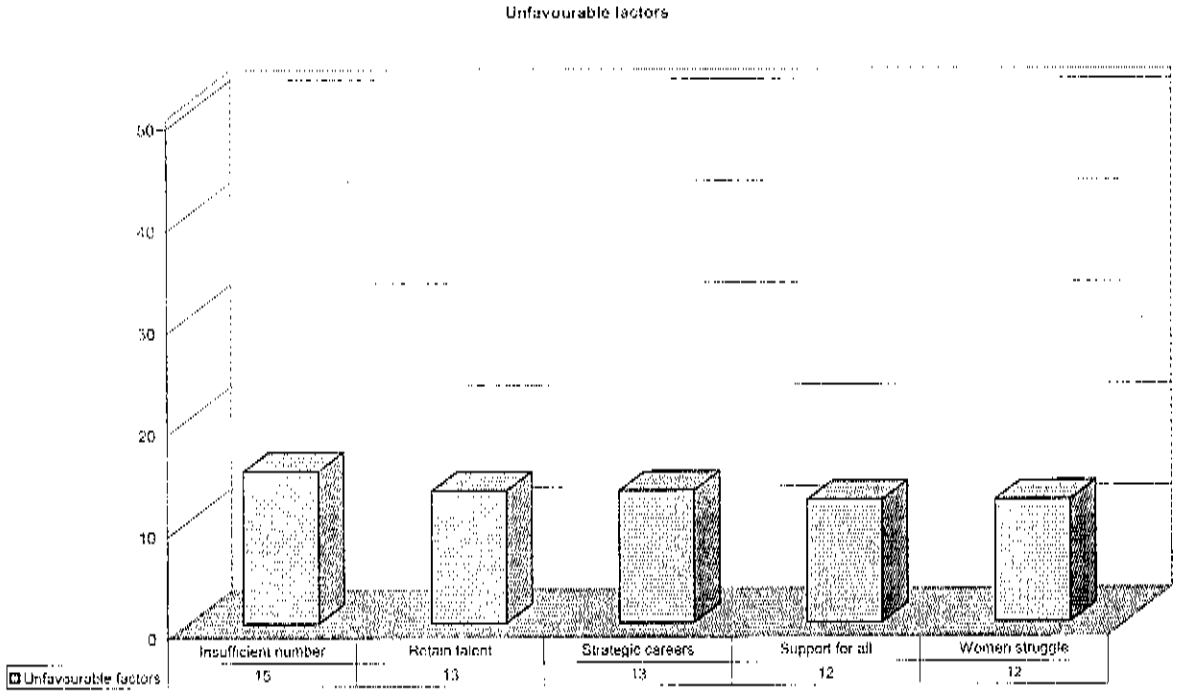

Figure 4 Factors that received the highest endorsement by interviewees that are unfavourable to women's participation

4.3.3 Policies and strategies to address gender and equity issues

Part of the in-depth interview questions focused on policies in the organisation that addressed gender and equity issues as well as any strategies used to support these policies. Across the 21 organisations that participated in the study, 15 of the 38 interviewees affirmed that their organisation had a gender or equity policy or some type of non-discrimination policy. Fourteen interviewees reported that their organisation had gender specific targets, did head counts or tracked equity in terms of race and gender. The existence of sexual harassment policies was mentioned by 15 interviewees. Twelve interviewees said that they did not have a gender policy, but what they called a "people policy".

The reported strategies that organisations use to support the implementation of these policies are presented in figure 5 below:

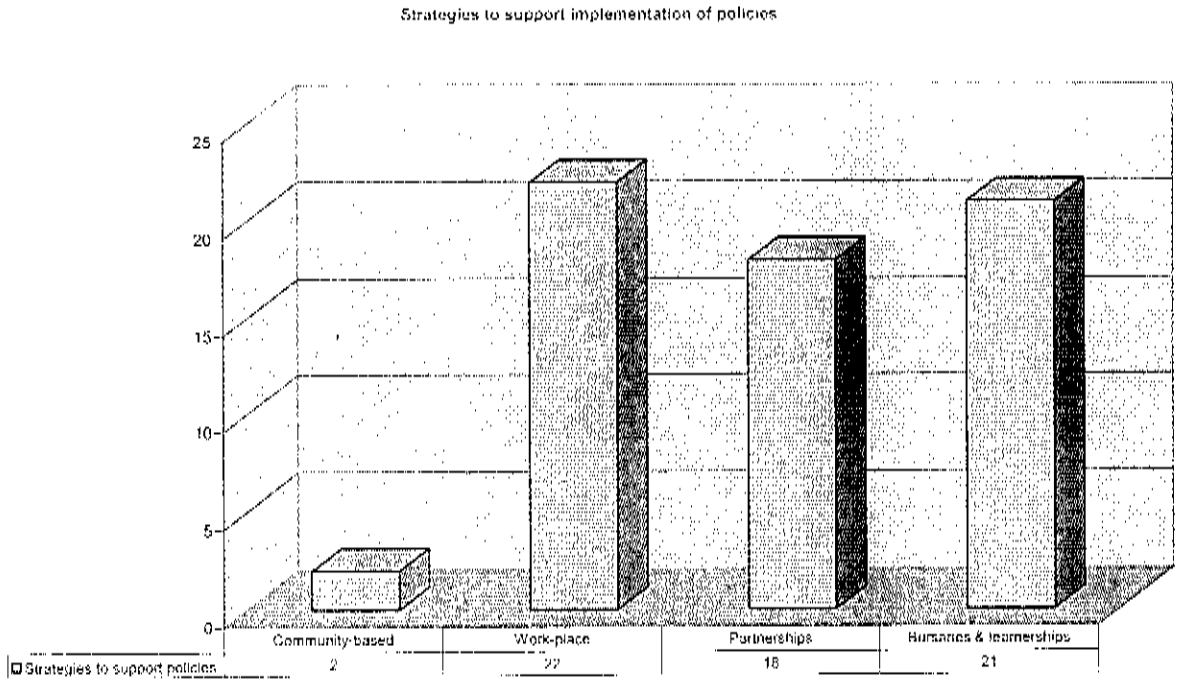

Figure 5 Strategies that companies use to support the implementation of policies

The interviewees did not commonly discuss policies specifically addressing gender issues. Both men and women did not regard them as important, especially at SMMEs. One of the female interviews at an SMME stated that there are "No real issues that women have that require them to get special treatment". Furthermore, incorporating issues for women into a gender policy is constructed around women as child-bearers, i.e. what maternity leave benefits exist.

Interviewees at SMMEs perceive having policies like sexual harassment policies to be linked to the size of a company and so because they see themselves as 'small' they do not see it as necessary to have these kinds of policies in place. One interviewee (senior male) at an SMME said that they "would go to what the labour laws say" if sexual harassment did take place. One male CEO of a private company stated that the company did not have a sexual harassment policy, but that these matters were dealt with as a contravention of the company's code of conditions of service.

There appeared to be a lack of female mentors in private companies. This implies that male seniors often mentor young women entering the industry. A male CEO confirms that "For the young ladies in the company, we have relatively few people we can choose from to be mentors and unfortunately we don't have senior enough or experienced enough women to act as mentors".

Some interviewees felt that there needs to be a national strategy for the SET sector. This strategy should be focused on retaining women in the specific Science, Engineering and Technology industries through a quota system. In other words, the strategy needs to clearly indicate the number of women needed in each sector to balance the playing fields. SET industries would then have a framework from which to develop their employment equity strategies in the workplace.

4.3.4 Factors contributing to or inhibiting women's participation in specific organisational contexts: thematic analysis

4.3.4.1 Factors in recruitment, retention and advancement of women in JSE listed companies

Women at JSE listed companies may feel that they are recruited, retained and advanced because legislation dictates that these entities must implement affirmative action and employment equity policies. One senior woman believes that quotas must be set through charters such as the one for the ICT sector, but that "once these quotas are set you will get people that can do the job and other people you provide training for them, they need mentoring, they need coaching for them to survive within their own jobs". Implementing quotas will also ensure that companies work hard to retain women as once women are in these positions it will be costly to replace their skills if they leave.

> That is what they are guided by, they are guided by legislation, they are guided by what they have to do not by what they want to do.
> - Senior female
> There are certain things that women got that men don't but that's according to the law.
> - Male CEO

There seems to be a tendency for women to leave JSE listed companies after a short while. According to a senior female in a JSE listed company women "seem to come and go and the next thing you hear they are gone so they study and then work for about three years on a contract where they mostly do planning work in the office and don't really do any projects and then they disappear and I don't know what happens to them." This interviewee links the lack of advancement opportunities for women in her company to the problems with retention of women, but also states that women do not remain in a job long enough to prove that they can contribute to the industry and thereby advance.

A male CEO at a construction company feels that although his company does not have specific empowerment strategies for women their family commitments are given priority: "We do try and help the females more than the males when it comes to their children being ill or having to cart them around. When we have two engineers who are married and we have got quite a few of them we try to put them on the same projects".

4.3.4.2 Factors in recruitment, retention and advancement of women in private companies

A woman who has been headhunted for an organisation may feel that "even if she is second best she will be employed to ensure that numbers are correct". According to the man that made this statement women who have been headhunted for a position may not always feel accepted and may leave "to start their own thing". The perception that women are part of the equity plan and that they are not as competent as men may be pushing women out of private companies into entrepreneurial opportunities.

> ... with the BEE charters who is going to be forcing industries to look more on women, predominantly black women. I mean if you could find a black woman engineer I think you would pay the earth to have her in your organization because of the points allocated to something like that so I think companies are going to be forced if they don't have the culture already they will be forced to adopt that culture.
> - HR executive

When women feel "accepted, acknowledged and recognized" a female engineer believes that they will be retained in the SET industry. She has had positive experiences in her organization: "I am part of the company, people know me, people recognize me and I don't feel alienated and on my own. I have male colleagues that I can go to and say you know this is the situation and how would you deal with it so I have got those structures and I have got the acceptance and recognition and I don't know how you would instill that if it is not there".

> The CEO knows every person's name, he knows their children's names and how old they are. He knows intimate things about people and I think that is what people really enjoy about the company. You are not just another worker. You have circumstances. I think the women find this very important as they look after the family and they need their employer to be aware of them and their families ...
> - Senior male
> When I was very ill with my baby and this company went to great lengths to accommodate me with my leave and my sick leave and all the things they did and I will always remember what the refinery manager said, he said "if we assist her now we will retain her, if we don't assist her we would lose her" and it was the same words he used when I went to university to do my honours ... he had this whole approach "if we do little favours for people, little things to make them happier, more comfortable, outside of a policy we will retain people" and I think this has been more our strategy as opposed to making everything policy.
> - Female HES manager

Private companies tend to have flexi-time for employees which makes it easier for women with family commitments to be retained by the organisation. This works on an output model, i.e. you are judged by the work you deliver and not on the time you spend in the office. Other ways of accommodating women is to give them half-day jobs, although benefits are cut accordingly.

4.3.4.3 Factors in recruitment, retention and advancement of women in SMMEs

SMMEs battle to compete with the salaries that government is prepared to pay at lower levels. One example is that local or national government is prepared to pay a deputy director large salaries although he or she only has a year or two technical diploma experience whereas they should have ten to fifteen years post-graduate experience. Women were not discussed separately from men in this example and it therefore seems to be a broader sector problem than a challenge specific to women.

A challenge related to the perceived size of SMMEs is establishing formal mentoring systems. These kinds of systems are seen as beneficial for people in big companies, but also that instituting mentoring could be perceived as underestimating the extant capacity of individuals. Women are not necessarily seen as being in more need for mentoring than men.

SMMEs may have policies that affect the retention of women in the SET sector such as allowing women to take maternity leave only after the completion of 18 months of a contract. There is also uncertainty amongst women in these institutions about whether her job is reserved for her on not while she is on maternity leave.

SMMEs feel that do not participate sufficiently in promoting SET and would like to become more involved with showing school children what good opportunities there are.

4.3.4.4 Factors in recruitment, retention and advancement of women in SOEs

Women in SOEs feel that they do not have flexibility in terms of work hours. This makes it difficult to take care of their family commitments like dropping children off at school in the mornings.

The HR manager at an SOE feels that the burden is on the state to take the leadership position and achieve equity while it should be a national objective. SOEs also have the problem of retaining women in their organisation due to the pressure of employment equity on other organisations: "... people keep on poaching them, each and everyone out there is trying to push their numbers so they are under pressure because of the few numbers that we have so we experience huge problems". Investing in women does not ensure that they will be retained in the organization: "You will recruit a woman, take her overseas to overseas training courses and all that, when she comes back she leaves, somebody else attracts here, they give her a higher salary because you have to pay a premium all the time when you are a female" (executive female interviewee). According to this interviewee the solution is to ensure a working environment that is conducive, very welcoming and enabling, but that high salaries and top positions remain the best way to attract women.

In general young people are not attracted to SOEs as these institutions do not offer the same financial rewards as the private sector. A senior woman at an SOE also complained that "there is no entrepreneurial drive, innovation is stifled which is specific to SOEs".

> You have youngsters coming from varsity, some they have started in companies that in the name of employment equity, made certain sections of the population progress faster than others. And in six months time they are driving a BMW and they are able to buy themselves a small townhouse or penthouse or something small that's very nice, and chic, and very up market place. And then you have someone that starts at our organization and he has to start and try to understand what to do in our position, and what is the reason for our existence and starting almost from scratch, and therefore aiming at the level of supervisor ... they simply go.
> - Female General Manager
> But they stay because they believe – I will stay in a company when I believe I still have a lot to learn ... However, if the environment is such that I cannot achieve or learn that which I want to learn, clearly I am wasting my time sticking around.
> - Female General Manager

In SOEs, it was generally felt that advancing women too quickly could be counter-productive for both the employee as well as the company. It was mentioned that this type of fast-tracking sets the female employee up for failure. Gender equity at senior levels can also be a barrier to women's career interests: "There is a drive to put women into management positions and so they can't become specialists if they want to. Its too rigid; people should be placed where their interest lies" (senior female manager of IT division).

> In our haste to empower women, and this could relate to affirmative action in terms of race as well, people who have all the professional qualifications have sped through the ranks at such a pace that sometimes they are set up for failure, where they might have benefited from a slightly slower path to development.
> - Senior woman at an SOE
> I think whilst we need specific programmes for women and we need to focus on that we also need now to start taking care of the ageing workforce, unfortunately it is white male mostly, we need to start appreciating the value those people still have to enhance skills development for our people because that is where the knowledge is.
> - HR manager at an SOE
> Gender representivity is a world-wide problem in engineering so when it comes to the sector in South Africa I don't think we should ever need to feel that we must force numbers for the sake of gender representation because we ourselves could be very irresponsible when we do that because we could be forcing another kind of discrimination between male and female ... of course I want to see more women with the right reasons where those women themselves must support ... our youth needs to participate in the SET sector not just women.
> - Female managing director of technology

4.4 Integration of findings: Balanced score-card, questionnaires and in-depth interviews

In this section the findings from the three data collection methods are integrated to provide a holistic picture of the participation of women in industrial SET. Interpretations of the perceptions of women and men in industrial SET towards the participation of women in this sector, women's ratings of their experiences of being in industrial SET and the results of the gender representivity survey and balanced scorecard are offered and contrasted with the literature discussed in Section 1.

4.4.1 Discourses of difference between men and women

There are clear discourses focusing on the differences between men and women. Women are constructed as different on an emotional level - they are described as 'softer', 'feminine', more emotional and bringing a more empathic understanding to the SET industry; they are constructed as different on a cognitive level - they think holistically and deeper consideration goes into the decisions they make; and they are constructed as different on a biological level – they cannot participate in unsafe jobs. These discourses are upheld both by the men and women who were interviewed.

These discourses serve to essentialise gender by claiming fixed, unified and opposed male and female natures (Wajcman, 1991:9). In industrial SET this assertion focuses on the inherent difference between men and women to elucidate their differences in the sector and by inference, their participation. This interpretation concurs with the literature in Section 1 that highlights constructions of gender differences as one of the main factors that force women out of SET.

There are also contradictions in what women say about themselves. They construct themselves as different to men, say that this difference is necessary as they bring new attributes to the workplace, but at the same time that they want to be equal. Women are often cast in supportive roles for men in the workplace which mirrors the typical role that women play in the home, e.g. being responsible for activities around food when on a field trip.

4.4.2 Women are not a homogenous group

The results of the questionnaires completed by women in industrial SET demonstrate that there is a considerable degree of diversity in terms of the specific experiences of individual women across SET workplaces, across women's life-cycle in terms of age groups and across position in the company. It is therefore important for policy-makers and implementers to realise that women are not a homogenous group and a 'one size fits all' solution is not always possible. The SET industry should also refrain from treating women as though they are a uniform group. Important differences may exist in terms of the needs and priorities for women from different racial, socio-economic, and age groups and across SET sectors.

At a macro-level, however, similarities do exist with variations being more apparent in terms of magnitude, severity and impact on the women involved. From a national policy perspective the nuanced nature of this reality, though important, is not of primary concern. Of particular interest is the need to address the existing gender imbalances in the SET sector of South Africa through a systematic process that ensure women's full participation in and benefit from the SET sector. Once a policy framework has been adopted and agreed on by all stakeholders, specific manifestations within each industrial context can then be addressed at a micro level.

4.4.3 The masculine image of science

The findings from this study concur with the literature discussed in Section 1 with regards to hegemonic masculinity and the association of technology with masculinity. The masculine image of SET relates strongly to the discourses of difference between men and women described above. Women often feel that they do not fit into a male-dominated culture as the benchmark for a successful scientist is a man and also that women must change in some way to match the role of the male scientist. The gendered dichotomy, i.e., that men are machine-focused, rational and abstract thinkers and women are people-focused, emotionally connected, concrete thinkers works to exclude women from SET as the dichotomy communicates to women that they are not being authentic to their genders. Although research shows that both of these types of thinking are required in SET fields men continue to dominate. More research needs to be conducted about the relationship between continued male dominance as well as the masculine images of technology and how they are sustained.

4.4.4 Women's increased participation in the SET industry must be a natural evolution

There seems to be a belief that it is not policy that will change women's participation in the SET industry; it is a natural evolution as more women enter the sector. Also, the perception exists that women should not be advanced too quickly as they will experience demands beyond their capability and eventually they will burnt out. What these positions fail to take into account, however, is that women do not often sustain long-term careers in the sector. In this research, as in previous studies commissioned by DST, males and females say that scientists exit the SET sector for more lucrative career paths in other sectors like the financial sector for example.

But it seems that women also leave due to gender-based obstacles such as discrimination, exclusion and family commitments. The construction sector seems to be a particularly harsh environment for women. Sadly, the 22 companies in this study did not report many (if any) decisive initiatives to retain women in their organisations.

International studies also show that the participation of both men and women in science and technology is declining. Added to this problem, the trend of women exiting the SET sector and the seeming reluctance of the sector not to do anything about this, could have an impact on the 6% growth rate desired by the South African government. The results from the in-depth interviews show that women, especially in private and JSE-listed companies, tend to exit the organisation to begin their own business/consulting practice. These women are in the ideal position to act as entrepreneurs and should be supported by funders and government to ensure their success. This might be one way of increasing women's participation in industrial SET.

Increasing women's participation in the SET industry should not be left to natural evolution. The European report on science and technology indicators (2003) examined a number of studies that make it clear that gender equality will never occur if left to "natural redress". The report states that "It is clear that 'simply waiting one's turn' is not an option for today's women. Moreover, merely condoning a short wait would also be a patronising attitude towards the question of women's participation in science" (p. 265).

4.4.5 Inequality of men and women in industrial SET

According to the participants in this study men and women in industrial SET are unequal in a number of ways. Although there may be more ways in which women feel they are unequal in the workplace four main types are discussed here. Firstly, men and women receive different remuneration for the work of the same value and on the same level. Although this was raised without being prompted by the interviewer by only three out of 38 interviewees, almost two-thirds (64%) of the women who returned the questionnaire are in agreement that male colleagues earn more than female colleagues at the same level. More than two-thirds (67.6%) of women on a non-management level and almost 77% of women between the ages of 35 and 55 years hold this perception. This perception is supported by the theory of human capital that asserts that inequality in career success is a result of differences in men's and women's human capital. Salary inequalities between men and women are also a consequence of human capital (Igbaria & Chidambaram, 2004).

Secondly, some women feel that they are not taken as seriously as men. This is often raised when women talk of having to work harder than men to prove themselves. Women's competence to practice science is sometimes questioned by men and their confidence may suffer as a result. As reported in the literature this lack of confidence may lead to attrition as well as restricting the development of women in the profession.

Thirdly, there is a difference between men and women in how much access they have to networking opportunities. Women are often excluded as networking typically revolves around activities such as golf and drinking in pubs after hours. Although these are activities that women could participate in some prefer not to or they are restricted by the family commitments they have to fulfil after office hours. These networking opportunities are perceived by women to be of great importance in doing business and some blame their lack of performance, and consequence departure from the SET sector, on the frustration they feel in not being able to network to the same extent as their male colleagues. This concurs with the literature discussed in Section 1 about engineering as a homosocial performance where career progression for men, especially in the engineering field, is based on involvement in successful projects and membership of networks of contacts and mentors (Melström, 1995). Most women who initially lack the hand-on experience and confidence, despite their competence, do not experience the thrill and obsession of their male counterparts (McIlwee & Robinson, 1992; Mellström, 1995). Women do not belong to the 'club' and are greeted with hostility by many male engineers; they lose out on their careers and it is not surprising that many women engineers opt to leave the profession.

Lastly, there seems to be a new glass ceiling that women cannot break through. The new glass ceiling relates to the highest position in the organisation. Thus, women feel that are able to reach management and even executive management and board of director level, but are very seldom appointed to head a company as CEO or managing director. The findings from the gender representivity survey support the observation by the research participants that women are well-represented at the lower levels of industrial SET companies, but not at the level of chairperson of the board, CEO, board of directors and executive management. Other research (Blau & Ferber, 1989) has also suggested that great returns on investment are primarily received by white males as opposed to women and 'minority' groups irrespective of educational level, skills and work effort, a claim that is particularly relevant to South Africa.

These inequalities may reproduce societal notions that science is for men when it seems that women cannot 'cope' and leave the sector. As stated above, however, women may be leaving due to obstacles such as discrimination and exclusion and not due to inability to practice science. The message that women are receiving (that they are not equal to men in the workplace) may be an additional factor that pushes women out of the sector.

4.4.6 Lack of adequate record-keeping of women in industrial SET

In the introduction of this report the relevance of this research was supported with a statement by Mario Ramos in the South African Women in Corporate Leadership Census (2004) that measurement is an essential component of establishing and planning for the progression towards gender equity. South Africa's National Policy Framework for Women's Empowerment and Gender Equality prepared by the Office of the Status of Women in 2000 also specifies the key institutional processes, role players, key partners, and mechanisms required to achieve gender equality in both the public and the private sectors of the South African economy. It seems, however, that these national objectives are not being integrated into the strategic management plans of all organisations in the industrial SET sector. For example, the responses to the gender representivity survey uncovered the lack of adequate record-keeping by some companies of initiatives that increase women's participation in the sector. Some responses received ('information not available' or 'no precise record of this') show that companies do not track essential indicators of how they are increasing women's participation. In addition, the women and men who were interviewed tended not to view the lack of policies (such as gender and sexual harassment policies) and strategies focused on retaining women in their organisation in a very serious light. Interviewees from SMMEs tended to rationalise this deficiency on the basis of size of organisation, i.e. the bigger the company the more important it is to have the necessary policies in place.

4.4.7 Allocation of responsibility for increasing women's participation in industrial SET

The majority of responsibility for increasing women's participation in industrial SET, in the perception of the research participants, seems to be located with national government. One discourse revolved around the function of quotas, i.e. government needs to formulate policy and put quotas in place to ensure an increase in women's participation. Another discourse is about perceived inequality in roles regarding responsibility. This discourse came from SOEs who complain that the bulk of the pressure to ensure equity, especially in science, engineering and technology, is on their shoulders due to them being an organ of the state. According to SOEs there is no national strategy in place that compels all role-players to contribute equally. They see themselves as having to take the leadership role to achieve government's objectives of gender equality in the workplace.

5 SECTION 4: RECOMMENDATIONS TO INCREASE THE PARTICIPATION OF WOMEN IN THE SET INDUSTRY

Recommendations to increase the participation of women in the SET industry include aspects that need to be addressed by industry, national government, funders and universities. Additionally, the media could be used effectively by these entities to showcase more inclusive images of a good scientist.

5.1 Recommendations for industry

- Implement flexi-time arrangements for women across all SET industrial sectors as equal access to these arrangements does not currently exist. Flexi-time should also be considered for men, where necessary, so that there is gender equity in terms of child-rearing responsibilities.

- Develop and provide policies that maintain a work-life balance (in agreement with current South African labour laws). This would include maternity and paternity leave, child-care facilities and family responsibility leave especially for caring for sick family members.

- Refrain from treating women as though they are a homogenous group. Important differences may exist in terms of the needs and priorities for women from different racial, socio-economic, and age groups and across SET sectors.

- Create a work environment that allows women to explore and develop their interests in technical fields without feeling pressured to accept management positions for the sake of representation.

- Create a work environment where innovation can flourish, where women can develop their careers according to their life-cycles and where they are measured by their output instead of the hours they spend in the office. This might include technological solutions and infrastructures that accommodate a woman's need for flexibility regarding work hours and specific work activities such as disproportionate travelling.

- Provide alternative networking opportunities for women that are not linked to activities that males traditionally use to do business such as playing golf and/or meeting in pubs after hours.

- Monitor the recruitment, retention and advancement of women in the organisation according to specific targets. Use this information to manage future activities or change organisational strategy related to the participation of women in industrial SET.

- Record statistics or other data from initiatives that support and encourage women internal to the organisation or externally such as entrepreneurial development programmes, procurement practices and/or industry-specific social development projects. Use this information to determine whether the organisation is on target for increasing the participation of women in industrial SET.

- Develop and implement specific strategies and programmes to retain and advance women like training, mentoring and support if needed and ensure the equal treatment of women.

- Monitor the exit of women from the organisation or SET sector and use the information gained from feedback exercises to improve retention strategies.

- Develop specific programmes that accommodate women who return to SET after a period at home with childcare responsibilities.

- Ensure equal pay for equal work across genders.

- Arrange partnerships with schools and tertiary education institutions that will encourage girls to enter the SET sector. Such partnerships may include internships, fellowships, role models, mentors, speakers and supporting events such as the *Take the Girl-child to Work Day*.

5.2 *Recommendations for national government*

- Enhance the unique position that women are in as entrepreneurs when they choose to leave formal employment and establish small businesses or become consultants. Specifically government could:
  - Provide public funds to match private sources of finance;
  - Provide financial support for researchers (especially women) at universities who want to test innovative ideas before they are placed in the public domain;
  - Gather sex-disaggregated statistics on entrepreneurs in industrial SET including details of who applies for and takes patents;
  - Commission research on women entreprenours in research and development to determine the factors (structural or otherwise) that limit their participation in industrial SET.
- Develop a national strategy for increasing women's participation in industrial SET at all levels of the organisation.
- Ensure that legislation is in place that addresses discrimination on the basis of sex and continually review the legislation to ascertain whether it is working or not. Government should specifically address the issues of equal pay for equal work.
- Create an environment that supports women in industrial SET such as revising tax laws based on the breadwinner/homemaker model where necessary and subsiding care for children or elders that is often a woman's responsibility.
- Collect, analyse and publish statistics that define and identify industrial researchers as a category and disaggregate these statistics by sex.
- Commission more studies such as this one that examines women in industrial SET and the policies and practices of companies to determine progress in the sector. This information should be disseminated as widely as possible and should be used in the planning and revision of national policies.
- Continue to debunk stereotypical views of women as well as of people of colour in terms of their ability to perform science. More inclusive images of the "good scientist" need to be broadcast to the general population that challenge social conditioning through gender and traditional beliefs about women. Initiatives may include gender awareness campaigns and equality training.
- Arrange conferences, forums and networking opportunities for women in the SET industry, not necessarily about SET but about gender and women's issues with clear objectives in terms of what the aim is.
- Support initiatives such as the *Take the Girl-child to Work Day* especially where women are in the minority like the SET sector.
- Benchmark support for women in industrial SET nationally using existing structures such as CEDAW and frameworks such as the GPF, and internationally with entities such as the Helsinki Group and Accord. Good practice should be adopted and publicised wherever possible.

- Policy-makers and implementers must refrain from treating women as though they are a homogenous group. Important differences may exist in terms of the needs and priorities for women from different racial, socio-economic, and age groups and across SET sectors. Policy needs to address each stage of the woman's lives.

- Assess the gender impact of new policies.

5.3 Recommendations for universities

- Provide compulsory courses in business skills to all under-graduate SET students.

- Provide facilities for students who want to test innovative ideas before they enter the workplace.

- Address gender biases in the teaching of SET disciplines.

5.4 Recommendations for funders of entrepreneurial projects

- Monitor applications and winners of bids by sex.

- Benchmark the number of women supported with other institutions that provide financial support to entrepreneurs.

- Ensure gender equity of forums where decisions are made about funding.

- Be pro-active in encouraging applications from women entrepreneurs and women who want to establish part-time businesses.

- Facilitate the establishment of companies by women who have had a period of work interruption.

- Identify and/or promote networking opportunities and mentoring schemes amongst women entrepreneurs or business networks.

Figure 6 below presents these recommendations grouped into major areas that should be addressed by the role-players and stakeholders who are able to increase women's participation in industrial SET.

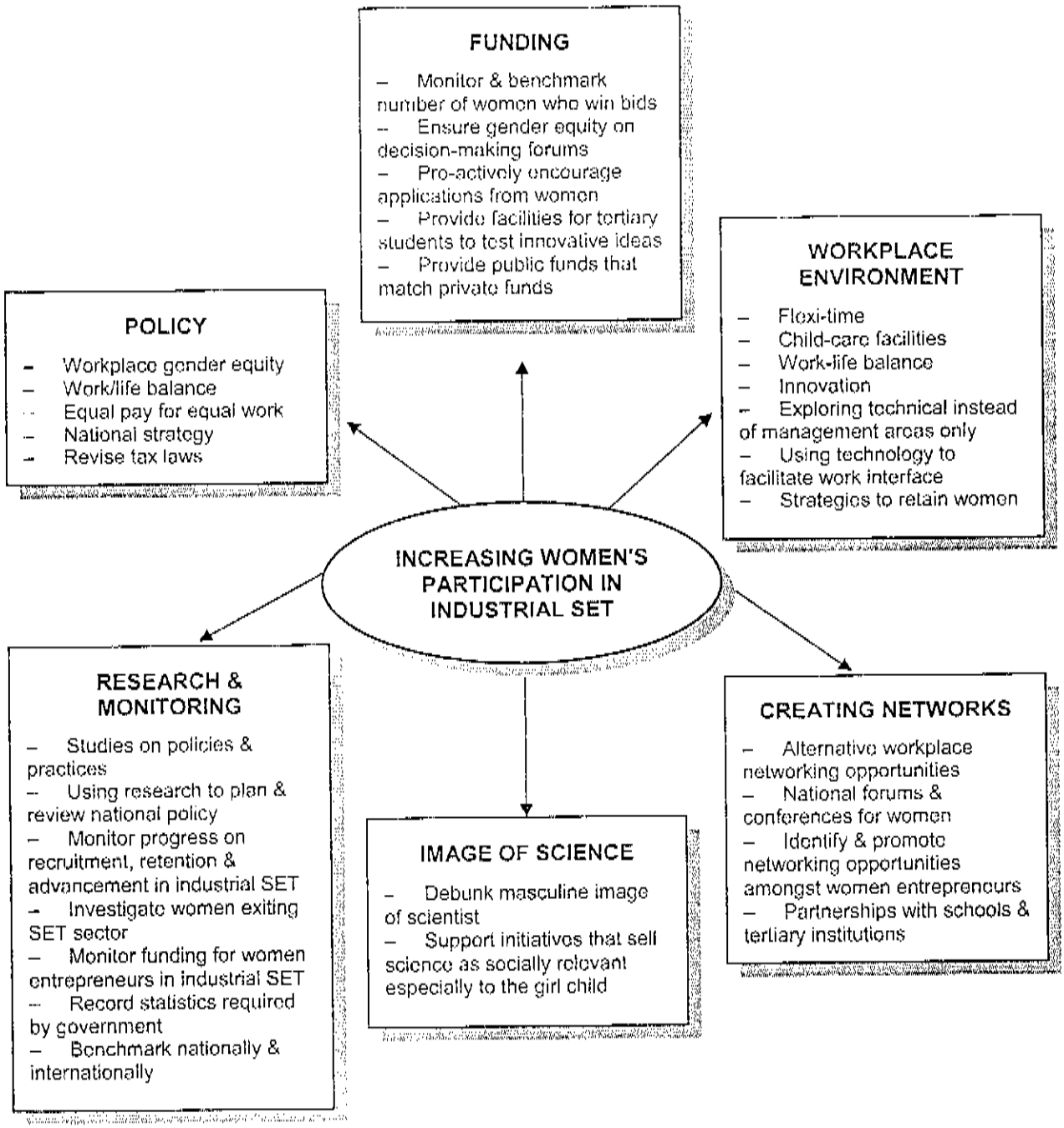

Figure 6 A schematic presentation of recommendations to increase women's participation in industrial SET in South Africa

6 CONCLUSION

The aim of this report was to present findings from one of the research projects undertaken by the Gender and Development Unit of the HSRC on behalf of the DST in preparation for policy formulation to address the lack of participation of women in the South African SET sector. The aim of the research was to determine factors contributing to or inhibiting women's participation in the SET sector of South Africa. The current situation with regards to gender representivity in the participating companies shows that women in these companies are under-represented and especially so at the highest levels of the organisation. Perceptions about women's participation demonstrate that although more women are entering the SET sector, science has maintained its masculine image and all the aspects that accompany this image. Recommendations for changes that will aid in increasing women's recruitment, retention and advancement in the industrial SET sector include debunking the masculine image of science, examining ways in which women's life-cycle needs can be accommodated in the work environment, increasing funding for women in the sciences especially for those who become entrepreneurs and creating networks amongst scientists that do not rely on activities that men traditionally use to do business.

It is therefore commendable in the light of the challenges that women face in the SET sector that government has taken the initiative to formulate a gender equity policy that addresses women's lack of participation across the SET sector, from school to the workplace. Furthermore, it is crucial to monitor and evaluate the policy's impact on women's participation. For example, although SOEs have risen to the challenge of compliance with gender equity requirements, an important challenge remains for departments such as DST and DTI to bring private and JSE listed companies to comply.

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APPENDIX A: Gender representivity survey – Balanced score-card

APPENDIX B: Questionnaire

APPENDIX C: In-depth interview guide

APPENDIX D: Balanced score-card methodology

Background

Like many governments around the world, the South African government, has adopted the Balanced Scorecard approach as a tool for, among other things, evaluating and monitoring various aspects of social transformation in the country. Indeed, the Department of Trade and Industry (DTI) issued the Balanced Scorecard as one of the Codes of Good Practice towards the end of 2004, and, requested various industry sectors to use this flexible framework to draw up their BEE Charters. To date, a number of such Charters have been developed for the various sectors of the South African Economy (e.g. the Transport sector, the Tourism sector, the Agricultural sector, etc).

Although the DTI's Codes of Good Practice were designed with Black Economic Empowerment in mind, it is apparent that the same methodological framework can be used to assess women's participation in various sectors of the South African economy. Development of the Balanced Scorecard presented below was based on a detailed review of both local and international (notably from the UK) literature available on websites and government publications. It is useful to highlight the fact that, internationally, the Balanced Scorecard came into focus in the early 1990s, thus coinciding with the birth of a new democratic dispensation in South Africa.

In time, and to its credit, the South African government seized the opportunity presented by this development in the area of performance measurement and management, and adopted this approach in its development of the '*Broad-based Black Economic Empowerment Framework*', published by the DTI towards the end of 2004. Section 12 of the Broad-based BEE Act of 2003 makes provision for the development of transformation charters for the various sectors of the South African economy. Section 9 of the same act also makes provision for the development of what are called Codes of Good Practice. The first draft of the Codes of Good Practice was released by the DTI in December 2004, and, includes the DTI Generic Scorecard.

In developing the Balanced Scorecard for Women in the SET sector presented in this document, the DTI Generic Scorecard was used as a guide. In many ways, the challenges faced by the government with regards to BEE, are quite similar to the challenges faced with regards to the empowerment of women in the SET sector. Thus, drawing on the existing tools used to foster BEE is not without reasonable justification.

What is a Balanced Scorecard?

Prior to the development and introduction of Balanced Scorecards into the management processes of companies and government departments around the world in the early 1990s, management theories stressed financial performance above other measures of success. Developers of the Balanced Scorecard felt that this approach did not give an accurate picture of how well specific organizations were performing with regards to the overall goals set out in their strategic plans. Thus, they created a methodology that included a number of non-financial measures, in order to produce a more 'balanced' picture – hence the name 'Balanced Scorecard'. An examination of Code of Good Practice #000 published by the DTI, as well as several other Balanced Score Cards (e.g. the Transport Sector BEE Scorecard, the Tourism Sector BEE Balanced Scorecard), as well as presentations made by the Deputy Director General (Enterprise and Industry Development Division) of the DTI was instructive in terms of clarifying our understanding of the major INDICATORS of a sound Balanced Scorecard, which we deduced to be:

- Ownership – Voting rights and economic interests associated with equity holding. Voting rights afford the rights to determine strategic and operational policies, while economic interests afford women in the company to rebuild and accumulate wealth.

- Management – Control of economic activities and resources; power to determine policies as well as the direction of economic activities and resources. This indicator can be sub-divided into: 'Board of Director' level, and 'Executive Management level'.

- Employment Equity – Mechanisms used to achieve gender equity in the workplace. This includes strategies for promoting the elimination of unfair gender discrimination in the workplace, as well as implementing affirmative action in order to achieve equitable gender representation in all occupational categories and levels in the work place.

- Skills Development – Development of core competencies among women in order to facilitate their integration into the mainstream of the economy.

- Preferential Procurement – Strategies for measuring the widening of women's access to the company as a market for their products (e.g. a manufacturing firm may have in place a policy of preferential outsourcing of its marketing, advertising and recruitment functions to agencies owned and run by women or companies in which women are active players.

- Enterprise Development - Strategies for assisting and accelerating the development of operational and financial capacity of entrepreneurial enterprises owned by women.

- Residual factor – includes any residual factors such as social development initiatives, community development, industry-specific initiatives, etc.

Weightings. All Balanced Scorecards involve a process of **weighting**, whereby the relative importance of the various indicators is determined. Similarly, sub-indicators are appropriately weighted. This issue requires a consensus to be reached with all stakeholders in this project. The research team proposes the weights indicated in the balanced scorecard shown in this document, but, we are open to suggestions regarding this matter.

Scoring. All properly constructed Balanced Scorecards involve the calculation of final rating score, usually out of 100. The sample scorecard presented in this document illustrates how the final rating score is determined. However, the final score is dependent upon the final weights to be agreed upon by the stakeholders through a consultative process. It is envisaged that each company will be appropriately scored, after which data within the various sectors identified will be aggregated to obtain an indication of how the various companies and sectors within SET fair relative to each other.

Usefulness. The last sentence in the preceding section on scoring makes the usefulness of the Balanced Scorecard methodology apparent. The results from this component of the study can be useful in terms of identifying transformation targets for companies and sectors within the SET sector, an output that could be of tremendous benefit in terms of the on-going policy formulation and implementation processes with the Department of Industry and Technology in South Africa.

Table 1 shows the proposed Balanced Score card for Women in Industry study. Table 2 shows a Model Balanced Scorecard, complete with ***illustrative*** data.

Table 1. Balanced scorecard for women in the SET sector of South Africa

CATEGORY OF INDICATORS	WEIGHTING	SUBWEIGHTING	INDICATORS (i.e. data to be collected from each entity) NB.1: All data to be collected, broken down by previous racial groups NB.2: For skills development, preferential procurement, enterprise development, and residual factors – ALL % should be for the previous financial year
OWNERSHIP			___% share of direct shareholding by women ___% share of indirect shareholding by women NB: Direct shareholding = employee share schemes; Indirect shareholding = ownership by women outside the organisation
MANAGEMENT			___% of women in the Board of Directors ___% of women in Executive Management
EMPLOYMENT EQUITY			___% of women in Middle Management ___% of women supervisors ___% of women highly skilled/professional category ___% of women junior professional category ___Women as a % of Total Staff ___ Presence/absence of gender equity policy
SKILLS DEVELOPMENT			___% of payroll spent on skills development on all employees ___% of payroll spent on skills development aimed at developing women's skills ___Number of learner ships as a % of total employees ___ Number of women learner ships as a % of Total learners
PREFERENTIAL PROCUREMENT			___% spent on Women Empowerment Companies /individuals as a % of Total procurement
ENTERPRISE DEVELOPMENT			___% of post-tax profits spent on women's entreprenecurial development ___% of employee time contributed to enterprise development ___% of twinning initiatives facilitated for women-owned SMMEs, as a % of the Total revenue of the

			company/organization
RESIDUAL FACTOR (Social Development and Industry-Specific Initiatives)			___% post tax-profits spent on education, community programmes, job creation, training, health, conservation, community tourism and marketing activities to develop participation of women ___% of new recruits with no prior work experience
TOTAL	100%	100%	

Table 2. Model balanced scorecard for women in the SET sector of South Africa

CATEGORY OF INDICATORS	WEIGHTING	TARGET	ACTUAL LEVEL	CONVERSION PROCESS	SCORE
OWNERSHIP	5%	50%	1.5%	1.5%/50%X5%	0.15
MANAGEMENT	10%	50%	2.5%	2.5%/50%X10%	0.50
EMPLOYMENT EQUITY	20%	50%	15%	15%/50%X20%	6
SKILLS DEVELOPMENT	20%	50%	38%	38%/50%X20%	15.2
PREFERENTIAL PROCUREMENT	10%	50%	13%	13%/50X10%	2.6
ENTERPRISE DEVELOPMENT	5%	50%	30%	30%/50%X5%	3
RESIDUAL FACTOR (Social Development and Industry-Specific Initiatives)	20%	50%	40%	40%/50%X20	16
TOTAL	100%				43.45

WE Score > 65 = Good WE Score > 40 = Satisfactory WE Score <40 = Limited

Appendix E: Tables of findings

Table 3 Demographic characteristics of respondents to questionnaire (N=90)

Variable	%	Variable	%
Marital Status		*Company type*	
Single	37.8%	Private	34.4%
Married	43.3%	State-owned	45.6%
Living with partner	8.9%	JSE-listed	11.1%
Separated/divorced/widowed	10%	SMME	8.9%
Race		*Number of children currently living at home*	
African/Black	35.6%	None	41.1%
Coloured	3.3%	One	13.3%
Indian	12.2%	Two to three	42.2%
White	46.7%	Four to five	3.3%
Other	2.2%		
Home language		*Position in company*	
Afrikaans	33.3%	Executive management	1.1%
English	25.6%	Senior management	4.4%
IsiZulu	6.7%	Junior management	16.7%
IsiXhosa	8.9%	Supervisory level	10.0%
SeSotho	5.6%	Skilled professional	58.9%
SePedi	6.7%	Trainee/Internship	4.4%
SeTswana	6.7%	Other - Junior	3.3%
IsiNdebele	1.1%		
Other	2.2%	*Cost to company*	
IsiZulu & SeTswana	1.1%	Less than R100 000	6.7%
English & Afrikaans	1.1%	R100 001 – R150 000	37.8%
English & German	1.1%	R150 001 – R200 000	21.1%
		R200 001 – R250 000	11.1%
Top 3 reasons for work interruptions		R250 001 – R300 000	11.1%
Maternity leave	60.0%	R300 001 – R350 000	2.2%
Study leave	12.5%	R350 001 – R400 000	5.6%
Child-rearing	5.0%	R400 001 R450 000	3.3%
		R450 001 – R 500 000	1.1%
Age			
20-24 years	11.4%		
25-34 years	63.6%		
35-55 years	25.0%		

Table 4 Women's ratings of their experiences in various SET companies (n=90)

Work environment	Disagree	Neutral	Agree
Working conditions take into account that I am a woman	32.9%	28.0%	39.0%
Current position in the company is quite challenging	17.0%	17.0%	65.9%
The working environment is quite stressful	25.6%	13.3%	61.1%
Women find themselves without the necessary instruments to perform duties	71.9%	12.4%	15.7%
Working environment more suitable for men than women	64.4%	8.9%	26.7%
Women deal with obstacles that men don't have to	29.2%	18.0%	52.8%

Remuneration and promotion opportunities	Disagree	Neutral	Agree
Sufficiently rewarded for my efforts at work	42.5%	23.0%	34.5%
Men are often more easily promoted than women	29.8%	20.2%	50.0%
Male colleagues earn more than women at the same level	26.0%	10.0%	64.0%
Men in SET sectors have more opportunities and advantages than women	25.6%	17.4%	57.0%
Other people more easily promoted than Black women	45.8%	18.1%	36.1%

Feedback on work performance	Disagree	Neutral	Agree
Regularly given a formal performance evaluation	25.0%	8.0%	67.0%
Regular informal feedback on my work	32.2%	7.8%	60.0%

Gender relations in the workplace	Disagree	Neutral	Agree
I feel comfortable working with my male colleagues	1.1%	3.3%	95.6%
My male colleagues feel comfortable working with me	2.4%	5.9%	91.8%
Not taken seriously by male colleagues	59.6%	13.5%	27.0%
Men are taken more seriously during meetings	43.4%	20.5%	36.1%

Mentorship & career development	Disagree	Neutral	Agree
Given the resources and training necessary to do work	27.0%	19.1%	53.9%
Adequate opportunities for professional development	38.9%	14.4%	46.7%
Given work assignments that demonstrate capabilities	20.7%	17.2%	62.1%
'Coach' at work who helps address the technical issues	42.2%	14.5%	43.3%
Mentor in organization	51.2%	16.3%	32.6%
Excellent career advancement opportunities at company	42.9%	19.0%	38.1%
Success in career should come before any other considerations	34.1%	12.9%	52.9%

Implications of a career in SET for family life	Disagree	Neutral	Agree
Family life suffers due to work relate responsibilities	66.7%	22.6%	10.7%
Family life suffers due to work related travelling	78.9%	10.5%	10.5%
Often expected to work overtime	46.9%	12.3%	40.7%

Experiences in the SET industry	Disagree	Neutral	Agree
Constantly need to prove myself because I am a woman	38.2%	18.0%	43.8%
As a woman, I sometimes feel marginalised in my industry	29.3%	22.0%	48.8%
I am not taken seriously in my industry	41.2%	21.2%	37.6%
Experienced many difficulties, challenges entering SET	60.5%	9.3%	30.2%
Women should be encouraged more to enter SET sector	4.5%	10.1%	85.4%
Black women should be encouraged to enter SET sector	8.1%	10.8%	81.1%
Excellent career advancement opportunities in SET sector	14.1%	14.1%	71.8%

Race & gender in the work environment	Disagree	Neutral	Agree
Need to prove myself because I am a Black woman	34.0%	17.0%	48.9%
Feel marginalised in my industry as a Black woman	23.9%	23.9%	52.2%
Black women often have to deal with obstacles that others don't have to	27.1%	25.0%	47.9%
Black women find themselves without the necessary instruments to perform duties	72.9%	12.5%	14.6%

Table 5 Women's experiences of the SET industry according to position in the company (n=90)

Work environment	Disagree	Neutral	Agree
Current position in the company is quite challenging			
Management	15.0%	5.0%	80.0%
Non-management	17.9%	20.9%	61.2%
Working conditions take into account that I am a woman			
Management	41.2%	23.5%	35.3%
Non-management	29.7%	29.7%	40.6%
The working environment is quite stressful			
Management	20.0%	10.0%	70.0%
Non-management	27.5%	13.0%	59.4%
Women find themselves without the necessary instruments to perform duties			
Management	80.0%	15.0%	5.0%
Non-management	69.1%	11.8%	19.1%
Working environment more suitable for men than women			
Management	70.0%	5.0%	25.0%
Non-management	62.3%	10.1%	27.5%
Women deal with obstacles that men don't have to			
Management	35.0%	5.0%	60.0%
Non-management	27.9%	22.1%	50.0%

Remuneration & promotion opportunities	Disagree	Neutral	Agree
Sufficiently rewarded for my efforts at work			
Management	25.0%	35.0%	40.0%
Non-management	48.5%	18.2%	33.3%
Men are often more easily promoted than women			
Management	57.9%	15.8%	26.3%
Non-management	20.3%	21.9%	57.8%
Men in SET sectors have more opportunities and advantages than women			
Management	33.3%	11.1%	55.6%
Non-management	22.4%	19.4%	58.2%
Other people more easily promoted than Black women			
Management	52.9%	23.5%	23.5%
Non-management	44.4%	14.8%	40.7%
Male colleagues earn more than women at the same level			
Management	25.0%	16.7%	58.3%
Non-management	24.3%	8.1%	67.6%

Feedback on work performance	Disagree	Neutral	Agree
Regularly given a formal performance evaluation			
Management	10.0%	10.0%	80%
Non-management	29.9%	7.5%	62.7%
Regular informal feedback on my work			
Management	20.0%	0%	80.0%
Non-management	36.2%	10.1%	53.6%

Gender relations in the workplace	Disagree	Neutral	Agree
I feel comfortable working with my male colleagues			
Management	0.0%	0.0%	100.0%
Non-management	1.4%	4.3%	94.2%
My male colleagues feel comfortable working with me			
Management	0.0%	5.0%	95.0%
Non-management	3.1%	6.2%	90.8%
Not taken seriously by male colleagues			
Management	80.1%	10.0%	10.0%
Non-management	52.9%	14.7%	32.4%
Men are taken more seriously during meetings			
Management	70.0%	5.0%	25.0%
Non-management	33.9%	25.8%	40.3%

Mentorship & career development	Disagree	Neutral	Agree
Given the resources and training necessary to do work			
Management	15.0%	20.0%	65.0%
Non-management	30.9%	19.1%	50.0%
Adequate opportunities for professional development			
Management	25.0%	20.0%	55.0%
Non-management	42.0%	13.0%	44.9%
Given work assignments that demonstrate capabilities			
Management	15.8%	5.3%	78.9%
Non-management	22.4%	20.9%	56.7%
'Coach' at work who helps address the technical issues			
Management	38.9%	5.6%	55.6%
Non-management	43.8%	17.2%	39.1%
Mentor in organization			
Management	38.9%	5.6%	55.6%
Non-management	56.9%	16.9%	26.2%
Excellent career advancement opportunities at company			
Management	35.0%	20.0%	45.0%
Non-management	44.4%	19.0%	36.5%
Success in career should come before any other considerations			
Management	55.6%	16.7%	27.8%
Non-management	28.8%	12.1%	59.1%

Implications of a career in SET for family life	Disagree	Neutral	Agree
Family life suffers due to work relate responsibilities			
Management	45.0%	40.0%	15.0%
Non-management	73.0%	17.5%	9.5%
Family life suffers due to work related travelling			
Management	66.7%	16.7%	16.7%
Non-management	82.5%	8.8%	8.8%
Often expected to work overtime			
Management	41.2%	17.6%	41.2%
Non-management	47.6%	11.1%	41.3%

Race & gender in the work environment	Disagree	Neutral	Agree
Need to prove myself because I am a Black woman			
Management	57.1%	14.3%	28.6%
Non-management	25.0%	18.8%	56.3%
Feel marginalised in my industry as a Black woman			
Management	42.9%	14.3%	42.9%
Non-management	12.9%	29.0%	58.1%
Black women often have to deal with obstacles that others don't have to			
Management	28.6%	21.4%	50.0%
Non-management	27.3%	27.3%	45.5%
Black women find themselves without the necessary instruments to perform duties			
Management	85.7%	7.1%	7.1%
Non-management	66.7%	15.2%	18.2%

Experiences in the SET industry	Disagree	Neutral	Agree
Excellent career advancement opportunities in SET sector			
Management	10.0%	15.0%	75.0%
Non-management	15.6%	14.1%	70.3%
Constantly need to prove myself because I am a woman			
Management	55.0%	5.0%	40.0%
Non-management	33.8%	22.1%	44.1%
As a woman, I sometimes feel marginalised in my industry			
Management	45.0%	15.0%	40.0%
Non-management	23.0%	24.6%	52.5%
I am not taken seriously in my industry			
Management	50.0%	20.0%	30.0%
Non-management	37.5%	21.9%	40.6%
Black women should be encouraged to enter SET sector			
Management	5.3%	10.5%	84.2%
Non-management	9.3%	11.1%	79.6%
Experienced many difficulties, challenges entering SET			
Management	65.0%	10.1%	25.0%
Non-management	58.5%	9.2%	32.3%
Women should be encouraged more to enter SET sector			
Management	5.0%	5.0%	90.0%
Non-management	4.4%	11.8%	83.8%

Table 6 Women's experiences of the SET industry according to age group (n=90)

Work environment	**Disagree**	**Neutral**	**Agree**
Current position in the company is quite challenging			
20-24 years	10.0%	20.0%	70.0%
25-34 years	21.4%	16.1%	62.5%
35-55 years	10.0%	20.0%	70.0%
Working conditions take into account that I am a woman			
20-24 years	20.0%	10.0%	70.0%
25-34 years	38.8%	30.6%	30.6%
35-55 years	28.6%	28.6%	42.9%
The working environment is quite stressful			
20-24 years	40.0%	10.0%	50.0%
25-34 years	25.0%	14.3%	60.7%
35-55 years	22.7%	13.6%	63.6%
Women find themselves without the necessary instruments to perform duties			
20-24 years	60.0%	30.0%	10.0%
25-34 years	70.9%	12.7%	16.4%
35-55 years	77.3%	4.5%	18.2%
Working environment more suitable for men than women			
20-24 years	40.0%	30.0%	30.0%
25-34 years	66.1%	5.4%	28.6%
35-55 years	72.7%	9.1%	18.2%
Women deal with obstacles that men don't have to			
20-24 years	40.0%	30.0%	30.0%
25-34 years	27.3%	18.2%	54.5%
35-55 years	27.3%	13.6%	59.1%

Remuneration & promotion opportunities		Disagree	Neutral	Agree
Sufficiently rewarded for my efforts at work				
	20-24 years	33.3%	0.0%	66.7%
	25-34 years	42.6%	25.9%	31.5%
	35-55 years	40.9%	27.3%	31.8%
Men are often more easily promoted than women				
	20-24 years	37.5%	25.0%	37.5%
	25-34 years	38.5%	17.3%	44.2%
	35-55 years	9.1%	27.3%	63.6%
Other people more easily promoted than Black women				
	20-24 years	66.7%	0.0%	33.3%
	25-34 years	47.6%	23.8%	28.6%
	35-55 years	36.8%	15.8%	47.4%
Male colleagues earn more than women at the same level				
	20-24 years	60.0%	20.0%	20.0%
	25-34 years	26.7%	10.0%	63.3%
	35-55 years	15.4%	7.7%	76.9%

Feedback on work performance		Disagree	Neutral	Agree
Regularly given a formal performance evaluation				
	20-24 years	22.2%	11.0%	66.7%
	25-34 years	25.5%	7.3%	67.3%
	35-55 years	27.3%	9.1%	63.6%
Regular informal feedback on my work				
	20-24 years	20.0%	10.0%	70.0%
	25-34 years	39.3%	8.9%	51.8%
	35-55 years	22.7%	4.5%	72.7%

Mentorship & career development		Disagree	Neutral	Agree
Given the resources and training necessary to do work				
	20-24 years	10.0%	0.0%	90.0%
	25-34 years	15.0%	5.0%	80%
	35-55 years	31.8%	18.2%	50.0%
Adequate opportunities for professional development				
	20-24 years	20.0%	20.0%	60.0%
	25-34 years	46.4%	10.7%	42.9%
	35-55 years	27.3%	22.7%	50.0%
Given work assignments that demonstrate capabilities				
	20-24 years	0.0%	22.2%	77.8%
	25-34 years	29.6%	18.5%	51.9%
	35-55 years	9.1%	13.6%	77.3%
'Coach' at work who helps address the technical issues				
	20-24 years	0.0%	33.3%	66.7%
	25-34 years	44.2%	13.5%	42.3%
	35-55 years	55.0%	10.0%	35.0%
Mentor in organization				
	20-24 years	30.0%	40.0%	30.0%
	25-34 years	56.6%	5.7%	37.7%
	35-55 years	47.6%	33.3%	19.0%
Excellent career advancement opportunities at company				
	20-24 years	30.0%	20.0%	50.0%
	25-34 years	40.4%	21.2%	38.5%
	35-55 years	55.0%	15.0%	30.0%
Success in career should come before any other considerations				
	20-24 years	11.1%	33.3%	55.6%
	25-34 years	37.0%	7.4%	55.6%
	35-55 years	40.0%	20.0%	40.0%

Implications of a career in SET for family life	Disagree	Neutral	Agree
Family life suffers due to work relate responsibilities			
20-24 years	75.0%	25.0%	0.0%
25-34 years	70.4%	18.5%	11.1%
35-55 years	55.0%	30.0%	15.0%
Family life suffers due to work related travelling			
20-24 years	83.3%	0.0%	16.7%
25-34 years	76.0%	12.0%	12.0%
35-55 years	83.3%	11.1%	5.6%
Often expected to work overtime			
20-24 years	80.0%	0.0%	20.0%
25-34 years	38.8%	18.4%	42.9%
35-55 years	50.0%	5.0%	45.0%

Experiences in the SET industry	Disagree	Neutral	Agree
Excellent career advancement opportunities in SET sector			
20-24 years	12.5%	0.0%	87.5%
25-34 years	13.0%	13.0%	74.1%
35-55 years	14.3%	19.0%	66.7%
Constantly need to prove myself because I am a woman			
20-24 years	50.0%	10.0%	40.0%
25-34 years	40.0%	20.0%	40.0%
35-55 years	27.3%	18.2%	54.5%
As a woman, I sometimes feel marginalised in my industry			
20-24 years	28.6%	42.9%	28.6%
25-34 years	28.3%	20.8%	50.9%
35-55 years	35.0%	20.0%	45.0%
I am not taken seriously in my industry			
20-24 years	55.6%	11.1%	33.3%
25-34 years	38.5%	25.0%	36.5%
35-55 years	40.9%	18.2%	40.9%
Women should be encouraged more to enter SET sector			
20-24 years	10.0%	20.0%	17.0%
25-34 years	3.6%	9.1%	87.3%

35-55 years	4.5%	9.1%	86.4%
Men in SET sectors have more opportunities and advantages than women			
20-24 years	50.0%	10.0%	40.0%
25-34 years	28.3%	17.0%	54.7%
35-55 years	9.5%	23.8%	66.7%
Men are taken more seriously during meetings			
20-24 years	50.0%	10.0%	40.0%
25-34 years	42.3%	23.1%	34.6%
35-55 years	42.1%	21.1%	36.8%
Experienced many difficulties, challenges entering SET			
20-24 years	77.8%	0.0%	22.2%
25-34 years	54.7%	15.1%	30.2%
35-55 years	63.6%	0.0%	36.4%
Black women should be encouraged to enter SET sector			
20-24 years	20.0%	10.0%	70.0%
25-34 years	4.3%	12.8%	83.0%
35-55 years	13.3%	6.7%	80.0%

Gender relations in the workplace	Disagree	Neutral	Agree
I feel comfortable working with my male colleagues			
20-24 years	0.0%	0.0%	100%
25-34 years	1.8%	5.4%	92.9%
35-55 years	0.0%	0.0%	100.0%
My male colleagues feel comfortable working with me			
20-24 years	0.0%	0.0%	100%
25-34 years	3.8%	5.8%	90.4%
35-55 years	0.0%	9.1%	90.9%
Not taken seriously by male colleagues			
20-24 years	60.0%	20.0%	20.0%
25-34 years	60.0%	10.9%	29.1%
35-55 years	54.5%	18.2%	27.3%

Race & gender in the work environment	Disagree	Neutral	Agree
Black women find themselves without the necessary instruments to perform duties			
20-24 years	57.1%	28.6%	14.3%
25-34 years	72.7%	12.1%	15.2%
35-55 years	87.5%	0.0%	12.5%
Black women often have to deal with obstacles that others don't have to			
20-24 years	33.3%	33.3%	33.3%
25-34 years	29.4%	26.5%	44.1%
35-55 years	12.5%	12.5%	75.0%
Need to prove myself because I am a Black woman			
20-24 years	42.9%	0.0%	57.1%
25-34 years	34.4%	18.8%	46.9%
35-55 years	25.0%	25.0%	50.0%
Feel marginalised in my industry as a Black woman			
20-24 years	25.0%	50.0%	25.0%
25-34 years	24.2%	21.2%	54.5%
35-55 years	22.2%	22.2%	55.6%

Table 7 Women's experiences according to type of SET industry company (n=90)

Work environment		Disagree	Neutral	Agree
Current position in the company is quite challenging				
	Private	12.9%	12.9%	74.2%
	SOE	22.0%	19.5%	58.5%
	JSE	12.5%	12.5%	75.0%
	SMME	12.5%	25.0%	62.5%
Working conditions take into account that I am a woman				
	Private	41.4%	24.1%	34.5%
	SOE	32.4%	24.3%	43.2%
	JSE	22.2%	55.6%	22.2%
	SMME	14.3%	28.6%	57.1%
The working environment is quite stressful				
	Private	19.4%	16.1%	64.5%
	SOE	36.6%	12.2%	51.2%
	JSE	10.0%	0.0%	90.0%
	SMME	12.5%	25.0%	62.5%
Women find themselves without the necessary instruments to perform duties				
	Private	80.0%	10.0%	10.0%
	SOE	73.2%	9.8%	17.1%
	JSE	40.0%	20.0%	40.0%
	SMME	75.0%	25.0%	0.0%
Working environment more suitable for men than women				
	Private	61.3%	3.2%	35.5%
	SOE	75.6%	9.8%	14.6%
	JSE	50.0%	10.0%	40.0%
	SMME	37.5%	25.0%	37.5%
Women deal with obstacles that men don't have to				
	Private	25.8%	12.9%	61.3%
	SOE	42.5%	22.5%	35.0%
	JSE	0.0%	20.0%	80.0%
	SMME	12.5%	12.5%	75.0%

Remuneration & promotion opportunities	Disagree	Neutral	Agree
Sufficiently rewarded for my efforts at work			
Private	44.8%	17.2%	37.9%
SOE	39.0%	26.8%	34.1%
JSE	55.6%	33.3%	11.1%
SMME	37.5%	12.5%	50.0%
Men are often more easily promoted than women			
Private	25.0%	14.3%	60.7%
SOE	33.3%	28.2%	38.5%
JSE	10.0%	0.0%	90.0%
SMME	57.1%	28.6%	14.3%
Men in SET sectors have more opportunities and advantages than women			
Private	26.7%	16.7%	56.7%
SOE	31.6%	23.7%	44.7%
JSE	0.0%	0.0%	100.0%
SMME	25.0%	12.5%	62.5%
Male colleagues earn more than women at the same level			
Private	17.6%	0.0%	82.4%
SOE	39.1%	21.7%	39.1%
JSE	0.0%	0.0%	100.0%
SMME	33.3%	0.0%	66.7%
Other people more easily promoted than Black women			
Private	40.0%	24.0%	36.0%
SOE	55.9%	14.7%	29.4%
JSE	11.1%	22.2%	66.7%
SMME	75.0%	0.0%	25.0%

Feedback on work performance		Disagree	Neutral	Agree
Regularly given a formal performance evaluation				
	Private	29.0%	9.7%	61.3%
	SOE	22.5%	5.0%	72.5%
	JSE	20.0%	20.0%	60.0%
	SMME	28.6%	0.0%	71.4%
Regular informal feedback on my work				
	Private	25.8%	9.7%	64.5%
	SOE	31.7%	7.3%	61.0%
	JSE	50.0%	10.0%	40.0%
	SMME	37.5%	0.0%	62.5%

Mentorship & career development		Disagree	Neutral	Agree
Given the resources and training necessary to do work				
	Private	23.3%	60.0%	33.7%
	SOE	22.0%	24.4%	53.7%
	JSE	60.0%	10.0%	30.0%
	SMME	25.0%	12.5%	62.5%
Adequate opportunities for professional development				
	Private	41.9%	12.9%	45.2%
	SOE	43.9%	17.1%	39.0%
	JSE	30.0%	0.0%	70.0%
	SMME	12.5%	25.0%	65.5%
Given work assignments that demonstrate capabilities				
	Private	20.7%	10.3%	69.0%
	SOE	26.8%	22.0%	51.2%
	JSE	10.0%	20.0%	70.0%
	SMME	0.0%	14.3%	85.7%
'Coach' at work who helps address the technical issues				
	Private	46.7%	6.7%	46.7%
	SOE	33.3%	25.0%	41.7%
	JSE	60.0%	0.0%	40.0%
	SMME	42.9%	14.3%	42.9%
Mentor in organization				

	Private	48.4%	19.4%	32.3%
	SOE	50.0%	13.2%	36.8%
	JSE	60.0%	10.0%	30.0%
	SMME	57.1%	28.6%	14.3%
Excellent career advancement opportunities at company				
	Private	51.7%	13.8%	34.5%
	SOE	43.2%	21.6%	35.1%
	JSE	20.0%	30.0%	50.0%
	SMME	37.5%	12.5%	50.0%
Success in career should come before any other considerations				
	Private	51.7%	10.3%	37.9%
	SOE	25.0%	15.0%	60.0%
	JSE	20.0%	10.0%	70.0%
	SMME	33.3%	16.7%	50.0%

Implications of a career in SET for family life		**Disagree**	**Neutral**	**Agree**
Family life suffers due to work relate responsibilities				
	Private	74.2%	16.1%	9.7%
	SOE	65.7%	20.0%	14.3%
	JSE	40.0%	50.0%	10.0%
	SMME	75.0%	25.0%	0.0%
Family life suffers due to work related travelling				
	Private	77.8%	14.8%	7.4%
	SOE	73.5%	8.8%	17.6%
	JSE	100.0%	0.0%	0.0%
	SMME	87.5%	12.5%	0.0%
Often expected to work overtime				
	Private	37.9%	10.3%	51.7%
	SOE	63.9%	8.3%	27.8%
	JSE	22.2%	22.2%	55.6%
	SMME	28.6%	28.6%	42.9%

Experiences in the SET industry		Disagree	Neutral	Agree
Excellent career advancement opportunities in SET sector				
	Private	23.3%	10.0%	66.7%
	SOE	5.1%	12.8%	82.1%
	JSE	11.1%	33.3%	55.6%
	SMME	28.6%	14.3%	57.1%
Constantly need to prove myself because I am a woman				
	Private	43.3%	16.7%	40.0%
	SOE	36.6%	12.2%	51.2%
	JSE	30.0%	30.0%	40.0%
	SMME	37.5%	37.5%	25.0%
Experienced many difficulties, challenges entering SET				
	Private	75.0%	7.1%	17.9%
	SOE	57.5%	10.0%	32.5%
	JSE	50.0%	10.0%	40.0%
	SMME	37.5%	12.5%	50.0%
As a woman, I sometimes feel marginalised in my industry				
	Private	28.6%	17.9%	53.6%
	SOE	38.9%	30.6%	30.6%
	JSE	0.0%	10.0%	90.0%
	SMME	25.0%	12.5%	62.5%
I am not taken seriously in my industry				
	Private	10.0%	20.0%	70.0%
	SOE	21.4%	16.1%	62.5%
	JSE	21.4%	16.1%	62.5%
	SMME	10.0%	20.0%	70.0%
Women should be encouraged more to enter SET sector				
	Private	6.5%	9.7%	83.9%
	SOE	0.0%	15.0%	85.0%
	JSE	0.0%	0.0%	100.0%
	SMME	25.0%	0.0%	75.0%
Black women should be encouraged to enter SET sector				
	Private	7.1%	10.7%	82.1%
	SOE	5.6%	13.9%	80.6%

JSE	0.0%	0.0%	100.0%
SMME	50.0%	0.0%	50.0%

Race & gender in the work environment	**Disagree**	**Neutral**	**Agree**
Feel marginalised in my industry as a Black woman			
Private	23.1%	15.4%	61.5%
SOE	28.6%	32.1%	39.3%
JSE	0.0%	0.0%	100.0%
SMME	0.0%	0.0%	100.0%
Need to prove myself because I am a Black woman			
Private	53.8%	7.7%	38.5%
SOE	27.6%	17.2%	55.2%
JSE	0.0%	66.7%	33.3%
SMME	50.0%	0.0%	50.0%
Black women often have to deal with obstacles that others don't have to			
Private	21.4%	21.4%	57.1%
SOE	31.0%	31.0%	37.9%
JSE	0.0%	0.0%	100.0%
SMME	50.0%	0.0%	50.0%
Black women find themselves without the necessary instruments to perform duties			
Private	85.7%	7.1%	7.1%
SOE	65.5%	17.2%	17.2%
JSE	66.7%	0.0%	33.3%
SMME	100.0%	0.0%	0.0%

Gender relations in the workplace		Disagree	Neutral	Agree
I feel comfortable working with my male colleagues				
	Private	0.0%	3.2%	96.8%
	SOE	2.4%	4.9%	92.7%
	JSE	0.0%	0.0%	100.0%
	SMME	0.0%	0.0%	100.0%
My male colleagues feel comfortable working with me				
	Private	0.0%	9.7%	90.3%
	SOE	5.4%	2.7%	91.9%
	JSE	0.0%	10.0%	90.0%
	SMME	0.0%	0.0%	100.0%
Men are taken more seriously during meetings				
	Private	33.3%	22.2%	44.4%
	SOE	55.3%	18.4%	26.3%
	JSE	20.0%	20.0%	60.0%
	SMME	50.0%	25.0%	25.0%
Not taken seriously by male colleagues				
	Private	71.0%	6.5%	22.6%
	SOE	65.0%	12.5%	22.5%
	JSE	20.0%	10.0%	70.0%
	SMME	37.5%	50.0%	12.5%

Table 8 Participants' perceptions of favourable and unfavourable factors for women's recruitment, retention and advancement in industrial SET (n=38)

Category	Factor	Favourable to women's participation	Unfavourable to women's participation
Recruitment of women into SET industry	*Women in SET pipeline*	More women are studying SET (8)	Insufficient number of women studying SET (15)
		Should be quotas to ensure women have equal opportunities to enter SET (1)	Insufficient number of women in management positions (5)
	Masculine image of science	Women bring softer, feminine, more holistic, more emotional, more empathic understanding side to SET industry; deeper consideration goes into making decisions (23)	Certain SET fields (e.g. oil rigs) unavailable to women / women are seen as weaker than men (7)
			Women not attracted to unsafe SET jobs (6)
			Not enough women to recruit as women don't think that they can do science (8)
			HR interviewers need to be trained to not stereotype women applying for positions in company (2)
	Race and gender based recruitment	Race and gender are interrelated – need to recruit more black women (3)	Recruitment based on talent irrespective of race and gender (8)
			Insufficient number of black people in management positions (2)
	Image of science in society	Selling science as exciting and socially relevant particularly to young girls (6)	Invisibility of scientists in society (2)
		Organisations should look broader for SET workers than only people who have studied science (2)	Scientists constructed as simple people, submissive, lacking confidence and interpersonal skills (3)
	Women's multiple roles in society		The SET industry needs to be more flexible in terms of women's multiple roles (2)

Category	Factor	Favourable to women's participation	Unfavourable to women's participation
	Other factors		Recruitment agencies charge too much to place appropriate people within the SET industry (2)
			Difficult to attract people to certain geographic locations (1)
			Recruiting women depends on the management of the company (1)
Retention of women in SET industry	*Masculine image of science*	Women need to carve their own space within SET industry without assimilating into prevailing masculine culture (7)	Women must/should assimilate into masculine culture in SET industry (4)
			Women leave industry because of gender discrimination, abuse and masculine culture (6)
			Women have to refrain from socially-normative feminine behaviours in order to remain in the SET industry (need to be assertive and confident) (5)
			Women not given a chance to prove themselves, big jobs given to men (7)
			Women struggle in a male-dominated environment, don't speak out when marginalised (6)
			Disparity of salaries between men and women (3)
			Women should not be stereotyped as soft (2)

Category	Factor	Favourable to women's participation	Unfavourable to women's participation
	Race and gender based retention	Female scientists leaving the organisation, not the field (4)	Retain talented people, irrespective of race and gender (13)
		Women's successes in the industry need to be celebrated (4)	Individual support and development, irrespective of race and gender (12)
			Gender becomes subjugated in order for 'race' quota to be filled (3)
			Previously disadvantaged people are used as guinea pigs in the transformation process (2)
		Regulations & quotas wil ensure that companies retain women (3)	No efforts made to retain female employees (6)
	Women's multiple roles in society	Revising policies to accommodate women's family commitments (12)	Women leave/struggle because of socio-economic circumstances and family commitments (12)
		Retaining women through communication technology (5)	Definitions of a 'good scientist' need to accommodate for women's multiple roles (4)
		Women and organisations need to be flexible to make things work (10)	
		Work-life balance is difficult but women do cope and succeed in the industry (10)	
		Flexitime (14)	
	Image of science in SET industry		People leave SET for more strategic career paths (business for e.g.) (13)
			SET becomes less attractive as one advances within the field (3)
			Science not financially rewarding (7)

Category	Factor	Favourable to women's participation	Unfavourable to women's participation
			Career in SET does not fulfil expectations (2)
			Lack of opportunities for scientists to interact within academic arena as researchers (3)
			Young people are not being retained in SET (4)
			The SET industry must create a space for diversity in terms of language, religion, race, gender etc. (4)
	Image of women in industrial SET	Male employees don't have a problem with female managers (2)	Women expect to be treated differently when what they want is to be treated the same (2)
			Women use emotional blackmail to succeed in the industry (1)
			Women are made to feel that they are retained due to legislation (3)
	Other factors	Companies sponsor women to attend government initiatives/training for women scientists (5)	
			Cultural dynamics enter the workplace and affect relations between women and men (2)
		Have a grouping to discuss women's issues in the company (6)	Appropriate facilities needs to be put into place for female employees (4)
		Retain women if they feel their aspirations can be met (4)	
		Women must be exposed to all the opportunities in SET (1)	
Advancement of women in SET industry	*Image of advancement opportunities for women in industrial SET*		Women in SET industry are more visible and get scrutinised because they are part of a male-dominated culture (2)

Category	Factor	Favourable to women's participation	Unfavourable to women's participation
		Women do excel in SET industry (17)	Advancement based on delivery, not gender (7)
		Fast-tracking career paths to increase representivity in terms of race and gender (4)	Advancement of women should take place at a realistic pace to avoid burn-out (2)
		No glass ceiling (4)	Limited advancement opportunities for women (4)
		Senior women as role models (10)	
		Mentoring from successful employees irrespective of gender (5)	
		Women who enter SET need support systems (5)	Women can't progress in industry which requires flexibility because of lack of mobility due to family commitments (8)
			Women need PhDs to be taken seriously in SET (3)
		Women have to create/accept opportunities / have personal drive (3)	Women become complacent due to their PDI status (3)
			'Attractive' women face a number of challenges in the workplace (1)
			Women in different life phases want different advancement opportunities (2)
	Race and gender based advancement	Organisation has policy to advance women (6)	Priority is to advance more black people into top management, and then advance women (1)
		Government's precedent to advance women (3)	
		Policies & regulation needed to advance women (1)	

Masculine image of science	Women cannot advance to positions where safety is an issue (3)

APPENDIX F: Thematic analysis of factors in the recruitment, retention and advancement of women in the SET sector

1 Factors in recruitment

1.1 The masculine image of science

The masculine image of SET means that women often feel that they do not fit into a male-dominated culture. Women accuse themselves of thinking that they cannot do science: "Women don't think of becoming a technician. It is a man's world" (female human resources manager at a private company). In addition, women feel that they are measured against a masculine image of science, i.e. that science is for big, strong men who are willing to get their hands dirty. One interviewee feels that because she is physically small she is perceived during job interviews as young and unable to perform the physical tasks required from her. In contrast men and women interviewees speak about women being recruited into the SET sector because women bring a softer, feminine, more holistic, more emotional, more empathic understanding side to the industry. Women are also described as "more patient and willing to work with more routine type of work" and that they "tend to get all the other stuff that nobody wants to take responsibility for". There is also a perception that deeper consideration goes into the decisions that women make and that women are outperforming men in the SET sector. This is mostly seen as a benefit for women in the workplace. Men are constructed as quick decision makers, confident and not affected by moods, but also as very short sighted.

> And then a man comes in and even if he is in a suit and a tie, he's got broad shoulders and he sits and he fills up the whole chair and they say 'now he is going to go out and get himself wet, he's going to get the job done'.
> - Senior woman at an SMME
> My friend is also in my department. We were just chatting the other day because we are carrying these buckets and we are doing something really dirty ... can you imagine a nicely dressed young lady with lovely painted nails and high heels doing this job so it does come from your childhood and it does come from the way you are brought up because if you are like a Barbie doll you are not going to do chemical engineering ...
> - Senior woman at a JSE listed company
> But in the office environment I have found women to be much more productive than the men in my section where eighty percent are female and all races of women.
> - Senior woman at a JSE listed company

One senior female at an SOE felt that the type of discourse which claimed that women are 'softer', more emotional and so forth, functioned as discriminatory discourse: "I don't like the implication that women are softer, they are more creative. I don't like that because that stereotypes you and questions your ability to run a JSE company, for example. We have proven that women are performing". She argued that there are few differences between women and men and that the differences between people of the same sex could be greater. In essence, she believed that women and men face similar challenges in the SET industry.

Similarly, a male senior group executive felt that women in the industry tended to be more 'level-headed' and practical than men. He claimed that "I found my female colleagues to be a lot less given to emotional outbursts in the work environment and had a more level-headed approach to some of the problem-solving issues. Some of my male colleagues, however, have tended to go off on a tangent".

Certain SET fields are also unavailable to women such as working on oil rigs and as one male interviewee in an SMME puts it: "It could be that civil engineering have some logistical issues, e.g. have to go out to sites that are quite rugged and carry heavy equipment". Other fields are seen as more suited to women's normalized roles in society like electrical engineering: "With electronic you can sit in a lab and design". Women are also seen as less demanding in terms of career movement, promotion and remuneration than men and thereby perhaps better to recruit.

> Remember you are entering an arena which men think is theirs so when you step in you have got to prove to them that you know what you are doing and as a result of that I have had to learn a lot of things to cope ... I always look for something that has not been pointed out and that makes you confident and it also shows them that you know, you see, you look at the loopholes and you deserve to be there.
> - Senior woman at an SOE

1.2 *Gender blind recruitment strategies*

Six interviewees reported that recruitment in their organisations is based on talent irrespective of race and gender. Some senior women in SOEs felt that although it was important to recruit more women into the SET industry, this should not merely be done as a way to fulfill affirmative action quota.

> I want to see more women but we must not do that for the wrong reasons. We must not force gender representation, which is a worldwide problem, particularly in Engineering. That would be very irresponsible.
> - Senior woman at an SOE

2 Factors in retention

2.1 *Gender blind retention strategies*

Top management in private companies often spoke about retention not being gender-specific, i.e. the company's aim was not to specifically retain women, but to retain talented people. A result of this gender-blind strategy, the need to retain female employees' in SET is not prioritized, and no strategies are formalized to retain women's employment in the industry. Six interviewees (across the spectrum of organisational context) specified that their organisation makes no effort to retain female employees.

> At our company, they just say take it or leave it and that's how they work with everybody, men or women. If you don't like it, we will get somebody else
> - Female senior employee

Male participants in senior positions in private companies very often used gender-blind discourse in their responses in that their companies aimed to retain competent people, not necessarily competent women. In other words, it appeared that gender was not a factor when decisions were made in management regarding the retention of employees.

> It's on merit, capability, personality, skills, value to the workplace. It's really not gender, race or age
> - Senior male at a private company

2.2 *Casting women into supportive roles for men*

Women are cast into supportive roles for men such as being part of the supporting staff or bringing skills to the workplace that complement those of men. Some of the words used to describe women in the SET sector include 'submissive' and 'lacking confidence' when compared to men.

In one case a women scientist at an SMME reported that she is being paid less than the men scientists because she is not perceived to be the breadwinner.

> And also males and females they do complement one another because one has got strength ... and the fact that a man is always seen as a strong person as opposed to the women
> - Senior executive female at an SOE

Women and men talk about activities traditionally associated with women, such as making food and looking after others, being made the responsibility of women in the workplace. One interviewee (a female at an SMME) differentiates women who fulfill traditional female roles in the workplace and women who tend to get married or become housewives from "your real professional women, real career women" who would settle for other jobs if they left the company.

Women are seen as complicit in this perceived difference of roles: "I think because they don't have one iota's notion of what it is like to be independent and to take care of yourself and to take responsibility for yourself, I think they cannot relate to it and so yes that is all they know themselves, their identity in relation to men, they don't actually know anything else. I think women until actually for themselves start to experience that and start to realize it actually feels a lot better your self esteem is a lot more intact if you are doing it for yourself and you are responsible for yourself but I think there are a lot of women that are not even they cannot even see the possibilities, they only see themselves in relation to their husband, in relation to their children, that's their lot in life" (female engineer at a private company).

According to a male interviewee in a private company the reason women may be leaving is that they are not doing stimulating work: "Don't give them boring monotonous work, no, involve them in everything and make them part of the team and feel at home". It was common for senior women in SOEs to state that male and female staff in SOEs complemented each other in terms of the work they put out. However, it appeared that men were seen to do the 'real', practical work and women merely 'added' creative touches to the work the men did.

> If you give men a task, they will just want to finish it quickly. The quality and beauty will come from the female counterpart, like placing the diagrams.
> - Senior woman at an SOE

Women can attain equal status to men if their technical knowledge level is high: "On the technical side people admire you for the output of the technical work that you are doing. Lots of female contractors on our site, female engineers who do excellent work and when work is produced nobody looks at them ... there is no difference" (Female HES manager at a private company).

2.3 *Women struggle in a male-dominated environment - they don't speak out when marginalized*

Six interviewees articulated that women struggled in the male-dominated environment of SET industries. They claimed that women either assimilated into the male culture or became silenced within that environment. Overall, women in SET industries generally had to work extra hard to be recognized as 'good workers'.

> Women have to work extra hard to earn respect and a lot of them assume that in order to make it in a man's world, you must behave like a man and you actually have to do better than a man in his work.
> - Senior woman at an SOE

Through assimilation into masculine culture, some interviewees felt that women were denying their 'true' selves – their 'femininities'. Women were believed to be naturally more nurturing and caring than men and less willing to take risks, therefore more cautious in technical environments.

2.4 *Women need to carve their own space within SET industry without assimilating into prevailing masculine culture*

The masculine image of science, as described above, means that women feel that they have to assimilate into the prevailing masculine culture in the SET industry. Some women are against this assimilation arguing instead for carving out their own space. On a concrete level this would include women wearing "pink and frills" to meetings rather than "dark suits" according to a female interviewee in a JSE listed company.

A senior executive female interviewee at an SOE says that women can also be their own worst enemies "because now they have to fight one another instead of fighting the issues or if for example they have differences amongst themselves they take it personally which is different with men ...". Her solution to this problem is to build a network with spaces for women to discuss common issues that they face: "... because you always see men often going to play golf, they talk there but you never see a forum where women come together and chat about business issues, when they talk it is about children ... we must also have such forums even if it is informal".

> ... there is a fantastic young lady in production, she is brilliant and she is definitely going to go places, but she is emulating [the men's] bad behaviour and that worries me why does she do that. You don't have to become one of the guys to be as effective ... she is doing all the right things studying, whatever, to get there, but she is going to be held back by her attitude and I have been in my current position for five years but this is my first job from tech so I haven't been exposed to any other industries but I would like to think the way I have carried myself is I don't have to change who I am to fit in.
> - Senior woman at a JSE listed company

2.5 *It is challenging for women to balance work and family commitments*

Retention of women is often spoken about in terms of their commitment to family and specifically young children and is seeing as being specific to women. Although companies generally accommodate women's commitments to their families, such as allowing them to work from home when a child is ill or working flexi-time, women are expected to deliver the same outputs as men while having to simultaneously be a primary care giver. However, women talk about their company's willingness to accommodate them in a positive light and about how they cope with the work-life balance and even succeed in the SET sector despite having an extra load to deal with. Also, being perceived as the primary care-giver in society, women lack mobility to participate in work-related demands such as travelling and doing fieldwork. They sometimes have to drop out because they cannot balance their work with family commitments or are surpassed by women (young and single) or men who are mobile.

> I do think that the family set-up is the core of any nation and I don't necessarily think that it is a good thing that women have other people to raise their children. So that is the biggest problem and we have to face it ... And it is not for me to say that I don't want to employ a female engineer cause she might have babies cause a male engineer can leave the company in three years' time. So you have to plan for movement of both genders.
> - Senior man at an SMME
> I still think for a woman her family comes first and the construction industry is a very hard industry and I don't think if you are a quality manager your husband is going to move all over the place for you like one day in PE and next in Botswana and I think that this is once of the factors that make women not want to stay.
> - Senior woman at a JSE registered company

There is also a fear to have children because of maternity leave policies that bind women to working for at least a year and a half before taking this benefit. Women may thus be indirectly forced to exit the sector if they do not comply with employment requirements.

2.6 *Women and organisations need to be flexible to make things work*

A common theme amongst female employees in the SET industry was that companies were often not flexible enough in terms of accommodating for women's family commitments and child-rearing responsibilities. This is not surprising when one considers international literature such as the European's Commission's (2002) report. The report highlights the forced choices female employees in industry often have to make between family and children, and a professional career, often with little accommodation from the employer.

> I have a child of two years. On Tuesdays, I have to be at the factory at six o'clock. My child has to wake up at five o'clock so that he can be ready for school. He then has to sit with his father. You get men who can do it and men who can't, and my husband doesn't do it. If my husband isn't there, then I have to drop my child off at my mother at a quarter to six to be here at six and at work, all they say is sorry.
> - Female senior employee

Some directors in private companies felt, however, that the company was being flexible in terms of women's family and child-rearing responsibilities, but that is was important that female employees' male partners play a role in these responsibilities, hence providing support for women to advance in their professional careers. A senior woman at a JSE listed company says that "women must develop a situation where they can cope in their home environment by balancing things on the home front as well as the work front because that's why women are always more tired than anybody else because they have to do all those things". Times are also changing according to a senior woman at an SOE: "How are young husbands coping with a young mother who has to be sent on business conferences, who has to travel around domestically, it is a challenge, it was always a challenge but I think there again the perception is it is a new society. It is more advanced but it is so interesting the same social issues that affected us twenty years ago affects the community now so we are finding that we have to come in, bring in the partners, speak to the husbands as well".

> If you get involved in the food business, you can only go home once the job is done. That is reality so we need to be aware that when you appoint a manager, you also appoint a mother and the kids do go to school, they are small and they do get sick. The role of the father at home is also changing and that allows the mother to become more focused on her work environment by sharing the load. But if a woman in a work environment does not have the support of the husband, then she will find it very difficult. Personally, I feel very strongly that the mother is the cornerstone of the family and we are losing that.
> - Male HR director

2.7 Definitions of a 'good scientist' need to accommodate for women's multiple roles

Participants' discourses reflected that ideas around what constitutes 'good science' and who is representative of a 'good scientist' are framed within masculinist terms. In other words, 'good science' means hard science (Engineering, Biology, Physiology) best practiced and executed by those who have been constructed as more practical, technically minded individuals – men.

This leaves little space for women to be constructed as 'good scientists', particularly when their roles as mothers, caregivers and homemakers requires that flexitime is often a necessity within the SET industry. According to a male HR executive at a private company its a "struggle to prove competence all the time" as women are seen as less committed when they are absent from the workplace in order to fulfil their family commitments. However, interviewees raised the important role of technology (such as electronic communication) in affording women the opportunity to execute their work duties without being physically present in the work space. Women and their employers are or could be making use of technological means to satisfy the needs of the organisation as well as women who have family commitments. In some cases organisations are functioning by focusing on outputs rather than on time spent physically in the workplace, but in many cases this shift needs to be made to accommodate more women. This kind of arrangement is easier to implement at senior levels; at lower levels of the organisation women often have to be physically present in order to do her job (e.g. working on a production line). This makes women vulnerable in the recruiting process as their role as child bearers is seen as an inability to be physically present in the workplace at all times.

> A good scientist does take time for maternity leave. But it doesn't have to be for fourteen years. You can work on flexitime for fourteen years but you remain a scientist. So there is no either/or, you find this in-between space -- Female HR Director
> Our strategy is more to retain competence and that is kind of gender-blind. We want to retain people that we believe can add value to the company...particularly the ones we have invested in
> - Male CEO

A senior woman at an SOE felt that women needed to be retained in the company by accommodating for their needs. In other words, women should not leave because the SET environment has not accommodated for their particular physical needs. Instead, the SET environment needs to change to accommodate for these needs.

> It should be a requirement that when a woman is appointed in a particular position, we need to ensure that we have protective clothing which includes making the working environment conducive for them. They shouldn't leave because conditions are not conducive, they should leave because they are incapable of doing the job, not because of the masculine environment looking after only men's needs.
> - Senior woman at an SOE

A male executive at an SOE believed that the industry needs to accommodate for women's physical needs. For instance, he felt that it is problematic that women do not have separate change rooms or separate ablution facilities at train control centres and that these issues need to be dealt with effectively. This ties in with the notion of what constitutes a 'good scientist' in the SET industry. When the SET environment only caters for the needs of men, and women have few options but to assimilate into this masculine culture, women feel marginalized and that the SET industry defines 'good scientists' as those who fit into the traditional structure of SET.

2.8 Women leave industry because of gender discrimination, abuse and masculine culture

Some female employees in the SET industry felt that women left the industry because of experiences of gender discrimination and abuse by male employees. Female employees often felt that they weren't treated like professionals but were instead judged on their physical appearance. Moreover, Black women spoke about how racial discrimination intersects with gender discrimination and how it makes them feel invisible in the workplace. White women feel that gender becomes subjugated by race in order for 'race quotas' to be filled.

Furthermore, women leave the industry when they feel that they are not given a chance to prove themselves in the workplace as tasks of significance are given only to men. Women are also 'protected' from potentially harmful situations and places by not involving them in fieldwork, shift work or placing them in positions where there are other women.

The men in women's personal lives can also be the perpetrators of discrimination: "Because as soon as they start talking marriage then the husband doesn't want them to be out with other men in the rural areas on projects" (male CEO of a JSE listed company).

> It's not nice for a woman to work in production. Often people don't take you seriously and in a factory environment, men will whistle at women. Once I was wearing a short pants because it was so hot (and you couldn't see my pants because of the long coat) and when it came to me washing off my boots, this one guy was lying down and trying to see what I was wearing underneath my coat
> - Senior female
> I went to one of the more progressive mills, it was like stepping back in time, the white managers would not even greet me and I am not talking about ten or twenty years ago; this was 1999. It was like being on another planet and so how can you talk about even respect for other cultures or race or gender or anything when they do not see you, you do not exist ...
> - Senior female at a JSE registered company
> I got such uphill from the guys who were applying for the job and they basically implied that they would make my life an absolute misery if I got it ... and it was because I was a woman but it was also because I was a young Indian woman that they would be reporting to.
> - Senior female at a JSE registered company
> ... but there seemed to be no advancement for them because they were put on a site or just sort of left one side, but I also suppose it was for their own protection because there were so few of them, but I do think there are people who are interested but they seem to end up doing engineer consulting work and not fieldwork.
> - Senior female at a JSE registered company
> You find these companies that are run predominantly by white males that they are not open to give opportunities to engineers out there who have a brilliant mind and can actually meet some of their requirements. Its even more difficult for women including black and white women to actually make inroads or penetrate that block.
> - Female general manager at an SOE
> Women exit because one is reliant on a network (who you know, who you play golf with, drink in pubs with). I refuse to compromise. The organization tried to make me play golf by paying for it but I don't enjoy it and I don't do it anymore. Many deals are made on the golf course and in pubs and as a woman if you are excluded from these events you do not make the same deals as your male colleagues and you are told that you are not performing. Eventually you give up and leave.
> - Female IT division manager at an SOE

While some senior women felt comfortable with assimilating into the masculine culture of the SET industry, others felt that this male-dominated environment often left women employees feeling marginalised and silenced.

> When people take (problems) to be a gender issue, the way to show that there is not an issue is to actually just to go along until there isn't an issue and not to react too much.
> - HR Group Services Manager
> I am very male-orientated so I actually prefer working in a male environment than a female one. I actually changed to a company that was all female and I didn't like it. I am used to how they think and their dealings are not so intricate. Women can be emotional sometimes.
> - Female HR Executive

2.9 SET is not financially rewarding

SET is not a preferred industry or industry of choice as it is perceived to be not a very lucrative industry to be in. Engineers struggle to get their fees accepted and so they gravitate to other industries. This retention problem is blamed on the market forces operating in the industry. This challenge is not differentiated for men or women, but may be a factor that also affects women being retained in SET.

2.10 Marginalization of scientists

Engineers are marginalized and undermined in terms of their status, i.e. the credibility that people given them. There are two forms that this marginalization takes. Firstly, white people feel they are marginalized by the process of transformation where PDIs with no qualifications are put into positions (especially in government) that took someone twenty or thirty years to advance into. This causes men and women to move away from the industry or emigrate. Compared to the past South Africans are welcome everywhere and there are many international opportunities. Secondly, people are not recognized for their efforts in an industry that demands high intellectual capacity and input. This causes men and women to move away to so-called softer targets where their intelligence is recognized. Softer targets are often defined as the financial services sector or 'business'. In order to recruit more young people into the SET sector, the sciences need to be sold as exciting and socially relevant particularly to young girls.

3 Factors in advancement

3.1 Limited advancement opportunities for women

In some cases women felt that there are limited opportunities for them to advance. This might be contained to certain SET fields like construction that is seen as a man's world where women have very little impact: "But I feel in our industry it is very difficult for a woman ... you have all the tools, you do all the work and you are still overlooked and they know you are very important to the company, but they are still not going to go that extra mile to say we have got a female director or something, it is like they are saying 'No, not in our industry' " (senior female at a JSE registered company).

Even when women do advance and excel in the SET sector their perception is that they are not respected in the same way as men are: "Men do respect men more and they don't like having a woman as their boss" (senior female at a JSE registered company).

Advancement opportunities can also depend on how physically able women are perceived to be for a certain job. Many of the interviewees spoke about women not being able to advance to positions where safety is an issue or where a woman's physical make-up prevents her from performing certain duties, for example her upper body does not accommodate a heaving welding gun in a manufacturing workshop.

> And then the other challenge maybe with the males if they have to report to a senior person who is female they also tend some of them to experience a problem because they are saying oh you know it is very difficult for them to accept that things are changing to the direction whereby females can also take up top positions and supervisory positions and they can be superior to them so sometimes it becomes very difficult to accept that. Whereas if you put a male leader or a male supervisor then they just run around you know they are eager to deliver whereas if it is a female they just adopt a slow attitude.
> - Executive female at SOE

3.2 There are opportunities for women to excel in the SET industry

Although some women and men spoke about the lack of opportunities for women to advance in the SET industry, more interviewees were positive about women being able to excel. A senior woman at a JSE listed company says that "you know if you really believe in yourself and your own capabilities and the things that you can do you will be successful. There is no reason at all why you cannot be successful". Reasons for being optimistic include the following: Competent women who deliver good work are promoted to senior positions in companies, some companies fast-track career paths to increase representivity in terms of gender and race, there are senior women that serve as role models, there is no glass ceiling, and some organisations have a policy for the advancement of women.

Women often spoke about advancement being based on individual characteristics such as drive and ambition. A male CEO of a private company does not believe that it is a matter of a lack of opportunities for women to advance, only women who do not make use of the opportunities that are offered to them.

3.3 The new glass ceiling

Although many women believe that there are opportunities for them to advance and ultimately break through the glass ceiling, a new glass ceiling seems to be appearing. This occurs at the very top of organizations, i.e. at the position of CEO or managing director. A female HR executive at a private company cites the statistic of seven percent of women in leadership positions, but she believes that this is a dramatic change from five years ago and that things are moving, albeit slowly, in the right direction. Where women are in top leadership positions government is seen as the instigator due to President Mbeki's vision for gender equity in this country.

> I would agree women do leave the industry because their growth prospects are hampered. They can only reach one level and not beyond that and that is why if you look at the large industries in the country today there are very few women CEOs that actually run large corporations, they are executive directors and they can run the company but they don't.
> - Senior woman at a JSE listed company

3.4 A woman's need for advancement opportunities depends on her life phase

Women talk about foregoing opportunities for advancement in their organizations due to family commitments even when these organizations are willing to promote women: "I feel almost like a let down for not wanting to go further but I need to put my needs, my family's needs first, but if it wasn't for my children and let's say I wanted to progress I am still confident [my company] would support me" (senior woman at a JSE registered company). Higher positions can involve shift work or require a woman to be flexible in terms of mobility, things that women often feel they cannot do. Some women ascribe the stagnation of their careers to the life phase that they are in: "And I think it is great for people to want different things, we are all in different places, if I didn't have children, if I wasn't married I would consider going into Africa it will be an exciting opportunity and there are endless opportunities for engineers in Africa so where I am right now ..." (senior women at a JSE registered company). Single women without children are seen as more fortunate as they can take the same kinds of opportunities in SET that men do.

3.5 Women are becoming complacent due to their PDI status and are establishing bad track records

A female interviewee in a senior executive position at an SOE warns that women are becoming complacent as they become more popular to appoint due to their PDI status. Women's attitudes are becoming careless in terms of their work which she describes as "a recipe for disaster because at the end of the day you are just digging your own grave. No one would want you and you must also think about your track record that you have made because people will talk, they will say oh sorry". This interviewee states, however, that we should perceive women being head-hunted and moving from one company to another in a better light than the current exodus of young scientists from South Africa.

> And you know the problem with that is that over time these same people are priced out of the market because the level of knowledge and experience compared to what's expected of them elsewhere does not match. And in the end they find out they have to stick with that company, they are so unhappy ...
> - Female General Manager at an SOE
> If they can show that they are good and they can perform then they should get promotion but as I said they disappear before they can have impact. So I think there will be advancement for them if they could just stick around longer and not go looking elsewhere.
> - Senior female at JSE listed company
> Because what we have been trying to do is to recruit very deliberately because we are trying to look and screen the candidates for those who are not go-getters for flashy things in life but we like the sensible who want to contribute.
> - Managing director of technology at an SOE

It is difficult even for private companies to attract top professionals to certain geographical regions in South Africa like the Eastern Cape according to a female HR executive: "For black people generally it is more difficult because they believe it is more hip to be in Gauteng, there is more stuff happening internationally and what kind of entertainment do you have in the Eastern Cape." This statement has more to do with race (and probably gender), however, than only with gender.

3.6 'Attractive' women face more challenges in the workplace

It was suggested that socially constructed 'attractive' women would experience more challenges in a male-dominated work environment. This type of discourse, utilized by a female HR Group Services Manager of a major private company, suggests that professional women who are considered to be 'attractive' would not necessarily be taken seriously in terms of their competencies and capabilities in the SET industry.

> We have just promoted a female engineer to an industrial engineer and she both internal and external customers are going to have to put up with her and she is a hugely attractive girl so it is going to be very interesting.
> - Female HR Group Services Manager