

Exploring the career path barriers of women professional engineers in a South African context

by Yvonne du Plessis* and Nicolene Barkhuizen**

Abstract

Despite various initiatives to address inequalities and barriers faced by women in engineering, it appears that once women engineers enter the workforce, they tend to leave engineering faster than their male colleagues, despite having worked so hard to qualify. The aim of this study is to explore the barriers to the career advancement of women in the engineering profession that exist despite the enforcement of labour equity, and try to determine why women engineers go into management rather than staying in the profession. The results and findings revealed various barriers, in both the professional and the psychological categories, to the advancement of women engineers in South Africa. Gender issues, a lack of training and real exposure to engineering practice, poor talent management and a lack of mentorship were the most prominent career barriers highlighted. A majority of the sample group of women engineers considered management as a career option as opposed to engineering. Recommendations on how organisations may address these barriers are made.

Key words: women engineers, employment equity, career advancement, career barriers, career path

1 Introduction

Since the beginning of the 20th century, women have increasingly entered professions and occupations previously reserved for men. However, in some of these male-dominated professions – with engineering as a leading example – gender inequalities have been slow to change and women engineers are still in a minority (see Chinyamurindi & Louw 2010; Fouad & Singh 2011; Hill, Corbett & St Rose 2010; Hoh 2009; Murphy 2007; Page, Bailey & Van Delinder 2009; Mamaril & Royal 2008; Smith & Dengiz 2010). Activists have fought an uphill battle to achieve recognition and acceptance of women as engineers, and to revolutionise the education and employment conditions of women in this field (Bix 2004).

Although the South African Government has passed labour laws (i.e. the Employment Equity Act 55 of 1998) which aim to address inequalities in the workplace, women engineers are often perceived as “oddities at best or outcasts at worst” (Bix 2004:27). Consequently attracting women into and retaining them in the engineering

* Prof Y du Plessis is a Full Professor at the Graduate School of Business and Government Leadership, North-West University, Mafikeng Campus.

** Prof N Barkhuizen is a Full Professor Research of the Faculty of Commerce and Administration, North-West University, Mafikeng Campus.

profession remain a challenge (Fouad & Singh 2011; Tsui 2009). This applies in South Africa as well.

Despite many initiatives to attract and retain women in engineering it appears that once women engineers enter the workforce they tend to give up their hard-earned place in this field faster than their male colleagues (Gatta & McKay 2003; Murphy, Steele & Gross 2007). Previous research has identified several professional and personal barriers that would explain the gender gap in engineering. Some of the most prominent work-related barriers include gender stereotyping and discrimination, lack of networking and mentorship opportunities, sexual harassment, salary inequity, lack of training and career advancement and poor work/life balance (see Barrett 2011; Chinyamurindi & Louw 2010; Fouad & Singh 2011; Hoh 2009; Ingram, Bruning & Mikawoz 2009; Mamaril & Royal 2008; Shantz & Wright 2011). Other barriers include lack of perseverance, lack of self-efficacy and self-confidence, support barriers and interest congruence issues that might be the result of the societal influences of parents, school teachers and university and industry advisers (see Hoh 2009; Lyon 2009; Mamaril & Royal 2008; Wender 2009). As mentioned by Shantz and Wright (2011), social influences often deter women from entering mathematics- and science-related fields as they are made to believe that they will not perform well in those fields.

It is therefore not surprising that in many countries women who began their career in engineering opted for other career paths, one of which is management in preference to professional engineering (Mamaril & Royal 2008; Smith & Dengiz 2010; Yeh 2008). However, in Malaysia, Ismail (2003) found the opposite to be true, with women engineers preferring to remain in the engineering profession as specialists, where their male counterparts opted for the managerial career option, which "carries with it the highest prestige".

In South Africa the focus of employment equity has supported women who wish to enter the male-dominated engineering profession. However, it has simultaneously opened the way for women to advance into management. This shift in the focus of employment equity to the upper echelons of management propels talented women engineers on an accelerated career path to management, thus robbing the engineering side of businesses of skilled technical employees. The existing historical under-representation of women in engineering is further exacerbated by the numbers who leave the profession (Mamaril & Royal 2008).

Science, technology, engineering and mathematics (STEM) are regarded as vital to the economic development and sustainability of any country (Hill et al 2010; Wynarczyk & Marlow 2010). Hill et al (2010:3) further maintain that "attracting and retaining more women in the STEM workforce will maximise innovation, creativity and competitiveness". The general issue confronting organisations is to attract women into engineering and in particular to retain women in the profession and not lose them to management or other categories.

Against this background, this study aims to address the following research questions:

- What are the barriers, as perceived and experienced by women professional engineers, to their advancement in the engineering profession despite the enforcement of employment equity?
- Is the management career option a preferred career choice of professional women engineers and if so, why?

Little empirical work has been published on the South African situation regarding women in engineering positions. Statistics are limited to university graduation figures and professional registration trends (Engineering Council of South Africa website (ECSA) 2014; Women in Engineering Forum 2011). The statistics show, however, that women are still a minority group compared to their male engineering counterparts, which is not surprising because engineering is a male-oriented profession. According to the Engineering Council of South Africa's 2012-2013 annual report, only 561 women are registered in the category of professional engineers, in comparison with 15 036 men (ECSA 2014). This is a pivotal study in the management of women engineers, who are an under-researched group that offers a necessary and scarce skill in the engineering environment. This study aims to provide insights into the possible career barriers and career choices as perceived and experienced by professional women engineers in the South African context. It does not set out to draw a comparison between women and men.

In the next sections the core of the literature in support of the study will be discussed, followed by the research method, results and findings, discussion and finally the conclusion and further recommendations for research.

2 Literature review

Women engineers are faced with various career challenges which may include specific barriers to professional advancement as well as career choices. Barriers faced by women engineers seem to fall into two major categories, namely *professional barriers* (for example a lack of advancement, mentoring and training) and *psychological barriers* (such as self-esteem aspects, family/work issues and gender discrimination). A brief description of these categories is presented, along with the career path opportunities offered by the professional and managerial career options for women engineers.

2.1 Professional barriers experienced by women engineers

2.1.1 Advancement opportunities

According to Maskell-Pretz and Hopkins (1997:33), there are two factors, namely "style" and "experience", which limit the advancement opportunities of women engineers in the workplace. Women tend to be uncomfortable with an aggressive and competitive style in the workplace. Most prefer to conform to the "softer-style" expectations established by society as acceptable and appropriate for women (Barbercheck 2001; Duff 1993; Gatta & McKay 2003). This might also be the reason why the Malaysian women engineers mentioned by Ismail (2003) opted for the specialist engineering career and not the managerial option mentioned earlier.

However, in today's highly competitive global marketplace, the preferred and accepted attitude appears to be that of aggressiveness and competitiveness. A study by Powell, Bagilhole and Dainty (2009) found that women engineers tend to adopt an "anti-woman" approach as they tend to behave like "one of the boys" in an active engineering field in order to gain acceptance by their male counterparts. This type of behaviour may be detrimental to women as they experience internal conflict, ambivalence and a sense of "not belonging" (Chu 2005; Etzkowits, Kemelgor & Uzzi 2000; Morris & Daniel 2008).

2.1.2 *Mentoring opportunities*

The importance of mentorship for women engineers has been widely documented. Researchers maintain that formal mentorship programmes and mentoring opportunities are critical for the employability and career advancement of women engineers in engineering companies (Gatta & McKay 2003; Ingram, Bruning & Mikawoz 2009; Mamaril & Royal 2008; Page et al 2009). Schaefer (in Smith & Dengiz 2010) and Lyon (2009) emphasise that good role models are needed for women engineers when they enter the engineering workforce. However, in a male-dominated profession such as engineering, women's access to mentors is limited as most mentoring networks are primarily rooted in social situations controlled by men.

This is problematic as cross-gender mentorship often produces less satisfactory results (Weisenfeld & Robinson-Backmon 2007). In the past, male mentors used to play a more important role in organisations; however, research indicates that women tend to be better mentors as they are more patient, caring and innovative (Lo & Ramayah 2011). A lack of female role models may also result in many girls doubting that they could succeed in engineering and science and choosing alternative career paths (Page et al 2009; Lyon 2009). In addition, a study by Smith and Dengiz (2010) showed that women engineers also believe that having women peers is important. Many women learn and grow differently from the ways in which their male counterparts do. The opportunity to network with other women in the industry is thus a great asset to their growth and development.

2.1.3 *Training and education*

In spite of all that has been done to remove barriers for women in engineering education, disparities in this field have proved hard to overcome. A study by Chu (2005) revealed that women engineering students in the USA are significantly more likely than men to consider leaving engineering programmes. Other research has shown that women students have to face and overcome daunting obstacles in order to obtain a degree in engineering (Bix 2004; Chu 2005; Eagly, Makhijani & Klonsky 1992; Gatta & McKay 2003; Mamaril & Royal 2008; Smith & Dengiz 2010; Tonso 1997; Valian 2000). Gender discrimination, an unfavourable learning environment, lack of peer support, the paucity of role models and societal criticism are only a few of the obstacles these women have to overcome in order to reach their goal. With regard to further studies, there are few women in engineering departments, especially above the levels of assistant professor (Bix 2004; Ozkanl & White 2008; Page et al 2009; Tsui 2009).

Because of family and domestic commitments, women in STEM occupations also find it more difficult to increase their human capital through education and training, and because they are ill-equipped they often remain in secondary positions in the labour force (Wynarczyk & Marlow 2010). The continued existence of the boundaries and obstacles that face women engineers in training and further studies affects their level of expertise in the workplace, reducing opportunities for advancement. Researchers suggest that there are too few training opportunities in diversity and gender issues in engineering businesses and argue that such training would remove a significant barrier for women engineers in the work environment (Maskell-Pretz & Hopkins 1997; Page et al 2009).

2.1.4 *The "old boys' club" network*

Informal networking plays an important role in advancement opportunities in most organisations (Shantz & Wright 2011). It facilitates information exchange, career

planning and strategising, professional support and encouragement, as well as increased visibility in the business (Cooper Jackson 2001). The “old boys’ club” is a longstanding tradition in most male-dominated organisations, especially those in the fields of science and technology (Cooper Jackson 2001; Gatta & McKay 2003; Shantz & Wright 2011; Smith 2003). Men tend to position themselves in a “fluid, contested and diverse set of discursive practices” as a tactic of masculine domination to exclude women (Connel & Messerschmidt, in Page et al 2009:5). This may not be intentional as much of such deeper cultural behaviour is unconscious (Hall 1976). Many decisions are therefore made in informal or social situations (for example, on the golf course), or at “invitation only” meetings (Gatta & McKay 2003; Maskell-Pretz & Hopkins 1997; Van Raaphorst-Johnson 1997). In a male-dominated profession such as engineering, women are often not integrated into professional networks (Shantz & Wright 2011).

Consequently, women are less likely to be given the same opportunities as their male counterparts in terms of information exchange, career planning, mentoring opportunities and professional support (see Page et al 2009). It is acknowledged that these factors play an important role in upward mobility and exclusion or limited exposure affects the advancement opportunities open to women engineers (Cooper Jackson 2001; Shantz & Wright 2011; Smith 2003).

2.1.5 Salary inequity

Regardless of substantial progress made in gender equity over the last few decades, research shows that there are still inequities with regard to remuneration in the engineering field. A study by the National Science Board (US) (in Mamaril & Royal 2008) found that male engineers earn 25% more than women. Another study conducted by the University of Wisconsin-Milwaukee found that half of the women working in engineering considered leaving the field because of low salaries (Barrett 2011). Although engineering appears to be a highly paid profession, this does not necessarily apply to entry-level employees, particularly women (Mamaril & Royal 2008). Career progress of women is slower in engineering and it consequently takes longer before they are earning a higher salary (Hoh 2009; Mamaril & Royal 2008). Women can therefore be expected to leave the engineering profession because of lower pay.

2.2 Psychological barriers experienced by women engineers

2.2.1 Family/work

Despite the increase in the number of women in the labour market, there seems to be no change in gender-role expectations for men and women in society (Mostert 2009:145). Women, especially in the science, engineering and technology sectors, face a myriad of challenges in their working life which their male counterparts do not face (Chinyamurindi & Louw 2010). Research shows that women in engineering still spend a disproportionate amount of time on child care and family responsibilities. Unlike men, women remain primarily responsible for child care, elder care and other household responsibilities (Hoh 2009).

As a result women in employment are pressured into having to juggle the demands of work and family roles (Mostert 2009). Ginther and Khan (in Minerick, Wasburn & Young 2009) found that single women in engineering had a slightly better chance of earning tenure than single men. In the same study it was also found that married women had the same chance as males of gaining tenure in engineering, but only if they were childless. Longer working hours also contribute to work/life imbalance for

women engineers as the work climate in engineering, science and technology seems to be rooted in a perception that longer working hours equate to better work (Gatta & McKay 2003:11). Women perceive the long working hours and the expectation that they should work overtime and work over weekends as the main barrier to their professional careers (Sandy & Burger 1999). Consequently, women leave engineering jobs because the perceived expectations are detrimental to their families.

2.2.2 Gender issues

2.2.2.1 Discrimination/harassment

Despite the substantial progress made during the past 50 years in the area of gender discrimination, research indicates that it remains a significant barrier for women in male-dominated occupations (Martin & Barnard 2013) and in engineering today (see Weisenfeld & Robinson-Backmon 2007). Weisenfeld and Robinson-Backmon (2007: 28) in particular refer to gender discrimination as a “glass-ceiling”, a type of labour market discrimination which “represents a job inequality that is not explained by job-relevant characteristics such as education, experience, past qualifications, or achievements”. In this context majority groups deny minority groups access to the most desirable organisational opportunities, which include networking, mentoring support and career advancement into senior positions. Consequently, minority groups perceive themselves as being treated unfairly and leave their companies (Weisenfeld & Robinson-Backmon 2007).

In addition to these discriminatory behaviours in the workplace, research shows that sexual harassment exists in many engineering environments, with a negative impact on the psychological well-being as well as the professional progress of women engineers (Ingram et al 2009; Maskell-Pretz & Hopkins 1997). With sexual harassment issues receiving daily attention from the media, employees have become more aware of the legislation regulating such conduct, and the most pronounced and blatant forms of sexual harassment against women engineers have been reduced (Maskell-Pretz & Hopkins 1997:35). However, according to the Catalyst Report (2000), sexual harassment, as well as sexist comments and jokes, are deeply rooted in the engineering culture.

2.2.2.2 Gender stereotyping

A long-standing tradition of gender segregation has had a negative impact on the self-confidence of women engineers, and consequently on their performance (Chu 2005). According to Gatta and McKay (2003:6), “women and men develop different occupational perspectives and skill sets based on what is culturally considered appropriate for each sex”. Gender-related behaviour in men and women is reinforced by parents and role models (Gatta & McKay 2003). The expectations of the parents and teachers of young girls, for instance, with regard to non-traditional careers such as science and engineering and the differential treatment based on gender in these fields may reinforce girls’ perceptions of appropriate behaviour (Gutbezahl 2001; Mamaril & Royal 2008; Wender 2009). Further, the stereotypical images of engineers and scientists as men may discourage young women from pursuing careers in engineering (Hoh 2009).

In addition, societal expectations and perceptions regarding both women and the fields of science, mathematics and engineering play a cardinal role in the perceptions of the women engineers themselves (Chu 2005; Wender 2009). Science and scientific institutions are characterised by a masculine culture because of the historical

exclusion of women from this field and the consequent development of masculine behaviours, activities and perceptions (Alev, Gonca, Acar Ece & Yasemin 2010; Male, Busha & Murray 2009; Mamaril & Royal 2008). McIlwee and Robinson (in Ingram et al 2009) found that the career mobility of women engineers was hampered in a culture where male engineers cultivate an interactive style that involves aggressive displays of technical ability, self-promotion and self-confidence. Clearly, occupational gender stereotyping may serve as a barrier to women's career advancement in male-dominated occupations (Alev et al 2010).

2.2.4 Lack of self-esteem

The issues of self-concept, self-efficacy and self-confidence have gained considerable research attention in attempts to explain the exclusion of women from technological fields such as engineering (Wender 2009). Sagebiel and Dahmen (in Mamaril & Royal 2008) point out that the most powerful influence on women in engineering is a lack of self-confidence in their intellectual abilities which may be the result of their minority status and feelings of isolation in this profession. Gender stereotypes and gender role expectations may contribute to a lack of self-efficacy on the part of prospective women engineers in that their parents, school and university teachers and business instructors try to influence them against entering male-dominated occupations such as engineering (see Hill et al 2010; Hoh 2009; Ismail 2003; Mamaril & Royal 2008; Wender 2009). Saifuddin, Dyke and Rasouli (2013) found that both men and women indicated self-efficacy as the most important predictor of determination in engineering.

2.3 Career path choices of women engineers: professional engineering and management

Although extensive research has been done on women in management, women in engineering and barriers to managerial positions, research on these topics has, for the most part, not been integrated. From the existing literature reviewed, our deduction is that very little has been documented on the specific barriers perceived and experienced by women professional engineers regarding their career mobility.

Evetts (1997) is one of the few authors to have documented some studies on this integrated topic. She states that barriers, both psychological and professional, have made women "reluctant managers" (Evetts 1997:25). Some have chosen the alternative of specialist careers in an attempt to advance in the organisation (Ismail 2003).

This choice between a specialist and a managerial career path, or a "dual ladder career system", was investigated by Maimunah Ismail in a study of the perceptions of women and male engineers in a big organisation in Malaysia (Ismail 2003). According to Ismail (2003:64), the managerial route is widely perceived as the more successful and attractive alternative for male engineers. In South Africa, the dual ladder career path is only a reality in a few big engineering-oriented organisations. The rarity of this initiative may explain why no research is available regarding women professional engineers and managers, or women in the dual ladder career path system in South Africa. The main objectives of this study are therefore first to explore the barriers that affect the career advancement of women in engineering and second to determine whether (and why) women engineers choose the managerial route as opposed to a further career in engineering as a specialisation in a South African context.

3 Research design

3.1 Research approach

A mixed-method research approach was followed, combining quantitative and qualitative research methods. Mixed method research can be described as a process in which a researcher combines the elements of quantitative and qualitative research for the purposes of gaining a broader and deeper understanding of the research topic and also obtaining corroboration (Onwuegbuzie, Bustamante & Nelson 2010). The nature of the study was exploratory. Exploratory studies examine phenomena, and the attitudes, perceptions and ideas of specific social groups that have not really been examined as consistently and intensely as those of other groups (Field 2009). In this research we used a questionnaire comprising both closed-ended questions for quantitative data collection and open-ended questions for qualitative data collection in order to answer the research questions.

3.2 Research method

3.2.1 Research participants

The target population for this research was women professional engineers and managers (former professional engineers) in a large South African company in the energy sector. At the time of this research the participating company employed a total of 3 617 employees, of whom 129 female employees held a qualification in professional engineering. Sixty-nine of these employees were managers, 53 were in senior professional positions, and seven were specialists. All the professional women engineers were approached for the purposes of the study. From this sample, 37 females agreed to participate but only 29 returned their questionnaires, yielding a response rate of 78%. The final sample included 21 participating women engineers and 8 women managers.

The majority of the women engineers in this sample were 25–29 years old (38.1%), Afrikaans speaking (52.4%), married (47.6%) and did not have children. Most of the engineers had attained a Bachelor's degree while 14.3% had an Honours degree, and 4.8% held Master's and/or Doctoral degrees. Most of the responding engineers (52.4%) had been in their current positions for one to three years, and had been working for their companies for the same length of time, which indicates that they are still in their first job.

The managers in this sample primarily fall into the 25–29 year-old, 30–34 year-old and 35–39 year-old age groups. It is, however, a cause for concern that 25% of the respondents in management were under the age of 30, and that there were no respondents in management over the age of 44. The relative youthfulness of managers may indicate that women have been promoted along an accelerated career path in order to meet Employment Equity targets. Respondents were primarily Afrikaans-speaking (62.5%). Half of the manager respondents were parents, possessed a Master's degree and were employed mostly at middle management levels and above (75%). Most of the managers had been in managerial positions for seven to nine years (37.5%), and 62.5% had been employed by the company for ten years or longer.

3.2.2 Measurement

Two questionnaires were designed to measure the career barriers that female engineers experience in the engineering profession. The questionnaire for women in

engineering positions focused on obstacles in and barriers to future career paths, whereas the questionnaire for managers focused on the women's historical career path and the decisions made by them in choosing a managerial option versus an engineering option. The questionnaires were designed on the basis of an extensive literature review and pilot-tested to ensure face validity. Both questionnaires consisted of ten statements that had to be rated on a five-point Likert-type scale ranging from Strongly Disagree (1) to Strongly Agree (5). A five-point scale was deemed sufficient for the type of questions asked in the questionnaire. Most of the questions focused on the barriers to engineering identified in the literature, and endeavoured to determine the extent to which the participants encountered these barriers in the company. The questionnaire also attempted to determine whether these barriers were perceived to be higher and more prevalent in engineering than in corresponding management positions.

Finally, open-ended questions were included to substantiate the responses to the closed-ended questions and elicit more in-depth information and deeper understanding of the barriers that women engineers are facing in their careers. The questionnaires for both the engineers and the managers contained a section of four open-ended questions mentioned below:

- Question 1 (Managers only): Why did you choose a management career above a technical/specialist career?
- Question 2 (Engineers only): Are you considering management as a future career path, and if so, what are your main reasons?
- Question 3 (Engineers and Managers): What barriers do you perceive to women's advancement in your organisation in the technical/specialist career path?
- Question 4 (Engineers and Managers): What could be done to minimise the barriers and advance the career opportunities of female engineers in the professional (P) and specialist (S) job categories?

3.2.3 Procedure

Permission to carry out the study was obtained from the Human Resource Management Division of the company. Each questionnaire included a brief explanation of the aim of the research, as well as the perceived benefit of the research to the company. Questionnaires were sent out by means of email or delivered by hand. Responses were returned by hand or via email. All responses were kept confidential.

3.2.4 Data analysis

The mixed method approach of using quantitative and qualitative data in this study necessitated two types of data analysis, namely statistical analysis and qualitative content analysis.

Statistical analyses were performed on the quantitative data with the aid of SPSS (SPSS 2013). The data analysis techniques include descriptive statistics such as means, as this research was mostly exploratory in nature (Field 2009). The qualitative data obtained through the open-ended questions were analysed using content/theme analyses (Creswell, 2009). Content analyses are frequently applied in qualitative studies with the aim of obtaining a condensed and broad description of the phenomenon as well as the concepts and categories describing a phenomenon (Elo & Kyngäs 2008). Content analyses are therefore able to demonstrate how data can be analysed systematically and with scientific rigour (Thyme, Wiberg, Lundberg & Graneham 2013). The content of each response was firstly open coded, then axial

coded (relating categories to one another) and finally selective coding (integrating the concepts around the core category of career barriers experienced by women engineers) (Strauss & Corbin, 1998) was applied to identify similar responses and outliers.

4 Results and findings

4.1 Results and findings from the closed-ended questions

A comparative analysis was carried out between women engineers and managers on the barriers that women engineers experience. The results are presented in Table 1 below.

Table 1
Responses to closed-ended questions

	Career barriers affecting engineering	Women engineers (N=21)	Women managers (N=8)	Gap analyses
1	I would rather apply for a management position than an engineering position.	2.14	3.63	-1.49
2	There are more management positions available than engineering positions.	3.57	2.88	0.69
3	The dual career path for technically qualified women (engineers) caters adequately for women who prefer to advance in technical/specialist positions in the organisation.	2.86	3.75	-0.89
4	It is more difficult to obtain an engineering position than a corresponding management position because of the higher level of qualifications required for engineers.	3.62	3.63	-0.01
5	A management position is superior (i.e. more status or higher benefits) to a corresponding engineering position.	3.10	2.13	0.97
6	There are too few mentoring opportunities for women engineers.	3.48	2.63	0.85
7	There are too few training opportunities for women engineers.	3.05	2.13	0.92
8	The "old boys' club" is less prevalent in management than in technical positions.	2.86	2.13	0.73
9	"A management position would be easier to reconcile with the responsibilities of a wife and mother than a corresponding engineering position would be."	2.43	2.38	0.05
10	"Gender discrimination is less prevalent in management than in technical positions."	3.29	1.88	1.41

The results given in Table 1 show that on average women engineers perceived more career barriers than the women managers. The women engineers indicated more gender discrimination in engineering positions than in managerial positions, a lack of sufficient engineering positions and a lack of mentoring. These results might be the reason why women managers strongly indicated that they would rather apply for a management position than for an engineering position. Women managers also indicated that the dual career path in the company (i.e. engineering versus management) is sufficient for the career advancement of female engineers. Women managers also reported less gender discrimination than women engineers did.

4.2 Results and findings from open-ended questions:

A variety of responses were received to each question. The contents of the responses were carefully analysed to identify similar responses, which were then grouped together and categorised; a number was assigned to each category. The results and findings for the four open-ended questions are discussed below and reported on collectively in the following section.

Question addressed to managers: Why did you choose a management career in preference to a technical/specialist career in engineering?

The categories of responses and results are summarised in Table 2.

Table 2
Responses from managers relating to choice of a managerial career

Category	Description of category	Percentage
1 Better exposure	Ability to use a wider variety of skills and develop cross-functionally (Ability to apply business skills, financial skills, people skills)	36.3%
2 Lack of opportunities in engineering	Lack of opportunities in specialist positions More and better career opportunities in management	27.3%
3 Benefits	The position was offered - benefits too good to refuse	18.2%
4 Job satisfaction	Best of both worlds (manager in engineering company) Better work/life balance	18.2%

The majority of the managers (36.3%) indicated that they had entered management to broaden their horizons, gain exposure to a wider variety of experiences and use a wider variety of their skills. Some of the new experiences or skills indicated by the participants were ability to grow, and the opportunity to apply financial or business skills and acquire people skills.

The second response category reported a lack of opportunities in specialist fields. A significant portion of the participants (27,3%) in managerial positions replied that they had left engineering because there are a wider variety of career choices, or better career opportunities, in management than in engineering. Some respondents answered that, when they had to choose a career path, Employment Equity imbalances in management were being addressed and consequently there were more management jobs advertised than specialist/professional positions.

Some of the participants (18.2%) indicated that they had entered management because they were asked to apply for a certain position, or a position was offered and the offer was "too good to refuse".

Evidence quote: *Women are sought in management, especially in this male-dominated environment and then a premium is paid to attract you. You cannot refuse such offers...it is too good to be refused.*

The participants did not voluntarily disclose whether the benefits and rewards were in terms of status, remuneration or experience. Another reason given by some managers for accepting a managerial position was that it offered the "best of both worlds". These participants indicated that the specific management position they occupied involved significant specialist/technical expertise, and allowed them to use the experience they had gained as engineers as well as develop and apply their managerial skills. As mentioned by one of the women executive managers:

Evidence quote: *I am able to manage in the field that I studied and therefore build my expertise on two fronts - engineering and management..... who can wish for more?*

Question addressed to professional engineers: Are you considering management as a future career in preference to being a professional engineer?

If they were considering management as a future career path, they were asked to specify their reasons. The categories of responses and findings are indicated in Table 3.

Table 3

Responses by women engineers on management as a future career path option

Category	Description of category: management as a future career path	Percentage
NO	Management is not a future option	42.9%
YES	Management is a future option	57.1%
Why yes?	1. Better career opportunities, entry level standards lower than for specialist posts	38.1%
	2. Ability to use a wider variety of skills	9.5%
	3. More benefits or higher status	9.5%

The percentage of women engineers who indicated that they were not considering management as a possible future career choice was 42.9%. The participants replied that they enjoyed working in a technical field and would not exchange the challenges of engineering for a career in management. The quantitative data indicated that many of the engineers were young and were in their first job, which may have influenced their choice to stay in engineering positively as they had probably not yet experienced many specific barriers to advancement. However, the majority (57,1%) of the engineers indicated that they were considering management as a career option, which is alarming news for the engineering profession. The main reason for considering management (38.1%) as a possible future career option was that there are more career opportunities in management than there are in the specialist/professional fields.

Evidence quote: *I will consider management as an option as there are more management jobs available and it seems easier for us to enter into management...and the specifications in the specialist jobs are very high.*

Participants indicated that there were fewer positions available in professional/specialist careers than there were in management. They also replied that entry-level standards, or the minimum qualifications required for management positions, were lower and more readily attainable than those for professional/specialist positions.

Some (9.5%) of the engineers indicated that they had considered entering management to broaden their horizons, gain exposure to a wider variety of experiences and use a wider variety of their skills. They indicated that it might be a positive challenge to work and gain experience in a different field.

Another reason given for considering management as a possible future career was that it would offer more benefits or higher status. The participants in this category perceived management as more glamorous than engineering and therefore superior to it.

Evidence quotes:

1. *It is cleaner in management and you can at least act as a woman and look the part.*
2. *Your femininity is not affected as in many areas in engineering operations...you must see some of the conditions we have to work in... it is dirty.*

3. *We do not have proper toilet facilities and the like.*

Question addressed to both professional engineers and managers: What barriers do you perceive to women's advancement in the company within the technical/specialist career path?

This question also served as a means of confirming the results of the closed-ended questions. The categories of responses relating to barriers to the technical/specialist career path option derived from the open-ended question and findings are indicated in Table 4.

Table 4
Responses and findings relating to barriers to technical/specialist career path option

Category	Description of category: Barriers to technical/specialist career path	Percentage
1	Gender issues: Discrimination, stereotyping, harassment	20.51%
2	Lack of training or real exposure opportunities, lack of mentorship opportunities	20.51%
3	Ease of entry into managerial positions (Qualification requirements for managerial positions vs. specialist/professional positions)	15.38%
4	Opportunities for promotion to senior engineering positions (Perceived availability of managerial positions vs. specialist/professional positions)	12.82%
5	Lack of self-confidence as an engineer	12.82%
6	Family/work conflict	7.69%
7	Status of managerial positions	5.13%
8	Lack of recognition	5.13%
9	Lack of communication/information	2.56%
10	Hygiene and safety issues (Lack of proper facilities, cleanliness, safety in external environment)	2.56%

The key barriers to entering senior engineering positions, as identified by both managers and engineers, were gender issues (20.51%) and lack of training and real exposure to engineering practice (20.51%). Participants indicated that there is still a perception in the engineering environment and companies that women are not as competent as men in the technical fields. Some of the women felt that male colleagues do not respect them, and refuse to accept their recommendations or expertise, simply because they are women or are perceived to have less expertise.

Evidence quotes:

- 1 *Stop putting so much pressure on women to perform without given them the necessary operational and real experience. We have not the role models and the inner discussions as men have in the 'old boy's networks'. I have never had an assigned mentor and have to manage by myself. I am not asked to join in discussions at work...only attend formal meetings.*
- 2 *I can attend courses, but I do not get the opportunity to experience the real business in practice...I am often not included.*
- 3 *I have no engineers in my family who can show me the 'tricks of the trade'. It is going to take me twice as long as the men to learn things by myself and if I fail t is because I am a women. If I am successful I am OK, but if I make a mistake I am labelled.*

- 4 *I am ignored in meetings just because I am a woman...I often have good ideas...it is not just disrespectful but it affects my motivation.*

Question addressed to both professional engineers and managers: What can be done in organisations to advance the opportunities of professional women engineers in the P and S job categories (Professional/Specialist posts)?

The categories of responses and findings are indicated in Table 5.

Table 5
Responses and findings relating to initiatives for career advancement of women in professional/specialist posts

Category	Description of category: Initiatives for career advancement in professional/specialist posts	Percentage
1 Talent management of women	Increase the number of entry-level women engineers in the business. Identification and development of talented candidates (training opportunities)	36.66%
2 Active mentorship	Create additional mentorship opportunities (more genuine role models)	16.67%
3 Equity culture	Foster an environment where women are treated as men's equals	16.67%
4 Job design	Create more specialist and professional positions	10.00%
5 Organisational support	Support for women in their dual role (Work/life balance)	10.00%
6 Suitable workplace facilities	Respect and consideration for women as engineers (suitable workplace facilities – washrooms/toilets)	6.67%
7 Managing gender diversity	Foster understanding of women engineers in the business. Embrace femininity	3.33%

It is evident from Table 5 that most of the participants suggested that a focus on talent management in women is important. This would include attracting more women into engineering and creating more training opportunities, with real operational learning, as mentioned previously. It was suggested that talented women candidates be identified, developed and trained as mentors. However, sometimes training opportunities do exist but women's workload does not allow them to take advantage of those opportunities. Women would be better equipped to meet the high requirements for professional and specialist positions if they were trained and developed to do so. The participants indicated that they wanted to see additional mentorship opportunities and more women role models in the technical field. It was suggested that role models should be identified and encouraged to be more visible and positive and to play a mentoring role. The women also suggested involving women in task teams where they can learn from each other and serve as role models for each other.

Evidence quotes:

- 1 *Women have all the necessary abilities, but organisations fail us by not giving us real exposure. Organisations must focus specifically on talent management of scarce skills such as women engineers – it must not just be part of the normal organisational process or system.*
- 2 *We need real active women mentors, not just someone on paper. I will also not mind a male mentor as long as he is willing to really assist me. Give these mentors the*

necessary training, recognition and incentives to make them take on this important job.

Another important developmental opportunity mentioned is that women should be treated as equal to their male colleagues and given the opportunities to develop themselves in order to be perceived by men as their equals in expertise. Regardless of Employment Equity, women engineers should not be forced or persuaded into roles before they are ready to make the decision for themselves, without external pressure. Women should also expect to be treated as men's equals and should not demand special treatment. They will earn respect through appropriate conduct. The following quote (with suggestions) summarises this section well:

Look at the development of the women and determine the need in the business. Then develop individuals for the specific positions and keep the knowledge in the company. People do not get far and do not even consider P and S band positions as a future, because of the difficulty to be considered for such positions and therefore the women are being bought by other companies to fill their EE positions. Look inside the company for the individuals instead of recruiting outside. People inside are being ignoredand their potential is never realised.

5 Discussion

Since 1994, businesses in South Africa have begun to focus more on gender equity in the workplace, including in technical professions such as engineering. Consequently, increasing numbers of women are entering previously male-dominated occupations such as engineering. Career advancement opportunities for women engineers are limited, however, and as a result many of them go into management. Unfortunately, when women move from technical positions to management, the organisations they work for are left with a shortage of technical skills. The objectives of this research were therefore twofold. First, the researchers aimed to explore the barriers that affect the career advancement of women in engineering. Second, they investigated the factors that drive women engineers to choose a career in management instead of choosing engineering as a profession.

The results of the research showed that women engineers experience more barriers in the engineering profession than women engineers who are currently employed as managers. A significant challenge pointed out by the women engineers is the lack of mentorship in their profession. Our results confirm previous research, which indicates that male-dominated professions such as engineering pose many challenges for women. Women's access to mentors is limited as most mentoring networks are primarily rooted in social situations controlled by men (see Gatta & McKay 2003; Ingram et al 2009; Mamaril & Royal 2008; Page et al 2009). Moreover, a lack of female mentors and role models may result in fewer women entering technical positions such as engineering (Lyon 2009; Page et al 2009). Indeed, formal mentorship programmes and mentoring opportunities are critical to the employability and career advancement of women engineers in engineering companies (Fouad & Singh 2011; Gatta & McKay 2003; Ingram et al 2009; Mamaril & Royal 2008; Page et al 2009).

Women engineers also perceived a higher level of gender discrimination in the engineering profession compared with women engineers employed as managers. As in the study by Weisenfeld and Robinson-Backmon (2007), women engineers in this study were also representative of the minority group of employees in their organisations and were therefore more prone to gender discrimination and subsequent lack of career advancement opportunities.

Another barrier that was highlighted by the women engineers was the lack of real training opportunities to teach them the specialist skills in operational arenas needed to further their career as engineers. As a result, they were likely to consider managerial careers, as indicated by the qualitative results. Wyncarczyk and Marlow (2010) found that the obstacles and boundaries relating to training opportunities for women engineers could have a negative effect on their level of expertise in the workplace and furthermore reduce opportunities for advancement.

Women managers tended to favour the dual career path in the company (i.e. engineering versus management) for the career advancement of women engineers. These results are in contrast with the findings of Evetts (1997), who suggests that women engineers are less likely to enter managerial positions than male engineers as a result of professional barriers. Similarly, Ismail (2003) found that women engineers preferred specialist positions as opposed to being in management positions.

6 Recommendations from the study

From the research findings it is strongly recommended that the company develop formal mentorship programmes with genuine role models that can assist women engineers in their career advancement. In addition, more care should be taken in establishing an organisational culture where women engineers receive equal treatment with men on a professional level and where femininity is appreciated and catered for on the professional (e.g. gender policies and practice, workplace facilities) and psychological levels (e.g. inclusion of women in a work team with the necessary appreciation for femininity). The organisation could also benefit from revising its organisational structure to include more senior engineering positions and revisit its talent management strategy and practice by retaining its younger female engineering talent through rigorous career development opportunities.

7 Contribution of the study

This research made an important contribution towards the current empirical knowledge of and insight into the career barriers of women in male-dominated environments such as engineering. The importance of women engineers and the barriers to career advancement that still exist in the workplace should not be ignored. This study highlights key barriers such as specific gender issues, lack of real career development and active mentorship which could be addressed by organisations to utilise and manage the career paths of their women engineers in an equitable manner. The South African Employment Equity Act ensures that organisations make an effort to sponsor and attract women into the field of engineering, but this alone does not guarantee their retention or that they will have an equitable career path experience. Neither is it any guarantee that we will be able to build the engineering capacity needed in the economy.

8 Limitations

This research had some limitations. This study was limited to one company, which resulted in a small sample being used. Therefore the results of the research cannot be generalised to other organisations or industries. In order for the research to be generalised to women in engineering in South Africa, it is recommended that the study be repeated with a larger sample of women in the science, technology, engineering and mathematics (STEM) occupations in South African organisations. In addition, the

sample size was small, which limited the type of statistical analysis that could be executed in terms of demographic variables such as age, ethnicity and work experience. From a quantitative perspective a cross-sectional research design was used, which limited the research in terms of cause and effect inferences. Longitudinal studies are useful in tracking the career barriers of women engineers over a longer period of time. Finally, the research made use of self-report measures. Future research could benefit from direct observations to provide an objective reflection of the career barriers experienced by women engineers.

9 Conclusion

In conclusion, the findings of this study have revealed some interesting facts about the career barriers and paths of women engineers in South Africa. It is recommended that the impact on businesses of Employment Equity, especially at the upper and executive management levels, be researched in relation to the career paths of women engineers. The Employment Equity Act makes it easier for women to enter a previously "male-dominated" profession such as engineering, but it does not secure their retention in the technical field. It is time that organisations and managers who employ women engineers take cognisance of the real barriers and address them actively and not just through policies and procedures.

A word of caution was directed by one of the executive women managers in this study to organisations that attract women engineers into management:

Placing women in management without sufficient experience in the field really automatically alienates and isolates women from the true day-to-day running of the business. It kills the technical expertise crop that the company, and this country (South Africa), could really reap from in the future. Long-term strategies should be about building a dynasty of sufficiently qualified, empowered people in their relevant areas of technical fields. Management should come later as a natural process – with much tested technical experience. Open the playing field but realise we have differing gender needs, adapt our facilities and embrace our capabilities.

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