

**UNIVERSITY OF KWAZULU-NATAL**

**Female engineers perceptions of gender discrimination**

**by**

**Rozeena Brijbans**

**213549672**

**A dissertation submitted in partial fulfilment of the requirements for the degree of  
Master of Business Administration**

**College of Law and Management Studies  
Graduate School of Business & Leadership**

**Supervisor: Professor Anesh Maniraj Singh**

**2015**

## DECLARATION

I, Rozeena Brijbans, declare that:

- (i) This research reported in this dissertation, except where otherwise indicated, is my original work.
- (ii) This dissertation has not been submitted for any degree or examination at any other university.
- (iii) This dissertation does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.
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Signed: \_\_\_\_\_

## ACKNOWLEDGEMENTS

- To my wonderful parents, Mr M. Brijbans and Mrs G. Brijbans, thank you for your prayers and for unselfishly putting my needs first before your own so I could follow my dreams.
- A heartfelt thank you to my extraordinary sister, Suraya Brijbans. Words cannot express my gratitude for your moral support throughout my life and educational journey. You have always been my pillar of strength who encouraged me through all my setbacks and your constant belief in my abilities always made me feel like I can accomplish anything.
- To my dearest brother, Yunus Brijbans, thank you for your support and carrying all the family responsibilities so I could effortlessly continue with my studies.
- To my amazing supervisor, Professor Anesh Maniraj Singh — you were not only a key role-player in the success of my dissertation, but throughout my MBA course. It was through our constant disagreements and your strict marking criteria that we shared a very unique relationship. Ultimately, thank you for your speedy and efficient feedback, guidance, encouragement and your critique that pushed me to soar to impressive heights.
- To my respondents, thank you for taking the time to participate in my questionnaire. Your contribution was critical for the completion of my dissertation.
- Thank you to the Engineering Council of South Africa (ECSA), CESA, to all the ECSA voluntary organisations and the Young Professionals Forum (YPF) that distributed my questionnaire, the Department of Higher Education and Training (DHET), and all other relevant organisations for assisting me to complete my research.
- To my friends and colleagues, thank you for your assistance and support through my research.

## ABSTRACT

Since South Africa achieved democracy in 1994, there have been unprecedented changes to increase women's participation in the workforce. The presence of more women in traditionally male-dominated occupations like engineering has caused the industry to experience extraordinary cultural changes. However, different forms of covert and overt gender discrimination still prevail in the engineering industry that prevents women from successfully integrating into this profession. The aim of this study was to determine whether female engineers experience gender discrimination in their work environments. A quantitative study was conducted to measure female engineer's perceptions of gender discrimination in their profession and to identify the underlying factors that hinder their advancement into senior management positions.

Non-probability sampling that utilised convenience and snowball sampling techniques was adopted for the study. The study focused on the perceptions of 285 female engineers who were registered on the Engineering Council of South Africa's (ECSA) database in the KwaZulu-Natal region. The participants belonged to the chemical, mechanical, electrical, civil and industrial engineering disciplines.

Almost two thirds (60%) of the participants felt that they needed to overachieve in their organisations to receive recognition. More than half (52%) stated that their career mobility to senior management positions was hindered due to the lack of organisational support to balance their personal and work responsibilities. However, the majority of the respondents (52%) did not feel discriminated in their project management positions. The respondents ranked equal recognition, equity in compensation and in promotional opportunities as the three crucial job characteristics that need to be improved to eliminate gender discrimination in organisations. These findings prompted several recommendations to overcome these gender inequalities; some significant recommendations include gender equality training programmes, flexible working arrangements and shared leadership. Five gaps for further research were also discovered, which will provide a comprehensive account as to why gender discrimination still prevails in the engineering profession.

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## LIST OF ACRONYMS AND ABBREVIATIONS

AA	affirmative action
B-BBEE	Broad-based Black Economic Empowerment
BWASA	Business Women’s Association of South Africa
CCMA	Commission for Conciliation, Mediation and Arbitration
CESA	Consulting Engineers of South Africa
CPD	continuous professional development
DHET	Department of Higher Education and Training
ECSA	Engineering Council of South Africa
HDI	historically disadvantaged individuals
Indsco	Industrial Supply Company
MBA	Master of Business Administration
PCI	Project Concern International
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
RSA	Republic of South Africa
SAICE	South African Institution of Civil Engineering
SPSS	Statistical Package for Social Science
Stats SA	Statistics South Africa
VEOHRC	Victorian Equal Opportunity and Human Rights Commission
WomEng	Women in Engineering
YPF	Young Professionals Forum

# CHAPTER 1

## Introduction

### 1.1. Introduction

South Africa has made momentous attempts to enforce gender transformation in the female labour workforce and to rectify historical imbalances. However, women's representation in the engineering profession remains relatively low. Women still encounter gender discrimination barriers that prevent them from integrating successfully into this profession. These barriers ultimately affect their retention in the profession, contribute to the skills shortage crisis in South Africa, and impact their career advancement opportunities into senior management positions.

The poor representation of women in engineering leads to a limited number of female engineers involved in project management and senior management positions where they can display their technical and leadership abilities. Therefore, female engineers lack the visibility and recognition for upward career mobility.

This chapter provides a brief introduction and the rationale behind this study. The focus of the study will be detailed and the major aim, objectives and research questions will provide a concise description of the issues that the study attempted to solve. A chapter outline will demonstrate the logical unfolding of this dissertation.

### 1.2. Motivation for the Study

Gender discrimination is one of the major barriers that contributes to women's low participation in the engineering profession (Martin and Barnard, 2013). This is usually a psychological barrier that women experience in different forms within the workplace without the knowledge of management and this hinders their career progression (Martin and Barnard, 2013). Therefore, it is vital to study the perceptions of female engineer's gender discrimination experiences in their work and project environments to verify the existence of gender discrimination.

Gender discrimination in this study is associated with the recruitment and retention of women in the engineering profession, and their under-representation in engineering occupations contributes to the country's skill shortage. Information from this research will

benefit policy makers in the South African government who can rectify the skills shortage and employment equity problems in the engineering industry. Government can use legislative means to increase women's participation in the engineering profession, which puts pressure on organisations to implement cultural changes that empower women and improve the economy.

The Engineering Council of South Africa (ECSA) and other professional associations can use this research to develop strategic plans or to regulate procedures in the engineering discipline that will overcome gender discrimination barriers, provide easier admittance of women into the engineering profession while also promoting the career advancement of female engineers.

Engineering employers will benefit from this study in that they will be able to comply legally and then provide a conducive working environment that supports the career needs of female engineers. Organisations can achieve this by implementing policies that provide women with more opportunities for career advancement.

The study will benefit female engineers who aspire to advance in their careers. This research will provide beneficial recommendations on how they can overcome any gender discrimination barriers that exist in their professional environments and assist them to achieve upward career mobility. The information from this research will also benefit those female engineers already in leadership positions. They can use the evidence from this study to create a working environment that supports the career advancement of female engineers and they can also display themselves as role models in order to influence young girls to pursue a career in engineering

### **1.3. Focus of the Study**

The focus of this study was restricted to female engineering professionals who were registered on ECSA's database in the KwaZulu-Natal region. ECSA is a statutory body that regulates the engineering profession and members pay an annual registration fee to receive the recognition as a qualified professional in their registration category. Engineering professionals in this study refers to all female candidate and professional engineers, technologists, technicians and certified engineers. Male engineering professionals have not been included.

The Commission for Conciliation, Mediation and Arbitration (CCMA) recognises fair and unfair discrimination in South Africa. This research study focused on affirmative action (fair discrimination) and both direct and indirect unfair gender discrimination. It explored the perceptions of female engineer's personal work and project environment experiences in relation to gender discrimination. The study aimed to identify the gender discrimination barriers that prevent female engineers from gaining admittance into the engineering profession and what prevents their advancement into senior management positions. Other forms of fair discrimination are not included in the study.

Additionally, project managers in this dissertation will refer to female engineers who manage projects that participate in some kind of decision making, and who have subordinates that report to them within their professional environments.

#### **1.4. Problem Statement**

South Africa's legacy of apartheid institutionalised racism and gender discrimination in organisational cultures and society and has contributed to males still having negative perceptions of women's capabilities in the country's post-apartheid era. In 1945, there were no female engineers employed in South Africa but by 1974 the number of females entering this profession began to gradually increase (Roodt and Du Toit, 2009). It is still concerning that according to ECSA's 2012/2013 membership statistics, there still remains a trend of under-representation of women in this profession. Society's perceptions that engineering is a male occupation, is one of the major factors that influences women not to pursue this profession and this further exacerbates the engineering skills shortage in South Africa (Roodt and Du Toit, 2009). Due to the male-domination in the engineering profession, women who are appointed as engineers are not always accommodated and tend to experience gender discrimination (Roodt and Du Toit, 2009). Female engineers experience gender discrimination through organisational and project environment practices and experiences that marginalise them from gaining acceptance in their profession and preventing them from advancing into senior management levels.

The literature review in Chapter 2 highlights theories such as the role congruity theory, human capital theory, Kanter's theory of tokenism and a gender in leadership paradigm to provide a formal and logical explanation of why female engineers may experience gender discrimination. The literature review also argues that even though the South African government introduced affirmative action and employment equity policies to eliminate

discrimination, it is still evident that gender discrimination exists in the engineering environment.

This raises the question: What are female engineers' perceptions of discrimination in the engineering profession and will their participation in senior management positions continue to remain limited?

### **1.5. Research Sub-questions**

The aim of this research study was to determine whether female engineers experience gender discrimination in their profession. The intention was to achieve this aim by measuring female engineers' perceptions of discrimination experiences in their workplace.

The following research questions were posed to achieve the aim of this study:

- (i) What are the types of workplace policies and practices that contribute to gender discrimination in the engineering profession?
- (ii) What are the workplace barriers that prevent female engineers from achieving upward career mobility?
- (iii) What are the workplace practices that will eliminate gender discrimination and facilitate female engineers in achieving success in the engineering profession?

### **1.6. Objectives**

The following objectives served to supplement the aim of this research and to guide the scope of this study:

- To determine if female engineers experience gender discrimination barriers in their profession.
- To identify the factors that hinder the advancement of female engineers into senior management positions.
- To identify the improvements that will eliminate gender discrimination of female engineers.



## 1.7. Limitations of the Study

The following limitations caused the greatest impact on the quality of the conclusions that were drawn from the research. These limitations will be discussed comprehensively in Chapter Five.

- The results of the study were slightly affected when an error was encountered on Questionpro where the totals reflected 286 in the demographic section but only 285 respondents participated in the study. This occurred because some respondents clicked on the browser back button which affected the totals. This caused a minor difference to the results of the study but is negligible.
- It was impossible to generalise the research findings to reflect the perceptions of the entire population of female engineers in the province of KwaZulu-Natal because non-probability convenience and snowball sampling was adopted for this study.
- The Likert scale made it difficult to ascertain why respondents selected a particular choice to the questionnaire statements.

## 1.8. Chapter Outline

The content within the study is structured into five chapters. Each chapter progresses to the next chapter in a methodical and structured manner according to the logic of the research process. The outline of the study is illustrated in Table 1.1

**Table 1.1:** Structure of this dissertation

<b>Chapter</b>	<b>Content</b>
<b>Chapter 1</b>	A brief introduction to the entire research study is presented in this chapter. It specifies the details of the motivation and focus of the study. The problem statement in conjunction with the research questions and the objectives are stated and the limitations of the study are also listed.
<b>Chapter 2</b>	This chapter presents a literature review pertaining to the concept of gender discrimination in the engineering profession. It introduces a theoretical background to discrimination in South Africa, defines all related concepts and statistically highlights the magnitude of the gender divide that still prevails in engineering and management positions. In addition, gender discrimination barriers which prevent women from gaining acceptance into this discipline and advancing to senior management positions are also discussed.

Chapter	Content
<b>Chapter 3</b>	This chapter presents the research methodology, describing what techniques were incorporated in the research process to conduct the study. A discussion on the overview of the South African engineering environment and defining the concept of research sets the scene for developing the relevant aim and objectives. The aim and objectives employed for this study justified the type of research design and methods, sampling decisions and data collection methods that were adopted for this study.
<b>Chapter 4</b>	This chapter contains a complete presentation of the data collected and a discussion of the findings that emerged from the data. Firstly, the demographic profile of the respondents is interpreted and secondly the findings are addressed according to the objectives of the study.
<b>Chapter 5</b>	The final chapter reports on the overall conclusions that may be drawn from the research and recommendations are made based on these conclusions. The limitations and potential areas for further research are also highlighted.

### 1.9. Summary

Women's underrepresentation in the engineering profession and in senior management positions is attributed to gender discrimination barriers. This research study analysed the perceptions of female engineers to determine if gender discrimination really exists in the engineering work environment, and the study provides recommendations for career enrichment. This was an introductory chapter that has provided the motivation, focus area and limitations of the study. The problem statement, research questions and corresponding research objectives were delineated. The structure of the study was also outlined. The next chapter will review appropriate literature pertaining to gender discrimination that is experienced by women in the engineering profession.

## CHAPTER 2

### Female engineers perceptions of gender discrimination

#### 2.1. Introduction

Engineering has traditionally been a male-dominated profession where all engineering practitioners participate in projects or project management activities. Regardless of women's qualifications, they still receive resistance based on male-orientated cultural beliefs when they try to gain acceptance in this profession. Despite this resistance, women have still taken tremendous steps to participate in male-dominated occupations. However, the membership statistics of ECSA reflects that female engineers continue to remain under-represented in this profession.

This chapter provides a background to discrimination in South Africa and defines the concept of discrimination, engineering, projects and project management. This chapter also outlines the role of the project manager, highlights the dyadic phenomenon that occurs in teams, quantifies the extent of female under-representation in senior management positions and lastly explains the gender discrimination experienced by female engineers in their organisations and project environments.

#### 2.2. Background to discrimination in South Africa

Prior to 1994, South Africa was governed by a policy of Apartheid and during the apartheid era, the white government used legislative means to exclude black people (Indian, Coloured and African race groups, etc.) from basic freedom and human rights (Ramlall, 2012). Blacks had inadequate access to a good education, skills development, employment opportunities, property and asset ownership (Ramlall, 2012). South Africa became a constitutional democracy in 1994 and the new government introduced legislation and policies such as Affirmative Action (AA), Broad-based Black Economic Empowerment (B-BBEE) and the Employment Equity Bill to support the constitution and empower historically disadvantaged individuals (HDIs) (Ramlall, 2012). Affirmative Action policies deem women and non-whites as HDIs (Bowen *et al.*, 2013). According to the Department of labour (RSA) (2015), affirmative action was enforced on employers to ensure that designated groups (black people, women and individuals with disabilities) receive access to equal opportunities in their places of employment. According to the

Statistics South Africa's (Stats SA) Labour force Survey of the third quarter of 2014, more than 60% of employed white men and women were working in skilled occupations whereas 42% of employed African women were working in low-skilled occupations. Furthermore, black African men and women had the highest unemployment rates of 26.4% and 31.2% respectively, and 62.9% and 58% of them respectively had below matric education levels. Unemployment levels were closely associated with below matric education levels (Stats SA, 2014). These figures indicate a rather slow progress in transformation towards employment equity in the country and it also raises the question whether government is doing enough to protect employees and job seekers from unfair discrimination.

### 2.3. The concept of Discrimination and Gender Discrimination

Landry and Mercurio (2009 as cited in Bowen *et al.*, 2013, p.621) defined discrimination as “a set of behaviours that create societal, psychological, and physical barriers that prevent minority group members from obtaining parity with majority group members”.

According to the CCMA (2002), South African law recognises two types of discrimination, namely fair and unfair discrimination as depicted in Figure 2.1.



**Figure 2.1:** Types of discrimination

**Source:** Adapted from CCMA. 2002.*Discrimination*. [Online]. Available: [http://www.ccma.org.za/UploadedMedia/InfoSheets\\_DISCRIMINATION%20-%20JAN%202002\(1\).pdf](http://www.ccma.org.za/UploadedMedia/InfoSheets_DISCRIMINATION%20-%20JAN%202002(1).pdf) [Accessed 20 February 2015]

According to the CCMA (2002), fair discrimination is based on affirmative action, discrimination related to essential requirements of a specific job, discrimination related to productivity and discrimination that is compulsory by law. Unfair discrimination is any practice or policy undertaken by the employer to display favour, prejudice or bias towards employees on any arbitrary grounds, for example gender, race, marital status, family responsibility, pregnancy, culture etc.(CCMA, 2002). Furthermore, there are two forms of unfair discrimination, i.e. direct discrimination and indirect discrimination (CCMA, 2002). Direct discrimination is easily recognised because there is a difference in treatment between employees and job applicants based on arbitrary grounds, for example remunerating a female employee less than a male employee for the same job (CCMA, 2002). Indirect discrimination is subtle and not as easily recognisable – it involves applying practices and policies that appear to be neutral and not distinguishing between employees and job applicants; however, in reality it has unequal and negative consequences for certain individuals and groups (CCMA, 2002). According to the Victorian Equal Opportunity and Human Rights Commission (VEOHRC) (2015), indirect gender discrimination may occur when employers have pre-conceived beliefs regarding the capability of males and females to perform certain types of work.

Gender and sex are terms that are used interchangeably in practice; however, they have different meanings (Cartwright and Gale, 1995). While sex is a biological type, where humans are born either a male or female sex type, a gender is socially constructed and learned (Cartwright and Gale, 1995). There is a strong association between biological sex type and gender values (Cartwright and Gale, 1995). According to the Project Concern International (PCI) (2015), gender discrimination is a practice that treats a group of individuals differently based on their gender. Usually women are treated differently because they are perceived to be inferior. Gender discrimination in the workplace can occur in all sectors of employment, such as recruitment, workplace terms and conditions, and dismissal (VEOHRC, 2015). This includes not recruiting females because employers believe they will not fit in a traditionally male work environment, offering different remuneration rates or benefits for similar jobs, dividing tasks based on whether employees are male or female, and not promoting women to senior positions because it is presumed that their authority will not be respected by staff (VEOHRC, 2015).

Many women experience these barriers based on gender discrimination when they try to gain entry into traditionally male-dominated professions such as engineering and project management.

#### **2.4. Defining Engineering, Projects and Project Management**

ECSA (2015a) defines engineering as a discipline that seeks to use science and technology to discover solutions to economically important problems that may impede society's growth/development. The success of the solutions is reliant on basic scientific, mathematical and engineering knowledge which also takes into consideration society needs, sustainability and the protection of environments (ECSA, 2015a). The fundamental component of all engineering work is the management of projects – this forms part of the daily tasks of personnel in all disciplines of engineering (ECSA, 2015a).

A project can be defined as a planned activity that aspires to achieve goals within limited resources (Suhonen and Paasivaara, 2011). According to the Project Management Body of Knowledge (PMBOK), “projects are a natural occurrence to any business that grows and expands its products, knowledge, or even its physical representation” (Lawson, 2013, p. 9).

Thomas and Buckle-Henning's (2007, p.554) research concluded that some of the masculine perspectives in defining projects focus on tasks that encompass a main authoritative individual, for example, “A project is the series of steps that the project manager leads to deliver...”, whereas some of the feminine perspectives associated with the project definition emphasise the connection and mutual reliance amidst the activities that occur within the team and the individuals who carry out these activities, for example “a project...is a series of interrelated activities that have to be accomplished...and most importantly it entails a team of people who are interdependent on each other for the successful completion of the project” (Thomas and Buckle-Henning, 2007, p. 555).

Project management is a disciplined approach consisting of knowledge, skills, tools and techniques required to successfully handle temporary endeavours that focus on producing a new and unique product or service (Lawson, 2013). Turner (1994 as cited in Ika et al., 2010) defined project management “as the art and science of transforming vision into reality”.

Thomas and Buckle-Henning (2007) found that both the masculine and feminine views on defining project management focused on people. The masculine perspective assigned individuals to the correct task to successfully execute a project, whereas the feminine perspective entails identifying the correct individuals for the task and constantly checking the appropriateness of the task against the changing perceptions of the stakeholders in the environment in which they were operating (Thomas and Buckle-Henning, 2007) .

An individual known as the project manager is assigned to apply his or her professional abilities to overseeing the project management applications.

## **2.5. The role of a Project Manager**

Project managers must stress their responsibility and accountability while working within a team without formal lines of authority (Henderson, Stackman & Koh, 2013). Firstly, they have to define the scope of the project, generate plans to achieve the scope requirements, then implement these plans successfully, on time, within budget, and at the expected level of quality, commonly known as the “iron triangle” (Henderson *et al.*, 2013). Thomas and Buckle-Henning (2007) maintained that the masculine view of the role of a project manager was to carry the responsibility for a favourable or unfavourable project outcome. They equated control with a favourable outcome and the lack of control with an unfavourable project outcome. In contrast, the feminine perspective of the role of a project manager required a significant amount of work to encourage and integrate different views and personalities (Thomas and Buckle-Henning, 2007).

When a project manager is working on a project he/she typically works outside the operations of the business but has an obligation to stay in touch with the operational section to understand how the project will affect operations or vice versa (Lawson, 2013). A project manager does not successfully execute a project alone – projects can only be completed by a team of professionals (Lawson, 2013).

## **2.6. The Dyadic Phenomenon in Teams**

The dyadic phenomenon is essentially used in teams for expertise recognition. This phenomenon consists of individuals subjectively evaluating one another’s expertise in order to establish whose abilities are required to execute their individual tasks and to achieve the teams goals (Joshi, 2014). There are two perspectives that can be used to understand dyad-level expertise recognition: firstly the target’s perspective, i.e. a focal

member of the team whose expertise is being evaluated, and secondly, the actor's perspective, i.e. the team member who is evaluating a target's expertise (Joshi, 2014). A person who is viewed as an expert by team members, despite his/her actual level of expertise, has more influence in decision-making, greater opportunities to perform and tends to be designated to informal leadership positions (Joshi, 2014).

In engineering settings, teams work on complex, interdependent tasks (Joshi, 2014). Project managers must be able to influence cross-functional team members without formal authority directing these members' work but with the responsibility and accountability for the work and outcomes of team members (Henderson *et al.*, 2013). The full potential of an engineering team is only realised once all the team members recognise and take advantage of the expertise of its diverse members. However, team members may find this challenging because expertise is usually not apparent in teams (Joshi, 2014). Consequently, team members depend on impertinent clues like gender to recognise expertise, and in these circumstances team members will tend to value male expertise. This is because engineering is traditionally a male-dominated discipline and gender dissimilarities among team members are powerfully salient and visible (Joshi, 2014).

Using gender as a basis to recognise expertise highlights the issue of gender discrimination. A theoretical framework is presented next to identify the other gender barriers that hinder women from gaining acceptance and thus from progressing in the workplace.

## **2.7. Theoretical Framework of Female Gender Discrimination**

Various theories highlight gender discrimination in the workplace. In this study the unique perspectives of the role congruity theory, the human capital theory, Kanter's theory of tokenism and a gender in leadership paradigm are analysed in order to discuss the gender discrimination and career advancement barriers that female engineers encounter in their contemporary organisational and project environments.

### **2.7.1. Role congruity theory**

Eagly and Karau (2002) proposed the role congruity theory of prejudice towards female leaders. This theory suggests that perceived incongruity between the female gender role and leadership role results in two kinds of prejudice: (a) Females are viewed less favourably than males as possible occupiers of leadership roles, and (b) evaluating



behaviour that fits the prescription of the role of a leader unfavourably when it is performed by a woman (Eagly and Karau, 2002).

The first form of prejudice may occur because descriptive norms that are associated with female gender roles are dissimilar to the agentic qualities that are expected and desired in leaders (Eagly and Karau, 2002). Women are usually associated with communal characteristics (e.g. kind, nurturing, helpful, cooperative, sympathetic, etc.) and men are associated as having agentic characteristics (e.g. assertive, competent, ambitious, independent etc.) (Berkery *et al.*, 2013). Lyness and Heilman (2006 as cited in Kusterer *et al.*, 2013) discovered that female line managers were more negatively evaluated than male line managers because there was a ‘lack of fit’ perception between their female gender roles and traditional masculine employment positions. In masculine settings, like engineering, team members regard women as being less competent and less influential in decision-making situations compared to their male counterparts, irrespective of their skills, because they are atypical and under-represented in these circumstances (Joshi, 2014). These “lack fit” perceptions of women have a vital and an expansive range of consequences on how women are treated in relation to hiring, compensation, job placement decisions, skills development, remuneration and promotions (Heilman, 2012). The perception that women are unsuitable to cope with male-type occupations and positions affects their selection for these positions, the responsibilities they are given while occupying these positions and their career track placement (Heilman, 2012).

Gender stereotypes also affect how women evaluate their own “fit” in masculine occupations, in that women have a negative view of themselves, for example women may proclaim they don’t possess a killer instinct or they have poor mathematical skills (Heilman, 2012). These negative perceptions affect women’s career development, such as a reluctance to grasp opportunities that lead to career advancement, an unwillingness to take risks and a lack of confidence in their competence, which can all have very adverse effects (Heilman, 2012).

The second form of prejudice can occur from injunctive norms of gender roles of how a woman should behave (Eagly and Karau, 2002). If a female leader fulfils the agentic requirements of a leadership role and does not display the communal behaviours traditionally ascribed to women, they may be negatively evaluated for this contravention while also receiving some positive evaluation for fulfilling this role (Eagly and Karau,

2002). This prejudice creates greater obstacles for women to be successful in these roles (Eagly and Karau, 2002).

Project managers depend on team-based structures to execute a project successfully (Lawson, 2013). The composition of these structures is usually matrix and flat organisational structures, yet their composition may exhibit role incongruity in relation to gender (Henderson and Stackman, 2010). In organizations, work roles become more segregated and gender-stereotyped for women when men are not proportionally represented in authority positions (Rudman and Phelan, 2008). According to ECSA 2012/2013 membership statistics, there were more male engineering professionals (95%) than women (5%) who were competent to lead projects. Therefore, if an engineering team comprises more male professionals, it suggests that females may encounter inadequate participation and more role incongruity as project managers or core team members than males (Henderson and Stackman, 2010). Female project managers' role incongruity could symbolize status incongruity between the greater influential role as project manager and their inferior citizenry status when compared to their male counterparts (Henderson and Stackman, 2010).

### **2.7.2. Human capital theory**

Human capital consists of characteristics such as education, experience and knowledge that permit individuals to access an extensive range of opportunities (Felicio *et al.*, 2014). Becker (1975 as cited in Birasnav and Rangnekar, 2010) defined human capital theory as comparing the amount of investment in skills and knowledge development with forthcoming benefits such as salary improvements or authority and status. According to Igbaria and Chidambaram (1997), this theory attempts to describe the continuing gender and racial discrimination by proposing that individuals benefit in their present jobs for their investment in education and job training and inequalities in career success stem from the dissimilarities in human capital of males and females. This theory suggests that women are more committed to their family responsibilities, invest insufficient time and effort towards their careers and this ultimately effects their experience, training and the outcomes in their profession (Young, 2010). The human capital theory focuses on voluntary choices of individuals towards work and family (Igbaria and Chidambaram, 1997). Female engineers' career progression usually involves displaying their competence in undertaking more expansive and demanding projects. This may involve working long hours and perhaps

relocating for international assignments (Jonsen *et al.*, 2010). A woman's voluntary work choices (e.g. undertaking challenging assignments/projects) differs from men because she tends to place more value on her domestic responsibilities (Kiaye and Singh, 2013). This contributes to the lesser experience, skills, social contacts and visibility of women in the job market and ultimately affects career vertical mobility (Igbaria and Chidambaram, 1997).

According to Powell (2000 as cited in Kiaye and Singh, 2013), one of the major pitfalls with this theory is the presumption of "free choice". The theory fails to identify the power differences between employer and employee which may prevent or impede the career advancement of female employees (Kiaye and Singh, 2013). Men have greater resources and definitional power in male-dominated occupations like engineering to enforce discriminatory practices (Martin and Barnard, 2013).

### **2.7.3. Kanter's theory of tokenism**

In 1977, Kanter studied the work environment experiences of women in an industrial supply company ("Indsco") (Stichman, Hassell and Archbold, 2010). In her study she found that "tokens" tend to have negative experiences in the work environment due to their lower numerical representation (Gustafson, 2008). Kanter (1977 as cited in Stichman *et al.*, 2010) defined a token group as a subgroup that occupies less than 15% of the entire work group and is perceived to be dissimilar to the group.

The "token" stigma has been attached to previously disadvantaged individuals in South Africa who are being appointed into senior roles, because of affirmative action and employment equity policies (April, Dreyer and Blass, 2007). The South African Employment Equity Act of 1998 transformed the country's labour relations by making it a requirement upon employers to provide employment and advancement opportunities to designated individuals (Odendaal 2013). Organisations began clambering to create affirmative action appointments (April *et al.*, 2007). As a consequence, individuals who lack the prerequisite qualifications, network or experience are being employed in executive positions frequently without genuine support and inevitably, these individuals are being set up to fail (April *et al.*, 2007). Heilman (2012) indicated that affirmative action appointments which were meant to help women and minorities instead worsen the "lack fit" perceptions of women in male-type occupations, may promote stereotyping and negative evaluation and contribute to women not succeeding in these positions.

Kanter also stated that as the number of tokens increases, they are more likely to have fewer negative experiences (Stichman *et al.*, 2010). The criticism of this theory is that it puts a strong emphasis on the numerical representation of tokens (Gustafson, 2008). Yoder (1994 as cited in Stichman *et al.*, 2010) concluded that the numerical representation of tokens alone was not sufficient to create tokenism and this theory does not acknowledge the effects of organisational and societal gender-based discrimination.

#### **2.7.4. Gender in leadership paradigm**

Jonsen *et al.*'s (2010) research on gender in leadership pointed out three paradigms that could impact the way in which gender is regarded in organisations. These consist of “The gender-blind view”, “The gender-conscious view” and “The perception creates reality” view (Jonsen *et al.*, 2010).

##### **Paradigm One – “The gender-blind view”**

This paradigm states that “Men and women leaders are not significantly different and should be treated the same” (Jonsen *et al.*, 2010, p.556). One of the principles behind this view is that men and women lead in a similar manner and therefore women should be provided with more workplace opportunities (Langlais, 2010). Although there has been an increase in representation of women in leadership positions and a growing understanding of the significance of traditionally feminine characteristics for proficient leadership, gender stereotypes have still remained consistent in the last several decades and masculine traits is still considered as a requirement for a successful manager (Lieberman and Golom, 2015). Regardless of gender, organizations still persist to evaluate leaders on characteristics that conform to leadership in male-dominated organizations (Baker, 2014). Therefore, women may need to change their behaviour to conform to these norms which could make them feel disempowered, thus negatively affecting their performance, leading to slower progression of women to senior positions (Jonsen *et al.*, 2010).

Women's historical roles is another concern for this paradigm because it forms the basis for gendered type occupations and workplace inequality (Langlais, 2010). Gender disparities related to cultural and structural barriers contribute to the scarce supply of women pursuing educational qualifications and faculty careers in STEM (Science, technology, engineering and mathematics) professions (Glass and Minotte, 2010). However, this perspective is difficult to achieve because individuals' traditional place in

our social systems is unequal (Jonsen *et al.*, 2010). Gender blindness can be compared to colour blindness because it does not take into consideration the cultural and economic legacy of centuries of discrimination against historically disadvantaged groups (Jonsen *et al.*, 2010).

### **Paradigm Two – “The gender-conscious view”**

This paradigm states that “Women and men leaders are significantly different and should be treated accordingly”(Jonsen *et al.*, 2010, p.556). Individuals who believe this paradigm usually implement human resource initiatives to address women’s particular needs and characteristics (Jonsen *et al.*, 2010). Some of the work-family benefits that organizations can offer employees is telecommuting, flexi-time, part-time return to work options, unpaid family leave, on-site childcare, improving employment conditions (Valk and Srinivasan, 2011). This perspective is suited for cultures, for example where religion is a vital regulator of daily life and where it supports the development that values gender differences (Jonsen *et al.*, 2010). The Middle East has Islamic views that values the different roles of men and women and recognizes that each gender may need different policies to permit equal participation in the public domain (Metcalf, 2008). The drawbacks of this perspective is that it may reinforce stereotypes and disempower women and men who do not conform to this stereotype (Jonsen *et al.*, 2010) . For example, a woman who prefers to put her career ahead of her family may harbour feelings of resentment for being grouped into women’s company initiatives such as flexi-time or work-family balance (Jonsen *et al.*, 2010). These different roles for men and women consistently result in women achieving a lower social status than men (Dolan, 2014). Thus, affecting women career advancement opportunities, were women only get employed for “traditional” female low paying occupations (Kaushik *et al.*, 2014).

### **Paradigm Three – “Perception creates reality”**

This paradigm states that “Women and men leaders are not significantly different. But people believe they are different (stereotyping) and these stereotypes create barriers to women’s advancement”(Jonsen *et al.*, 2010, p.556). Human resource initiatives are usually implemented to oppose gender stereotypes (Jonsen *et al.*, 2010). It is usually essential for individuals to undertake international assignments in order to reach senior management positions within numerous multinational organizations (Salamin and Hanappi, 2014). Jonsen *et al.*’s (2010) research used an example of a multinational company that usually

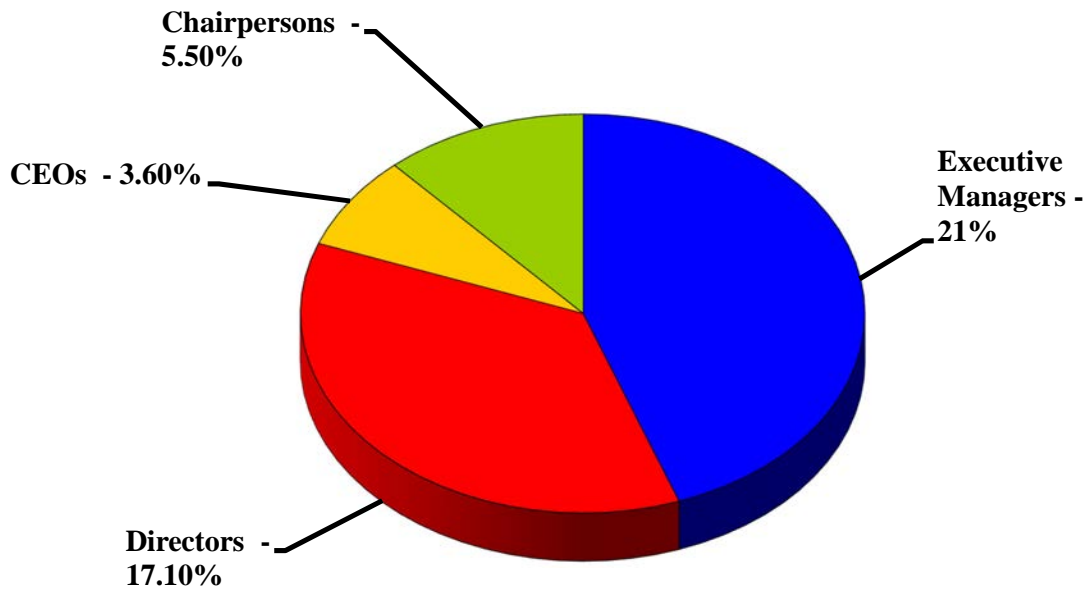
did not select married women for international assignments because the company assumed women will not be in a position to accept these assignments due to their spouse's reluctance to relocate. However, the company began launching programmes to combat these stereotypes (Jonsen *et al.*, 2010).

This view puts emphasis on diversity training as a method to combat stereotypes (Langlais, 2010). Even though numerous companies offer diversity training, most of these training programs are generic and does not address an organizations specific requirements (Nguyen, 2014). The problem with this paradigm is that masculine leadership styles are usually preferred in organisations and women may feel disempowered because they may need to behave like men (Jonsen *et al.*, 2010).

The above theories highlight the gender discrimination that women encounter in their careers. The low numerical representation of women in management positions will quantify the extent of how slowly women are advancing in their careers.

## **2.8. Representation of women in executive management positions**

According to Gale and Cartwright (1995 as cited in Henderson *et al.*, 2013), there is an under-representation of women project managers in traditional project-based industries such as engineering and construction; similarly, there is an under-representation of women in upper management positions. The figures in the Business Women's Association of South Africa's (BWASA) Women in Leadership 2012 Census reflects the under-representation of women in executive positions, as depicted in Figure 2.2.



**Figure 2.2:** Women in leadership 2012 census figures

**Source:** Adapted from DestinyConnect. 2014. *Women in engineering*. [Online]. Available: <http://www.destinyconnect.com/2014/03/11/women-in-engineering/> [Accessed 3 January 2015].

According to BWASA Women in Leadership 2012 Census, 21% of executive managers, 17.1% of directors, 3.6% of CEOs and 5.5% of chairpersons of listed and state-owned enterprises in South Africa were women (DestinyConnect, 2014). The Department of Labour's report on engineering professionals published in 2008 indicated that in 2005, 14.47% of managers with engineering qualifications were women. Therefore the BWASA Women in Leadership 2012 Census trend suggests that women hold a small percentage of senior management positions and it can be inferred that similar challenges will be encountered by female engineering professionals.

### **2.9. Gender discrimination encountered by female engineers**

Gender discrimination is seen as the most significant physiological barrier that affects women's career paths (Martin and Barnard, 2013). Some of the significant barriers that impede female engineers from participating and progressing in the labour market include insufficient role models, gaining respect and credibility amongst their male peers,

inadequate access to networks, inequality related to remuneration and promotional opportunities, and balancing their work and family responsibilities (Roodt and Du Toit, 2009).

The gender marginalisation that occurs in project management also includes biases that are entrenched in organisational culture, female roles and out-of-place status (Henderson *et al.*, 2013). This promotes giving females “token projects” that reinforces gender organisational practices, the embedding of the masculine logic system in the profession, and the social construction of gender, making women responsible for domestic work and child care (Henderson *et al.*, 2013). The above mentioned gender discrimination barriers will be further discussed comprehensively.

### **2.9.1. Inequalities in the South African organisational culture**

The South African organisational culture was white dominated for numerous years (Chiloane-Tsoka, 2012). The existing structure and operations of organisations were usually unsupportive of women’s career arrangements and their preference to integrate work and family responsibilities (Martin and Barnard, 2013). The South African National Policy Framework on Gender Equality was established by government and politicians to change these cultural views; however, unfairness still occurs in organisations (Chiloane-Tsoka, 2012). Hicks (2012 as cited in Martin and Barnard, 2013) drew attention to the hidden features of the male-dominated institutional culture that provides “lip service” to gender empowerment policies but persists to discriminate against women. Some of the discriminatory organisational practices women encounter in their organisations include a lack of training and development and a gender pay gap (Martin and Barnard, 2013).

#### **2.9.1.1. Inadequate training and career development**

Inadequate training and mentorship opportunities are considered the primary professional barriers that inhibit integration of women to the engineering profession (Martin and Barnard, 2013). ECSA regulates the engineering practice in South Africa and according to their code of conduct, all registered individuals need to practise engineering within their scope of competence and maintain and strengthen this competence (ECSA, 2013). Thus they established a system of continuous professional development (CPD) so that registered individuals can maintain their competence and be accepted for the renewal of registration (e.g. transition from candidate engineer to professional engineer) (ECSA, 2013). The



criteria for CPD credits vary for the different registration categories but are awarded on the basis of individuals undertaking development activities such as attending conferences, workshops, seminars, etc., engaging in work-based activities such as performing a required number of hours of engineering work and management work and implementing individual activities such as obtaining membership of an ECSA-recognised association, presenting papers at conferences, etc. (ECSA, 2013).

In most cases engineers are appointed as project managers because they are qualified in the engineering profession (Rwelamila and Purushottam, 2012). The problem with assigning a non-managerial specialist (e.g. Engineers) in managerial roles is that they first need to gain knowledge on how to manage (Nicholas and Steyn, 2012). Pinto and Kharbanda (1995 as cited in Rwelamila and Purushottam, 2012) are some of the authors who label engineering project leaders as “accidental project managers” who obtain an “accidental project management” development path. This traditional arrangement has led to project failures due to insufficient understanding of fundamental project management issues (Rwelamila and Purushottam, 2012).

Employers share a responsibility in providing a work environment which supports registered individuals in undertaking activities that are based on their competence (ECSA, 2013). Women still face inequalities in trying to gain access to employer training programmes and this contributes to the gender pay gap (Rainbird, 2007). The differences in the productive characteristics of women and men such as education and experience accumulated contributes to less than a third of the gender wage gap (Vincent, 2013).

#### **2.9.1.2. Female – Male pay gap**

Gender discrimination is further exemplified by salary inequities (Martin and Barnard, 2013). Women who are employed in similar jobs as men are still getting paid less than men (HR Future Magazine, 2015). According to Planting (2014), the 2013 World Economic Forum’s Gender Equity report indicated that South African women earned up to 33% less than males for similar work, whereas the average international pay gap is 13%. To a limited extent, gender pay inequality can be explained by human capital differences between men and women (Sidani, 2013). According to this perspective, women’s family responsibilities cause them to invest less in relevant education and training, therefore over a period of time, women do not build up relevant experience (Sidani, 2013). A women’s

human capital deteriorates due to her temporary absence from the work environment and this effects their pay in comparison to men (Vincent, 2013).

In performance appraisals, gender stereotypes and the gender of the manager performing the appraisals influence the assessment (Hessaramiri and Kleiner, 2001). Males are usually the decision makers in organisations and they tend to have male perceptions about performance which affects women's incentives (Hessaramiri and Kleiner, 2001). Other reasons could be that women do not realise they are being paid less or they do not request to be paid more for what they are worth because of fear of retaliation if they complain, and therefore organisations believe they can employ women for less pay (Hessaramiri and Kleiner, 2001).

### **2.9.2. Project culture**

Project culture forms part of the overall organisational culture (Stare, 2012). The organisational culture has an influence on how, why and when things will be completed and which individual will complete them (Cartwright and Gale, 1995). Projects are relatively short-term and temporary in nature, thus it may be difficult at the collective project level to develop a prevailing culture, considering that project team members and other stakeholders come from diverse organisations (Chipulu *et al.*, 2014).

The project management profession is powerfully influenced by the isomorphic effects of the Project Management Institute (PMI) and PMBOK (Thomas and Buckle-Henning, 2007). Isomorphism is a process where individuals in organisations behave in similar ways like imitating practices, processes or structures (Brandau *et al.*, 2013). The project management professional bodies develop documents that influence an individual's choices of appropriate behaviour and ways of thinking (Buckle and Thomas, 2003). Buckle and Thomas (2003 as cited in Henderson *et al.*, 2013) showed that the body of knowledge and methodology related to managing projects is heavily reliant on masculine cognitive styles and underutilises feminine cognitive styles. Women engineers face the challenge that their work efforts will not be recognised if they do not follow cultural expectations when they practise interpersonal and relational work in male-dominated occupations (Hatmaker, 2013).

Culture also plays a significant role in the many factors that cause project failure. One of these factors includes poor team integration, such as marginalising women in heterogeneous teams (Chipulu *et al.*, 2014).

### **2.9.2.1. Marginalising women in heterogeneous teams**

A homogenous team consists of team members that possess similar shared values and attributes (e.g. an all-female team), while a heterogeneous team consists of a diverse orientation of team members (e.g. culture, gender, and ethnicity) (managetheworld, 2011). Homogeneous teams have better communication and less conflict but involve more groupthink (managetheworld, 2011). However, if heterogeneous teams are managed properly they can function better than homogenous teams, e.g. discovering innovative solutions to challenging situations (Chipulu *et al.*, 2014).

Henderson and Stackman (2010) maintained that female team members are nine times more likely to work with female project managers than male team members, while female project managers are most likely to be scattered geographically from male team members. These results suggest that women are relegated to smaller projects, because bigger projects usually compromise heterogeneous teams (Henderson and Stackman, 2010). In comparison to men, this marginalises female project managers both geographically and culturally and prevents them from developing networks and relevant work and power-gaining experiences (Henderson and Stackman, 2010).

### **2.9.3. Project managers and issue selling (Influence abilities)**

Issue-selling is a series of actions where individuals influence others to understand events, developments, and trends that have an impact on organizational performance (Luo and Wang, 2014). Packaging forms part of issue selling; this refers to how an issue is presented by the issuer through a business plan rationale and relating issues with other issues in order to promote the issue (Haegermark and Andersson, 2015). Female project managers' contribution towards the success of a project is magnified by how proficient they are in their influence abilities, they need to be influential to individuals within and outside of their projects, with no direct authority but having the responsibility and accountability for their project outcome (Henderson *et al.*, 2013). Their influence is applied upwards to project sponsors and senior management, as well as horizontally to line or functional managers and stakeholders, both inside the project team and outside of their

organisation (Henderson *et al.*, 2013). The project manager influences individuals to ensure that the organizations objectives and deliverables are satisfied (Maseko and Proches, 2013).

Lee and Sweeney (2001 as cited in Henderson *et al.*, 2013), discovered minor gender differences where female project managers seemed to explain more frequently their reasoning and rationale for influence requests than male project managers. Women project managers also acquired advanced support more often from senior management to back up their influence requests. Henderson *et al.* (2013) added that some of the gender inequality challenges to issue selling are the so-called “old boys network” and gender stereotyping.

#### **2.9.4. Old boys networks**

Even though women come into an organisation with the same level of human capital as men, their consequential success is not determined by human capital only but also by the importance of participating in informal organisational networks (Henderson and Stackman, 2010). The old-boy network comprises of males who have obtained educational qualifications at similar institutions or who have achieved upward career mobility together and they have an inclination to promote individuals who are similar to themselves (Jakobsh, 2012). According to Henderson *et al.* (2013), women are marginalised from old-boy networks and these “inner circles” are not constantly viewed as institutionalised or organised, for example, they can be in the form of “bar/beer” cadres of “good ole boys” who engage in conversation related to sports at meetings or after-work functions. Furthermore, men tend to close deals in these networks and such networks may influence senior management’s promotion and other employment career decisions. Therefore, women are denied professional support, access to vital personnel and organizational information when they are excluded from these networks (Tlaiss and Kauser, 2010).

#### **2.9.5. Gender stereotyping**

The human phenomenon of gender stereotyping is used by both men and women to categorise themselves and others based on social norms, and descriptive and prescriptive features that construct the idea of how men and women should behave (Mensi-Klarbach, 2014). Engineering is considered a gendered profession where men, based on gendered stereotypes, are considered more appropriate for this occupation (Hatmaker, 2013). The engineering profession is associated with masculine characteristics and women are

perceived as attempting to invade and share this traditionally male-dominated occupation (Thurasamy *et al.*, 2011). Thus, women are viewed as anomalies and frequently proclaim being stigmatized for entering this profession (Wasilewski, 2015). Faulkner (2009 as cited in Hatmaker, 2013, p.384) indicated that women engineers reside in an “in/visible paradox, whereby women engineers are simultaneously highly visible as women yet invisible as engineers”.

Stereotype threat is the concern that other individuals are evaluating you through negative group-based stereotypes and consequently this could lead to performance deficits (Kalokerinos *et al.*, 2014). Women in management may develop the notion that they are incompetent of assuming leadership in what is considered a male territory and this could undermine their motivation and potentially lead to lower performance (Jonsen *et al.*, 2010).

The stereotype “spill over” affect is a social mechanism that suggests that societal gender roles may contaminate organisational roles, resulting in different expectations for male and female managers (Jonsen *et al.*, 2010). Women are commonly stereotyped as mothers, wives, etc. (Bauer, 2012). These communal characteristic conforms to the female gender role but it is inconsistent with a leadership role (Kusterer *et al.*, 2013). A major challenge for women is to refute the validity of stereotypes so that they can be considered as being competent enough to assume authority positions and, once in those positions, they must find a way to transform negative perceptions with regards to their ambition and self-promotion that are more positively ascribed to men (Henderson *et al.*, 2013).

These gender stereotypes that portray women as lacking the required competence further impact female engineers’ project allocation. Thus, female engineers are assigned to low-cost project assignments.

#### **2.9.6. Low-cost project assignments**

Henderson and Stackman (2010) concluded that female project managers and female team members were approximately twice as likely to be involved on projects that cost \$1 million or less, than their male counterparts. As such, they are likely to work on smaller, lower-cost, more geographically spread out projects and teams, where there is a reliance on technology-mediated communication, exemplifying a cruel homo-social reproduction cycle for women project managers (Henderson *et al.*, 2013). Women who are segregated onto smaller, cheaper projects and who spend more working time on virtual teams are not

ideally suited for women's project management careers or for the organisation (Harrin, 2011). The organisation could be disregarding top talent by sidelining women onto those smaller projects, with unconscious (or conscious) bias (Harrin, 2011).

Project assignments allow individuals to display their abilities, strengths and professionalism – they address a project manager's assigned responsibilities/accountability demands and permit individuals (project managers) to use project assignments to build their careers (Henderson and Stackman, 2010). If males are more likely to manage large-scale, more visible projects (e.g. larger number of team members and project costs), they are more likely to maintain their positions in the organisational power structure (Henderson and Stackman, 2010). Women's limited participation in these types of projects brings into question their ability to progress in contemporary project environments and to develop human and social capital (Henderson and Stackman, 2010). Social capital can be described as the combined value of all social networks and the propensities that emerge from these networks to undertake things for one another (Stone *et al.*, 2012). According to Kelly, Edkins, Smyth and Konstantinou (2013), social capital is vital to a project manager because it has a role of mobilising knowledge through "communities of practice" (an informal network that arises across formal hierarchies and informal networks where individuals have a common interest). Furthermore, "communities of practice" membership is earned through the strength of the professional ties in the network. The segregation that occurs on projects may in reality hinder a woman's ability to shatter the glass ceiling in the discipline of project management (Henderson and Stackman, 2010).

### **2.9.7. Glass ceiling**

The metaphor "glass ceiling" is used when women face barriers while trying to obtain leadership positions (Jonsen *et al.*, 2010). The glass ceiling may have the effect that women are relegated to lower-level jobs with less responsibility, visibility, influence and earnings, all of which contribute to impeding advancement of their careers (Kiaye and Singh, 2013). The glass ceiling discovered in general management also exists in contemporary project management where women are marginalised to smaller, low-cost projects and virtual teams which hinders their advancement to senior management positions (Henderson and Stackman, 2010).

Male-dominated professions have a male model of career progression (Martin and Barnard, 2013). This model indicates that performance equals working longer hours (e.g. managing

large-scale projects) to impress managers and it also consists of covert discrimination of women with family responsibilities (Martin and Barnard, 2013). According to social role theorists, women are associated with care giver roles and lack sufficient commitment to their careers (Kiaye and Singh, 2013). This situation is incompatible with leadership, and therefore decreases a woman's promotional prospects and ultimately contributes to the glass ceiling (Kiaye and Singh, 2013).

### **2.9.8. Leadership**

Female leaders are considered to be more "transformational", democratic and male leaders are associated with transactional, autocratic qualities (Taleb, 2010). There is no difference in the effectiveness of men and women in leadership positions, however, differences associated with cultural beliefs regarding gender and leadership behaviour result in women receiving prejudicial evaluations that affect their career advancement opportunities (Jonsen *et al.*, 2010).

#### **2.9.8.1. Gender in project leadership**

Leadership is mixture of unique traits such as behaviour's that influence its followers in order to accomplish a common goal (Eken *et al.*, 2014). In the present context, it indicates the way a project manager typically behaves towards other project members (Clarke, 2012). Project leadership is associated with project success and the factors pertaining to project success fluctuate over the different phases of the project life cycle (Anantatmula, 2010). Many different authors concluded that project managers required both relationship and task-orientated leadership styles during different project phases (Clarke, 2012).

The concepts of masculinity and femininity in project management refer to different ways of understanding and behaving and do not necessarily pertain to male and female gender differences (Henderson *et al.*, 2013). During appropriate project management practices either gender is capable of performing both masculine and feminine cognitive styles (Thomas and Buckle-Henning, 2007). However, PMBOK is predominately supplied with hard masculine logic systems which are more trusted and have more influence on "best practices" than feminine logic systems (Thomas and Buckle-Henning, 2007). Buckle and Thomas (2003 as cited in Henderson *et al.*, 2013, p.764) discovered that culturally viewed masculine values such as "independence, self-sufficiency, separation, power deriving from hierarchical authority, competitiveness and analytical and impersonal problem solving",

affected the content of project management practice directly and powerfully, more so than feminine values such as connecting with individuals, power and information sharing, and democratic or participant decision-making. Thomas and Buckle (2007 as cited in Henderson *et al.*, 2013) revealed that both male and female project managers balanced masculine and feminine cognitive styles. Their success resulted from “dancing in the white spaces” between the lines set out in the Project Management Institute’s Body of Knowledge (Henderson *et al.*, 2013).

The challenge women face is that they have to display male-characteristic behaviour, which is unnatural to them, in order to be successful in a male-dominated environment (Martin and Barnard, 2013). Women seem to be conflicted between adopting or resisting this male-characteristic behaviour because it has a negative effect on women’s feelings of authenticity and professional identity (Martin and Barnard, 2013).

### **2.9.9. Professional identity construction**

Professional identity can be described as a comparably constant set of attitudes, beliefs, motives, values and experiences that individuals use to define themselves in a professional position (Spehar *et al.*, 2015). An engineer’s identity is associated with educational and professional persistence (Meyers *et al.*, 2012). However, an individual’s training, education or self-definition as an engineer is usually inadequate to obtain legitimacy in this culture (Hatmaker, 2013). Women and men’s attempts to gain entry into the engineering community may differ because of the masculine social image of an engineer and prevailing masculine norms (Du, 2011). If an individual does not suit the desired professional type based on gender stereotypes and professional culture, this may interfere with the individual’s personal status and professional identity (Hatmaker, 2013). When labels such as “women engineers” are used, it places a qualifier on professional status and strengthens the perception that women take on a different meaning from men in a similar profession (Hatmaker, 2013). Women encounter major barriers when adjusting to the engineering culture and therefore may negotiate their identities in a relational environment that is dominant with masculinity (Saavedra *et al.*, 2014). An individual’s identity is often the basis for their actions and behaviour in interpersonal interactions, and cultures are created, recreated and maintained through the members’ actions, behaviour and interactions (Hatmaker, 2013). Black and white females may experience conflicts in their professional



development related to their race, gender and career expectations because of marginalisation in workplace interactions (Kyriakidou, 2011).

The professional role of a manager in engineering has different meanings for both genders, women in management positions may be given different messages about role behaviour considered appropriate from inside and outside their gender group (Kyriakidou, 2011). Women who want to assert their femininity by using characteristics such as empathy and cooperation are perceived as less competent, while women who display masculine characteristics like assertiveness and ambition are considered as unfeminine. (Saavedra *et al.*, 2014). A female engineers professional identity construction process is significantly different from their male counterparts because it concentrates on redefinition, which gives women permission to create positive professional identity (Barak, 2013) Redefinition commences when female engineers stop reacting to male engineers and establish their own unique set of values and goals, based on a positive female identity (Kyriakidou, 2011). One of the factors that plays a role in shaping professional identity is women role models (Meyers *et al.*, 2012).

#### **2.9.10. Lack of female role models and mentors**

Shapiro *et al.* (1978 as cited in Vinnicombe *et al.*, 2006) defined role models as people whose behaviours, styles and attributes are imitated by others. Role models have been linked in influencing women's decisions to choose male-dominated careers, however, the presence of female role models is lacking in masculine sectors such as engineering (Shortland, 2014). Female role models also protect women already in science and engineering professions against the detrimental effects of negative stereotypes (Drury *et al.*, 2011). When role models are not present at managerial levels, individuals who occupy authority positions in the corporate environment have an inclination to apply male norms and values to themselves, in the principle of the role concept (Chiloane-Tsoka, 2012). As a result of this practice, women instantly learn “masculine” to manage in their orientation, enforcing the stereotype of a male manager and affirming the negative female stereotype (Chiloane-Tsoka, 2012).

Mentoring is generally considered as a relationship between an individual who is younger and less experienced (protégé) and an individual who is older and more experienced (mentor) (Leck and Orser, 2013). A mentor provides advice, counselling and further improves the quality of their protégé's career development (Shortland, 2014). A mentor

can provide professional exposure to the protégé in the form of organizing appointments to desirable positions, being introduced to influential people so they become visible in organizations and providing a challenge that leads to the protégé to excel in her profession (Grima *et al.*, 2014). It was discovered that more career benefits are connected to mentoring, protégés that have been mentored proclaimed better career outcomes (e.g. linked to compensation and promotions) than those who had not been mentored (Leck and Orser, 2013). Women who have female mentors have stated more interpersonal comfort compared to women who have male mentors (Rockwell *et al.*, 2013). Women providing career support to women are most useful because women protégés benefit from being sponsored, challenged and coached by an individual who is similar to themselves and who has experienced the specific difficulties they may be encountering (Leck and Orser, 2013). The lack of male mentors embarking in cross-gender mentoring relationships with female protégés is due to sexual politics, office gossip due to their association and gender discrimination (Obers, 2012). Males may also be unwilling to mentor females because failure could affect the male mentor's career negatively (Leck and Orser, 2013). Gender role stereotypes may consciously or unconsciously lead to male mentors presuming female protégés have inadequate skills to understand complex problems (Leck and Orser, 2013).

These misconceptions are only some concerns that women encounter in their careers. However, work/life balance is the most critical challenge that female engineers encounter in their profession (Roodt and Du Toit, 2009).

#### **2.9.11. Work/Life balance**

Work life balance can be defined as maintaining a balance between an individual's work and their personal life (Agarwal, 2015). With age, women's responsibilities at home increase due to marriage, children and household chores together with her ascending to management levels, resulting in a work/life imbalance (Malyadri and Sumana, 2013). Women often experience more difficulty than men to balance work and family commitments because they carry a disproportionate burden of the domestic responsibilities and this becomes a major barrier in their career advancement (Rehman and Roomi, 2012). Women could experience role overload and time management problems while trying to fulfil family and work demands simultaneously (Martin and Barnard, 2013). There might be a spillover of meetings that clash with children's programmes and a continual change of deadlines that compete with family time (Malyadri and Sumana, 2013). Crisis management

both at home and the office that demands 24/7 attention could create a conflict, where the office is seen as priority and managers are constantly expected to be available to attend to delayed or emergency meetings just as wives/mothers are constantly expected to attend to sick or visiting relatives (Malyadri and Sumana, 2013). There are limited companies that grant women permission for flexible work hours that can assist them to manage their home and children without their work being disrupted (Harris, 2010). This causes a high degree of stress because women may need to take leave due to family commitments and management often sees this as an inconvenience (Harris, 2010).

Childbirth forces women to briefly discontinue employment, consequently these interruptions are responsible for a vast amount of gender associated differences in labour market outcomes (Carreon *et al.*, 2013). Even though having children does not alter their professional orientation, women in comparison to men tend to alter their careers in response to parenting (Ezzedeen and Ritchey, 2009). Women seemingly trade off employment endeavours and income for additional time to be dedicated to domestic responsibilities (Ahmad *et al.*, 2011).

Many adaptive strategies are used by couples to maintain their connection to the workforce while also having sufficient time for their family life (Lingard and Francis, 2008). These adaption strategies may include changes in thinking in regards to redesigning roles and relationships, and manipulating resources and demands to do so (Ezzedeen and Ritchey, 2009). Women who have a strong desire to succeed in their careers usually do not depend on organisational support regarding family demands for fear of reinforcing the communal stereotype (Subramaniam and Arumugam, 2013). Many women that occupy elite positions manage by making strategic decisions between their professional lives and their family like “opting out” or postponing marriage and parenting (Ezzedeen and Ritchey, 2009). Women also enlarge their personal domain resources by depending on spousal support, however, this does not necessarily promote women’s work-life balance (Subramaniam and Arumugam, 2013) .

## **2.10. Summary**

It is evident that women face unique challenges in traditionally male-dominated occupations in comparison to other occupations. Even though South Africa has implemented policies like Employment Equity and Affirmative Action to abolish old discriminatory apartheid practices, evidence of gender discrimination towards women in

engineering still remains. The BWASA Women in Leadership 2012 Census highlights the under-representation of women who occupy senior management positions. The inadequate representations of female engineers in South Africa also impact the leadership pipeline of women's progression into senior management positions.

It is not clear from this chapter to what extent women are discriminated against in the engineering profession and it is not clear how female engineers feel about being marginalised in project teams. This uncertainty raises the question "what are female engineers' perceptions of their role in their profession?" Chapter 3 outlines the methodology that was used in the research to answer this question.

## **CHAPTER 3**

### **Research Methodology**

#### **3.1. Introduction**

The literature revealed that a gap exists in that there is insufficient research to provide solutions related to the discrimination that is experienced by females when they try to gain acceptance in traditionally male-dominated occupations like engineering. This warrants an empirical study to further establish female engineers' workplace experiences, gender interactions and under-representation in this profession in order to establish if gender discrimination really exists in this profession.

The purpose of this chapter is to provide a detailed description of the research process and methodology that was followed for this study. This chapter presents the aim and objectives which guided the entire research process. It also provides a rationale for the research setting and approach, it justifies the sampling procedures and design methods and describes the instruments and procedures used to collect and analyse the data.

#### **3.2. Overview of the engineering environment in South Africa**

South Africa has a critical shortage of engineering knowledge and skills (Lourens, 2014). According to the South African Institution of Civil Engineering (SAICE) (2011), there are approximately twenty times fewer engineers in South Africa than in certain other countries in the world such as America, Australia, India and China. Furthermore, the white race group and males still dominate the engineering culture. As early as 1971, South Africa began addressing the engineering skills shortage issue by increasing the supply of civil engineers to satisfy the required demand of 14 585 engineers in 1973 (Pillay and Watermeyer, 2012). However, contemporary strategies now focus on developing graduate engineers' skills and experience through relevant programmes (Pillay and Watermeyer, 2012).

Historically, the gold mining industry was a major employer of engineers but the demand for engineers shifted from the traditional agricultural and mining industries to the manufacturing sector (Roodt and Du Toit, 2009). The construction industry suffered decades of decline but the country's investment towards the 2010 FIFA world cup to a moderate extent protected this industry (SAICE, 2011). Civil engineering is currently the

largest sector within the South African engineering and construction industry (Marketline, 2013). It constitutes 77.9% of the industry's total value and it is forecasted to grow from 1.9% (\$10.2 billion) in 2012 to 15.7% (\$11.8 billion) in 2017 (Marketline, 2013).

South Africa is also adopting the National Development Plan, whereby investment on infrastructure projects, transport, energy and communication will be undertaken to eliminate poverty and to reduce inequality by 2030 (Guarino and Dirie, 2014). The country is still in short supply of qualified and experienced project managers especially in the public sector to oversee these projects (Guarino and Dirie, 2014).

In 1945, there were no female engineers in South Africa; however, by 1974 there was a gradual increase of women's participation in the engineering profession (Roodt and Du Toit, 2009). In 1996, 16.21% of women were employed in the South African labour market but conversely in 2005 this figure dropped to 10.51% (Lourens, 2014). This highlights the issue of recruitment and retention of female engineers (Lourens, 2014). A young female's choice in pursuing engineering at tertiary institutions is influenced by the quality of their school's science and mathematics education, perceptions that engineering is a male occupation, the role of parents and the lack of role models (Roodt and Du Toit, 2009).

During the period from 1996 there was a growth in engineering graduates but in contrast a decrease of women in the engineering profession. This growth was due to successful government initiatives to attract females to pursue engineering qualifications (Lourens, 2014). However, engineering is still a male-dominated environment that does not always accept women's participation in this profession and therefore women face gender discrimination barriers that contribute to their retention in this profession and the skills shortage in South Africa (Roodt and Du Toit, 2009).

DHET (2013) engineering graduate's statistics highlights the low representation of women that are graduating with engineering qualifications in South Africa (Table 3.1).

**Table 3.1:** Engineering 2013 graduate statistics

Race and Gender	Number of Diploma/ Certificate Qualifications (3 Years of Study)	Number of Bachelor's Degree Qualifications (3 Years of Study)	Number of Bachelor's Degree Qualifications (4 Years of Study)
<b>African</b>	<b>4,590</b>	<b>82</b>	<b>2,889</b>
Female	1,480	41	962
Male	3,110	41	1,927
<b>Coloured</b>	<b>261</b>	<b>14</b>	<b>230</b>
Female	61	6	66
Male	200	8	164
<b>Indian</b>	<b>225</b>	<b>11</b>	<b>476</b>
Female	62	3	157
Male	163	8	319
<b>White</b>	<b>613</b>	<b>98</b>	<b>1,860</b>
Female	44	32	347
Male	569	66	1,513
<b>Overall Total</b>	<b>5,689</b>	<b>205</b>	<b>5,455</b>

**Source:** Adapted from Republic of South Africa (RSA). 2013. *Engineering graduates statistics*. Department of Higher Education and Training (DHET).

Table 3.1 reveals the total number of students who graduated with engineering diplomas and bachelor's qualifications in 2013 from higher education institutions in South Africa. These statistics indicate that 29% of females graduated with a national diploma, 40% of females graduated with a three years bachelor's degree and 28% of females graduated with a four years bachelor's qualification. The African race group had the highest number of diploma qualifications with 4590 out of a total number of 5 689 and the highest number with a four years bachelor degree qualification with 2 889 out of a total number of 5 455.

The ECSA 2012/2013 annual report also highlights the inadequate representation of women in engineering positions (Table 3.2).

**Table 3.2:** ECSA 2012/2013 category registration statistics

<b>Professional Category Registration Statistics</b>				
		<b>Professional Engineer</b>	<b>Professional Engineering Technologist</b>	<b>Professional Engineering Technician</b>
Total registered		15597	4479	4107
Gender	Male	15036	4300	3664
	Female	561	179	443
Race	African	1175	812	1571
	White	13479	3104	2121
	Indian	786	393	259
	Coloured	157	170	156
<b>Candidates Category Registration Statistics</b>				
		<b>Candidate Engineer</b>	<b>Candidate Engineering Technologist</b>	<b>Candidate Engineering Technician</b>
Total Registered		7016	2740	4750
Gender	Male	5687	2173	3467
	Female	1329	567	1283
Race	African	2050	1826	3787
	White	3743	575	569
	Indian	1065	244	284
	Coloured	158	95	110

**Source:** Adapted from ECSA. 2015b. *Annual Report 2012/2013*. [Online]. Available: <https://www.ecsa.co.za/news/SitePages/Annual%20Reports.aspx> [Accessed 3 January 2015].

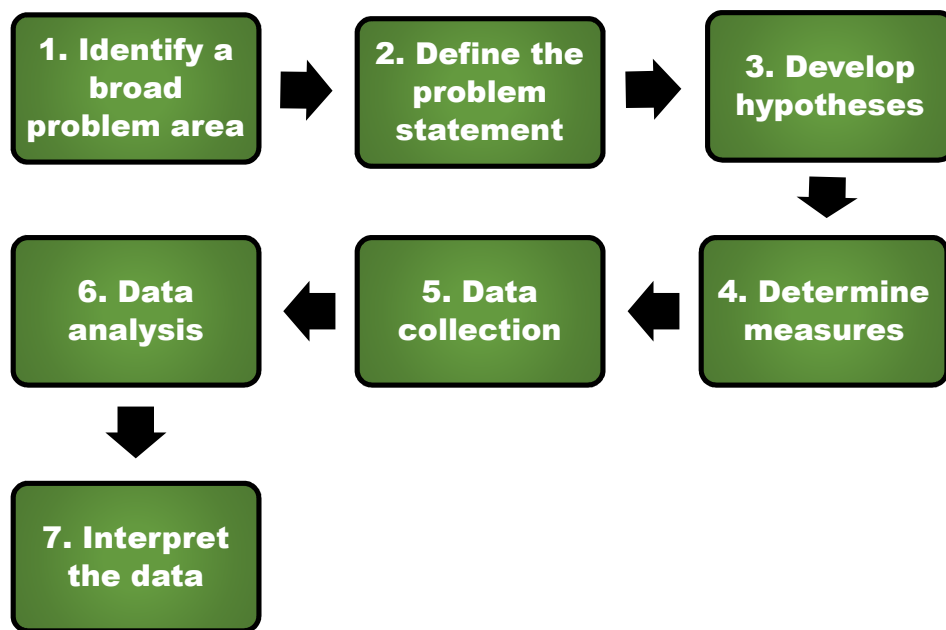
The above table extracted from this report revealed that the overall percentage of female candidate engineering professionals and female professional engineers registered with ECSA is approximately 21, 9% and 5% respectively. The total number of blacks (African, Indian and Coloured) registered in the candidate and professional categories amounted to 9 619 out of a total number of 14 506 candidate professionals and 5 479 out of a total number of 24 183 registered professionals respectively. This indicates that progress has been slow regarding equity and gender transformation in the workplace, regardless of the equity legislation implemented in South Africa (Martin and Barnard, 2013).



### 3.3. Research

Leedy and Ormrod (2010) defined research as a methodological procedure of collecting, analysing and interpreting information or data in order to increase our ability to understand the phenomenon with which we are concerned.

Scientific research draws attention to solving problems and follows a series of steps that is in a logical, organised and rigorous scientific method identifying the problems, collecting the data, evaluating them and drawing valid conclusions from them (Walliman, 2010; Sekaran and Bougie, 2013) . The hypothetico-deductive method is a conventional version of the scientific method which provides a beneficial, systematic approach for creating knowledge to solve basic and managerial problems (Lawson, 2000; Sekaran and Bougie, 2013). The hypothetico-deductive method involves seven steps as presented diagrammatically in Figure 3.1.



**Figure 3.1:** The seven-step process in the hypothetico-deductive method

**Source:** Adapted from Sekaran, U. and Bougie, R. 2013. Research Methods for Business: A skill building Approach. Australia: John Wiley and Sons Ltd.

The hypothetico-deductive method depicted in Figure 3.1 is initiated when a problem is identified (Sekaran and Bougie, 2013). Scientific research only commences with a clear aim, and therefore a problem statement including objectives and research questions should be created to find solutions to the problem that has been identified (Sekaran and Bougie,

2013). The research variables are measured in order to test the hypotheses (Sekaran and Bougie, 2013). Data is then collected, statistically analysed and interpreted to establish if the hypotheses are supported or unsupported so that the researcher can make recommendations (Sekaran and Bougie, 2013). The scientific research approach was used in the research methodology for this study but no hypotheses were developed because this study did not undertake causal research. However, research questions was formulated and presented in chapter one.

### **3.4. Aim and Objectives of the study**

Quinlan (2011) described an aim as a general statement of what the researcher intends to achieve and the objectives specify how the researcher intends to achieve this aim.

#### **3.4.1. Aim**

The aim of this research study was to determine whether female engineers experience gender discrimination in their profession. The intention was to achieve this aim by measuring female engineers' perceptions of discrimination experiences in their workplace.

#### **3.4.2. Objectives**

The following objectives served to supplement the aim of this research and guided the scope of this study:

- To determine if female engineers experience gender discrimination barriers in their profession.
- To identify the factors that hinder the advancement of female engineers into senior management positions.
- To identify the improvements that will eliminate gender discrimination of female engineers.

### **3.5. Type of Study**

The most applicable type and amount of research required depends on the quantity of uncertainty that encompasses the situation motivating the research (Zikmund *et al.*, 2013). Research can either be exploratory, causal or descriptive (McNabb, 2015).

Exploratory research is performed during the early phases of decision making where the decision situation is very ambiguous and management is usually uncertain with regards to what actions should be undertaken (Zikmund *et al.*, 2013). This research approach is usually unstructured and very productive because it generates a large quantity of ideas; however, the decisions made can be riskier since exploratory research does not test these ideas amidst a scientific sample (Zikmund *et al.*, 2013).

Causal research is conducted to establish a cause-and-effect relationship, it focuses on a small quantity of research hypothesis, it is very structured and yields specific results (Bailey, 2008; Zikmund *et al.*, 2013).

Descriptive research is used to illustrate the characteristics of objects, people, groups, organisations or environments and it attempts to “paint a picture” of a particular situation (Zikmund *et al.*, 2013). In descriptive research, the researcher has some knowledge of the dependent and independent variables in the study (Sekaran and Bougie, 2013). A variable can be described as anything that can undertake differing or varying values (Bailey, 2008; Sekaran and Bougie, 2013). These values can be dissimilar at the same time for different objects or individuals (Sekaran and Bougie, 2013).

This study is descriptive in nature because it measures variables. This study is also a correlational study. A correlational study describes the relationship between variables (Sekaran and Bougie, 2013). Therefore the problem statement, objectives and research questions were used as a basis to investigate the factors that impact gender discrimination, all of which is presented in this dissertation.

### **3.6. Research Approach**

The researcher can either use a quantitative or qualitative approach to address the research questions. The quantitative research procedure makes use of numbers and statistical methods (King, Keohane and Verba, 1994; Williams, 2011). It is usually based on numerical measurements of particular aspects of phenomena, it abstracts from specific instances to pursue general descriptions or to test causal hypotheses and its measurements and analysis can be replicated by other researchers (King *et al.*, 1994). Quantitative research uses large samples and generates results that are considered to be objective because when the survey respondent provides a commitment score on a quantitative scale, the number will remain the same regardless of the researcher involved in the analysis

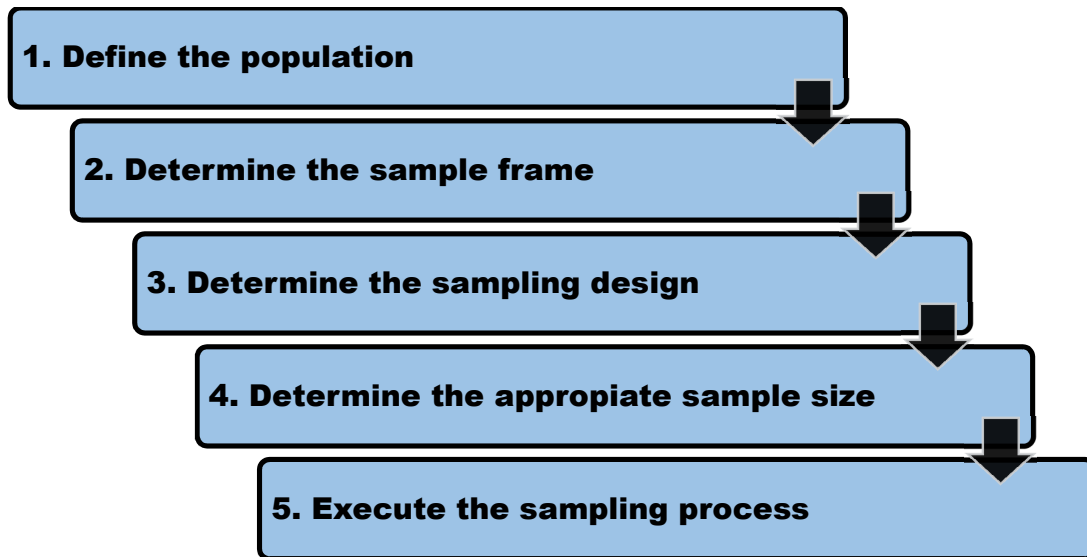
(Zikmund *et al.*, 2013). Quantitative research is most often used for descriptive and causal research designs (Zikmund *et al.*, 2013). In contrast, qualitative research encompasses an expansive range of approaches (King *et al.*, 1994; Ritchie, Lewis, Nicholls & Ormston, 2013). It tends to focus on one or lesser number of cases, it entails interviews or an intensive examination of historical materials, discursive methods, and considers an overall account of a certain event (King *et al.*, 1994). Qualitative research is considered as subjective because different researchers may arrive at different conclusions based on the same interview (Zikmund *et al.*, 2013). Qualitative research uses small samples and is most often used for exploratory research designs (Zikmund *et al.*, 2013).

A quantitative approach was used for this study because the study is descriptive in nature, as described in Section 3.5 above and also because the research compromised of a large sample size. A questionnaire was used as a quantitative measuring instrument to establish the perceptions of female engineers. It needed to determine if they really do or don't encounter gender discrimination in their profession.

### **3.7. Sampling**

Sampling is a procedure of making a selection of a sufficient number of the correct elements in order for the sample characteristics to be generalised to the population (Burns and Grove, 2010; Sekaran and Bougie, 2013). Sampling is often used by researchers because it would be impractical to conduct a census that measures the characteristics of all the elements within a population (Zikmund *et al.*, 2013).

According to Waruingi (2010), sampling techniques are essential because they save on expenditure and the tedious task of surveying the entire population. A properly selected sample, as compared to a census, provides accurate results by reducing tabulation errors, interviewer mistakes and other non-sampling errors because of the reduction of the workload (Zikmund *et al.*, 2013). Populations are dynamic in that people are constantly moving and migrating to various locations (Waruingi, 2010). The movement makes it difficult to include all the individuals in the target population, and therefore having a defined sample is a more suitable approach to avoid this problem (Waruingi, 2010). The sampling process is illustrated in Figure 3.2.



**Figure 3.2:** The sampling process

**Source:** Adapted from Sekaran, U. and Bougie, R. 2013. *Research Methods for Business: A skill building Approach*. Australia: John Wiley and Sons Ltd.

### **3.7.1. Description of the population**

A population as an entire group of individuals, events or objects that the researcher aspires to investigate (Sekaran and Bougie, 2013; Aparasu and Bentley, 2014). A population can be described as individuals who have similar characteristics (Lairson and Balkrishnan, 2004; Glantz, 2009 as cited in Waruingi, 2010). The population of this study consisted of all female engineers that are employed in KwaZulu-Natal. These individuals were appropriate to form the population of the study because they are employed in traditionally male-dominated and project-management professions and therefore they could verify if discrimination exists in their work environment.

#### **3.7.1.1. Participants and location of the study**

The characteristics of the participants are extremely important because the process for sampling participants determines the external validity, and the characteristics of participants also determine how good the results can represent the whole population (Waruingi, 2010).

The participants for this study comprised of female engineers in all the disciplines of engineering (e.g. chemical, mechanical, electrical, civil and industrial engineering). These participants could also occupy line, middle or senior management levels in their organisations.

Waruingi (2010) stated that the geographical location in a study is an important determinant of contextual conditions. Context dictates behaviour, for example populations that reside in a similar context tend to display similar behaviour while populations that reside in a different context tend to display different behaviours (Waruingi, 2010).

Therefore, the study was restricted to the province of KwaZulu-Natal. There are many engineering organisations, government-owned parastatals and municipalities (including local and district municipalities) located in this area and that employ engineers.

### **3.7.2. The sampling frame**

The sampling frame contains a list of individuals that is extracted from the target population (Aday *et al*, 2004 as cited in Waruingi, 2010; Marchevsky, 2012). A proficient sampling frame consists of the names and contact details of every person in the entire target population (Aday *et al*, 2004 as cited in Waruingi, 2010). The sampling frame for this study consisted of registered female members in the ECSA database as at March 2015.

Originally, the YPF of the Consulting Engineers of South Africa (CESA) and ECSA's voluntary organisations distributed the survey on behalf of the researcher. However, all these responses were eliminated from the study because these organisations distributed the questionnaire to all members without differentiating between male and females, while others posted the link to the questionnaire in their newsletters and the researcher could not verify the respondents' gender or geographic location. The CESA database was then used to identify participants because they included registered ECSA members on their database. The CESA database has a contact list of consulting engineering firms that are freely available to the public. The survey was distributed to female engineers employed in these firms.

### **3.7.3. The sampling design**

Sekaran and Bougie (2013) identified two main types of sampling designs as probability and non-probability sampling.

Probability sampling results in every individual in the population that has a known, greater than zero chance of being chosen as sample subjects (Sekaran and Bougie, 2013). The nonzero chance of being selected and the accuracy of that chance make it possible to generate unbiased estimates of the population (Waruingi, 2010). Probability sampling includes simple random sampling, systematic sampling, stratified sampling and cluster sampling (Zikmund *et al.*, 2013). The advantage of probability sampling is that random sampling error can be accurately predicted (Zikmund *et al.*, 2013).

Non-probability sampling results in the individuals in the population not having a foreseeable chance of being selected as subjects (Sekaran and Bougie, 2013). Non-probability sampling includes convenience sampling, judgment sampling, quota sampling and snowball sampling (Babbie, 2013; Zikmund *et al.*, 2013). The advantage of non-probability sampling is that it is convenient to use but its disadvantage is that there are no statistical techniques to measure their random sampling error (Zikmund *et al.*, 2013). The non-probability sampling technique is used when the individuals in the sample are selected on the basis of personal judgement or convenience (Zikmund *et al.*, 2013).

Convenience sampling and snowball sampling were used for the study. Convenience sampling is a non-probability sampling technique that collects information from participants who are conveniently available to provide it (Sekaran and Bougie, 2013). Convenience sampling was appropriate for the study because information could be extracted from any female participant who is located in the KwaZulu-Natal region and registered on ECSA's database and who was willing to participate in the survey. The researcher continuously engaged with the participants until the required sample size was achieved.

Snowball sampling is a non-probability sampling technique where additional respondents are obtained through referrals from the initial respondents (Zikmund *et al.*, 2013; Babbie, 2013). This technique is ideally used to locate individuals in a rare population (Zikmund *et al.*, 2013). There is a minority of females in the engineering profession and the researcher used this method to increase the response rates.

#### **3.7.4. The sample size**

The sample size can be described as the actual number of individuals selected as a sample to represent the target population characteristics (Sekaran and Bougie, 2013; Babbie,

2013). The decision with regards to how large the sample size should be depends on factors such as the research objective, the precision desired for the confidence level, the size and amount of variability of the population and the budget and time constraints (Kumar, 2002; Sekaran and Bougie, 2013).

Information pertaining to the total population of this study was obtained from the Engineering Council of South Africa. They confirmed that there is a total of 1017 female practitioners in the KwaZulu-Natal region as at 1 April 2015. These practitioners included candidate and professional technicians, technologists, engineers and certified engineers that are registered on ECSA's database. Sekaran and Bougie's (2013) sample size table was used to determine the appropriate sample size. This table indicated that a population of 1100 requires a sample of 285 respondents. Therefore, based on the values in the table that were in close proximity to the target population size, 285 participants were required for this study.

### **3.8. Data Collection**

The source of the information and the data collection method can have a major impact on the effectiveness of the research project (Sekaran and Bougie, 2013). A researcher can acquire data from primary or secondary sources (Salkind, 2010; Sekaran and Bougie, 2013). Primary data can be described as information that is acquired first-hand by the researcher on the variables of interest for the particular aim of the study (e.g. individuals that supply information through an administered questionnaire, etc.) (Sekaran and Bougie, 2013). Secondary data can be described as information that has been collected from existing sources (e.g. company records, government publications, websites, internet, etc.) (Sekaran and Bougie, 2013).

The advantages of secondary data are that it is cheaper to obtain than primary data, it is acquired rapidly and it may provide information that is usually unavailable to the researcher (Zikmund *et al.*, 2013). The disadvantages of secondary data is that it is not specifically intended to meet the researcher's needs and the researcher must cross-check different sources for accuracy, bias and soundness (Salkind, 2010; Zikmund *et al.*, 2013). A survey is a method of collecting primary data based on communication with the representative sample (Zikmund *et al.*, 2013).



A questionnaire which is a quantitative data tool and also constitutes as a primary data collection method was used for this study. Information pertaining to the perceptions of gender discrimination experienced by female engineers was obtained first-hand through self-administrated questionnaires. This study had 285 participants in the representative sample and a correctly designed and administered questionnaire would provide an unbiased, inexpensive and fast method of collecting data from large numbers of individuals.

### **3.8.1. Description and purpose of the instrument**

A questionnaire consists of a predetermined series of questions to which respondents document their responses, usually among a choice of closely defined alternatives (Sekaran and Bougie, 2013). A self-administered questionnaire can be published on paper, posted on the internet or transmitted via email (Zikmund *et al.*, 2013; Babbie, 2013). Paper questionnaires can be delivered to respondents through postal services, dropped off in person, inserted in publications (e.g. magazines) or faxed (Zikmund *et al.*, 2013). Electronic questionnaires can be distributed through email, internet website, interactive kiosk or mobile phones (Zikmund *et al.*, 2013).

Self-administrated questionnaires were traditionally delivered through the mail (Babbie, 2013; Zikmund *et al.*, 2013). Mail questionnaires have the advantage of reaching a greater geographically dispersed area, respondents can answer the questions at their own pace and convenience (Sekaran and Bougie, 2013). The disadvantages of mail questionnaires is that the response rate is low, there are administration costs associated with printing, posting and sending follow-up mailings (Zikmund *et al.*, 2013). The advantage of electronic questionnaires is that administration is almost effortless, it can extend globally, is very cost efficient, delivery is quick and data can be captured in real-time (Sekaran and Bougie, 2013; Zikmund *et al.*, 2013). However, the disadvantage of electronic questionnaires is that respondents must be computer literate, have access to the internet and must have the desire to complete the survey (Sekaran and Bougie, 2013; Zikmund *et al.*, 2013).

This study comprised of a large representative sample with no budget for postal administration costs, and due to time constraints, the lengthy period to deliver and collect the questionnaires would be inefficient. Since the digital revolution, the prospective respondents would use technology and the internet for communication. Therefore the most appropriate approach for this study was to use self-administrated electronic questionnaires.

### 3.8.2. Construction of the instrument

Sekaran and Bougie (2013) stated that when designing a questionnaire, it must incorporate sound principles that focus on three areas, namely the wording, the manner in which the variables will be categorised, scaled and coded and lastly the general appearance of the questionnaire. Some of the vital guidelines pertaining to a good questionnaire design include using language that corresponds with the respondents' educational level, avoiding leading or loaded questions that persuade respondents to provide socially desirable answers, and avoiding double-barrelled questions that create ambiguity and confuse the respondents (Boxill, Chambers & Wint, 1997; Zikmund *et al.*, 2013).

The design of the questionnaire for this study was based on the study's objectives and the research questions outlined in the literature review. Table 3.3 depicts how the questions in the questionnaire were linked to the research objectives

**Table 3.3:** Linking the survey questions to the objectives

NUMBER	OBJECTIVE	QUESTIONS
1.	To determine if female engineers experience gender discrimination barriers in their profession	12,13,14,15,16 17,18,19,20,21 22,23,24,27,28 29,30,31
2.	To identify the factors that hinder the advancement of female engineers into senior management positions.	25,26,33,34,35,36,37,38, 39,40,41
3.	To identify the improvements that will eliminate gender discrimination of female engineers.	32,42,43

Table 3.3 displays how the questions would sufficiently address the research objectives. The majority of the questions consisted of close-ended questions. In closed-ended questions the respondent is restricted to specific alternative responses and is requested to select an answer that is nearest to their viewpoint (Zikmund *et al.*, 2013). These questions consume less time and are easier to answer (Zikmund *et al.*, 2013). Standardised responses allow the researcher to code, tabulate and interpret the data more easily (Zikmund *et al.*,

2013). The questionnaire terminated with a final open-ended question. An open-ended question encourages respondents to provide comments on the subject matter that has not been completely or adequately covered (Sekaran and Bougie, 2013).

Sekaran and Bougie (2013) identified four types of scale measurements which consist of the nominal, ordinal, interval and ratio scales. Each scale has different degrees of sophistication (Sekaran and Bougie, 2013). The nominal scale, ordinal scale and the Likert scale were used for this study. A researcher uses a nominal scale to allocate subjects to specific categories (Sekaran and Bougie, 2013). An ordinal scale can be described as a ranking scale (Zikmund *et al.*, 2013). An ordinal scale categorises variables in a manner that depicts the differences among the categories while it also rank-orders the categories in a meaningful way (Sekaran and Bougie, 2013). The Likert scale was originally developed to measure the extent of attitudes/perceptions that range from a very negative to a very positive attitude (Quinlan, 2011; Zikmund *et al.*, 2013). The layout of the questionnaire with the relevant scales is illustrated in Table 3.4.

**Table 3.4:**Layout of questionnaire and type of scales

Classification	Description	Type of scale	Questions
Demographics	Respondents input their personal information. They must provide a single response to a set of alternative options for each question.	Nominal scale	1,2,3,4,5,6, 7,8,9,10,11,
Gender discrimination	Respondents must provide a single response to a set of yes/no options for each question.	Nominal scale	12,16,42
Gender discrimination	Respondents are required to rank the characteristics of their job in order of importance to them.	Ordinal scale Ranking scale	32,41
Gender discrimination	Respondents rate the extent of their agreement/disagreement to statements pertaining to their perceptions of gender discrimination.	Likert scale	13,14,15,17,18 19,20,21,22,23 24,25,26,27,28 29,30,31,33,34 35,36,37,38,39 40

Table 3.4 depicts how the survey questions were categorised to the type of scales used in the instrument. This study used an ordinal scale to measure the respondents' personal information and their yes/no responses in the gender discrimination portion of the questionnaire. It also used the ordinal (ranking scale) to determine the respondents' order of preferences to a set of job characteristics associated with gender discrimination. The respondents were required to rank these characteristics by assigning numbers (e.g. 1-8) in order of their most preferred to least preferred choice. Finally, it used a 5 point Likert scale to measure the extent of the respondents' perceptions in regards to gender discrimination. The respondents were offered five anchors in order to establish their level of agreement or disagreement. An ordinal scale was used to rank these anchors from one to five. The starting anchor was labelled "strongly disagree" denoting a rank number of 1, the ending anchor was labeled "strongly agree" denoting a rank number of 5 and the anchors in between followed the rank order.

### **3.9. Validity and Reliability**

Once measures have been assigned to the questionnaire, it is vital to ensure that the research instrument conforms to the reliability and validity requirements (Sekaran and Bougie, 2013). Reliability is essential for the measurement instrument but it does not constitute a sufficient condition for validity, as a reliable scale may not be valid (Zikmund *et al.*, 2013).

#### **3.9.1. Validity**

Validity refers to how accurate the questionnaire has been created and measures the intended concept (Sekaran and Bougie, 2013; Durand and Chantler, 2014). Sekaran and Bougie (2013) confined the validity tests under three broad headings, referred to as content validity, criterion-related validity and construct validity.

Content validity can be described as the degree to which a measure includes the breadth of the domain of the concept (Zikmund *et al.*, 2013; Durand and Chantler, 2014). Face validity is classified under content validity and it is considered as a biased agreement among qualified individuals that the scale logically depicts the concept being measured (Zikmund *et al.*, 2013).

Criterion-related validity occurs when the scale differentiates individuals on a known criterion (Sekaran and Bougie, 2013). Criterion-related validity can be categorised into

concurrent validity and predictive validity (Sekaran and Bougie, 2013; Zikmund et al., 2013). Predictive validity illustrates the scale's ability to differentiate individuals based on a future criterion (Sekaran and Bougie, 2013). In concurrent validity, the scale discriminates respondents who are different (Sekaran and Bougie, 2013).

Construct validity testifies how adequately the results have been obtained from using the measure that suits the theories related to the design (Sekaran and Bougie, 2013).

The face validity test was applicable to the study and this validity will be confirmed by a positive outcome reflected in the pre-testing of the questionnaire. Once the respondents from the pre-test confirm that the material in the questionnaire covers the aspects pertaining to the perceptions of gender discrimination, this will satisfy the researcher that the scale at face value measures the intended concepts.

### **3.9.2. Reliability**

Reliability is an indicator of the stability and consistency with which the questionnaire measures the concept (Bless, Higson-Smith & Kagee, 2006; Sekaran and Bougie, 2013). Zikmund *et al.* (2013) indicated two approaches to analyse the reliability of a measure, which consists of test-retest reliability and internal consistency.

The test-retest reliability method entails administering the identical scale to the identical respondents at two differing times for stability testing (Bless *et al.*, 2006; Zikmund *et al.*, 2013). On both occasions, the measure should reflect similar results if administered under identical conditions (Zikmund *et al.*, 2013).

Internal consistency refers to a measure of homogeneity (Zikmund *et al.*, 2013). Reliability is commonly assessed by using the co-efficient alpha estimate. The coefficient alpha must be at least 0.6 for the quality of the scale to be regarded as sufficiently reliable (Zikmund *et al.*, 2013).

For this study the researcher has assessed the coefficient alpha by using the Statistical Package for Social Science (SPSS) statistical software package.

### **3.10. Pretesting the questionnaire**

Pretesting of the questionnaire is a pilot study which compromises a small number of respondents to confirm their understanding of the questions (Sekaran and Bougie, 2013).

This assists the researcher prior to administration of the instrument to rectify any problems associated with the wording, identify points where respondents experience fatigue and tend to terminate the questionnaire and assess if particular questions are skipped (Sekaran and Bougie, 2013; Zikmund *et al.*, 2013).

According to Quinlan (2011), pilot studies are usually conducted with five to fifteen respondents. Six female engineers who were also studying towards the Masters of Business Administration (MBA) qualification participated in the pilot study. These individuals were chosen because they have same characteristics as the target population. These respondents had access to the questionnaire through the Questionpro website. The following issues were raised by the pilot study group and they were subsequently rectified to prevent inadequacies in the research results:

1. The question relating to gender was irrelevant and therefore removed. This action was appropriate because only females were required to participate in the survey.
2. The branching logic option on Questionpro was applied to specific questions in order to display relevant questions to the respondents based on their selection of choices in prior questions.
3. A non-management option was added to the selection of choices for the question relating to the respondents' level in their organisation.
4. Some grammatical errors were raised and thereafter corrected.

### **3.11. Administration of the instrument**

The data collection phase commences once the pilot study has been completed and all problems identified with the research instrument have been rectified. The data collection for this study was administrated electronically through a web-based survey software called Questionpro. Questionpro presents participants with a professional layout of questions and response alternatives, making it easier for participants to answer the questions. Questionpro also has the advantage of tracking the respondents' IP addresses and only accepting one response from each respondent's email address. This assists the researcher to reduce any bias or distortion of the results.

An email was sent to all individuals identified in the target population to invite them to participate in the study. The email contained a hyperlink to the Questionpro website, and

once the willing participant accessed this site, they were directed to the consent page where the purpose of the study and all confidentially procedures were explained to the participant. Once the participant was satisfied with the information, they were required to click on the “I agree” and continue button to proceed to the survey. Those participants who were unwilling to participate in the survey were also provided an option to exit the survey. To improve the response rates, follow-up emails were sent to participants to remind them to participate in the study.

### **3.12. Analysis of the data**

Once the data had been collected from the questionnaire, the next step was to analyse the data (Sekaran and Bougie, 2013). The researcher used the IBM SPSS Statistics 22 software program and Questionpro to analyse the data. The data had to be suitably coded, keyed and edited before it was entered into these programs for further analysis (Sekaran and Bougie, 2013). Quantitative data analysis investigates numerical data by adopting statistical methods (Quinlan, 2011). This study incorporated descriptive statistics and inferential statistics.

Descriptive statistics provides a description of the accumulated data (Quinlan, 2011). Each variable (e.g. gender, age etc.) can be described in various ways (Quinlan, 2011). Relevant descriptive statistics such as frequencies, means and median for each variable are generated. A frequency indicates how many times a value occurs (Singh, 2007). A mean or an arithmetic mean is a well-known measure of central tendency (Vogt and Johnson, 2011). A median is the middle measurement in a group of scores that have been ranked (Vogt and Johnson, 2011).

Inferential statistics assists the researcher to reach conclusions about the entire population by analysing the sample (Waruingi, 2010). The Chi-Square test and cross tabulations were the inferential statistics that the researcher used to make conclusions about the sample.

### **3.13. Summary**

This chapter presented the research methodology processes, incorporating a detailed description of the design and the procedures used to conduct the study. The critical aspects of this chapter were guided by the aim and objectives of this study. The participants of the study were identified as female engineers and the location of the study was restricted to the province of KwaZulu-Natal. The study was descriptive in nature because the researcher

had prior knowledge of the variables and a correlational investigation was also conducted. The research questions were suitably addressed by using the quantitative research approach. The sampling process highlighted the non-probability convenience sampling and snowball sampling design procedure chosen for the study. Electronic self-administrated questionnaires through the QuestionPro online survey tool were selected for data collection. Measures taken to enhance the trustworthiness of the questionnaire included face validity of the questionnaire, using a co-efficient alpha estimate as a reliability indicator and pretesting the instrument. Finally, the SPSS and Questionpro computational software tools were used to analyse the data

Chapter 4 will present the results of the study in the form of descriptive and inferential statistics.



## CHAPTER 4

### Analysis and Discussion of results

#### 4.1. Introduction

The research methodology presented in the previous chapter specified the appropriate research methods pertaining to the data collection from female engineers. This chapter presents the statistical techniques that were applied during the research to illustrate and evaluate the data that was collected from the empirical study. Thereafter the results of the data analysis are discussed and any relationships, disparities or any other relevant patterns will be identified. Firstly, the results from the respondents' demographic profile will be interpreted and then the findings related to the research objectives documented in Chapter 1 will be interpreted. The findings of the study will be discussed in the context of the problems and objectives that were posed in Chapter 1. The study used a non-probability sampling technique and therefore could not generalise the results to the entire female engineering population on ECSA's database and who were located in the province of KwaZulu-Natal.

Three hundred and eighty five (385) began participating in the study, however, 65 responses were incomplete and 35 responses were eliminated because these respondents had characteristics that did not conform to the sampling design of this study. Only 285 responses were valid and this produced a completion rate of 74%. However, an error was encountered on Questionpro where the totals in the demographic section reflected 286 responses. This occurred because some respondents clicked on the browser back button which affected the total count. However, this had a minor effect on the analysis of the results that it is almost negligible. All inaccurate data was eliminated prior to the data analysis.

#### 4.2. Treatment of data

The data obtained from the research survey was initially screened to avoid any statistical errors during the data analysis. All the survey responses were inspected and any data that was obtained by respondents who were not registered with ECSA, all incomplete responses and all responses where the researcher could not verify the respondent's gender or geographic location due to various ECSA voluntary organisations distributing the

questionnaire to all members without differentiating between male and females, while others posted the link to the questionnaire in their newsletters, was eliminated prior to the data analysis. Computer software packages called SPSS and Questionpro were used to assist in further analysing the cleaned data. The results of the data were communicated through tabular and graphical representation, and descriptive and inferential statistical procedures were also undertaken. The three scales used in the measuring instrument were the nominal scale, ranking scale and Likert scale. Relevant statistics pertaining to the scales, such as frequencies, means, median, chi-square test, were generated for specific variables.

#### **4.3. Reliability of the electronic questionnaire**

The SPSS statistical software program was used calculate the co-efficient alpha estimate in order to establish the reliability of the questionnaire. The results generated a low 0.410 score for this estimate. It was not a concern that the co-efficient alpha estimate was lower than the acceptable 0.6 reliability score because the questionnaire used various scales to measure female engineer's perception of gender discrimination. The Cronbach alpha estimate is commonly used for testing the reliability of a pure Likert scale when undertaking psychometric tests. This was a cross-sectional study and approximately 26 questions (60%) out of a total of 43 questions were Likert type questions. There was various other types of scales (nominal scales and ranking scales), including the open ended question that was used to better understand the perceptions of the respondents. If the study relied solely on Likert type questions then a Cronbach alpha estimate of less than 0.6 would be unreliable and unacceptable.

#### **4.4. Demographic and Employment Profile of the respondents**

The demographic characteristics of the respondents were investigated in terms of age, marital status, number of dependants, race, and highest education level and type of engineering qualification. The employment profile of the respondents was investigated in terms of their ECSA registration category, organisational sector, level in the organisation, the number of subordinates under their responsibility and their work experience. Male engineers were not invited to participate in the questionnaire because the study was investigating the perceptions of female engineers and therefore there was no demographic question related to gender. The demographic profile of the respondents reflects a total count of 286 due to the error in Questionpro, and these findings are illustrated in Table 4.1.

**Table 4.1:** Demographic profile of respondents

Description		Percentage	Frequency n=286
<b>Age</b>	Below 25	14%	39
	<b>25-34</b>	<b>50%</b>	<b>143</b>
	35-44	28%	79
	45-54	7%	22
	55 and over	1%	3
<b>Marital Status</b>	Married	44%	127
	<b>Single</b>	<b>47%</b>	<b>133</b>
	Widowed	3%	9
	Divorced	6%	17
<b>Number of dependants</b>	<b>1 and below</b>	<b>45%</b>	<b>129</b>
	2	35%	99
	3	14%	41
	4	6%	17
<b>Race</b>	Black	22%	64
	<b>Indian</b>	<b>50%</b>	<b>142</b>
	White	19%	55
	Coloured	9%	25
<b>Highest level of education</b>	Matric	1%	3
	Diploma	20%	57
	<b>Bachelors</b>	<b>33%</b>	<b>95</b>
	Honours/Postgraduate Diploma	26%	73
	Masters	19%	54
	Doctorate	1%	3
	Other	0.35%	1
<b>Branch of Engineering</b>	<b>Civil</b>	<b>38%</b>	<b>109</b>
	Industrial	9%	27
	Chemical	19%	52
	Electrical	20%	58
	Mechanical	14%	40

Table 4.1 illustrates that a significant portion (approximately 92%) of the respondents were relatively young and under 45 years of age. The majority of the respondents (50%) were within the 25-34 age category followed by the 35-44 age category (28%) and approximately 14% of the respondents were below the age of 25 years. According to Nienaber and Oosthuizen (2010), there is a major shortage of engineers in the midcareer bracket (35-50 years) that have the experience to execute major projects and to transfer their expertise to younger engineers.

Women are still portrayed as primary care givers and the most significant challenge they face in male-dominated professions is balancing their work and family life (Martin and Barnard, 2013). The majority of the respondents (47%) were single, 44% were married and 9% were either widowed or divorced. Most of the respondents (45%) had dependants that ranged from zero to one, the second highest category (35%) was from respondents that had a maximum of two dependants.

South Africa experienced a unique racial transformation after apartheid and therefore it is vital to explore the four official race groups' participation in the engineering profession. The majority of the respondents (50%) were Indians, the rest constituted 22% black, 19% whites and 9% coloured. It appears that the Indian female race group is integrating successfully into the engineering profession but these results contradict the ECSA registration 2012/2013 statistics where white and black racial groups predominately participate in the engineering profession.

The critical components of an engineer's professional development is having the relevant expertise and educational credentials. The respondents predominately had tertiary qualifications, 33% had a bachelor's degree, 26% an honours/postgraduate diploma and 20% had a diploma. These are the main qualifications that an engineer requires to belong to an ECSA registration category. Although one percent (1%) of respondents had a matric qualification, they can still register as a certified engineer if they have the relevant work experience.

Most of the respondents (38%) belonged to the civil engineering discipline, while the electrical engineering discipline (20%) was the second highest category. Respondents from other engineering disciplines such as mining, metallurgy, mechatronics, electronic and computer engineering also participated but were eliminated from the study because these

respondents belonged to various ECSA voluntary organisations that distributed the questionnaire on the researcher's behalf and the researcher could not verify their geographic location or their gender.

The employment profile forms part of the demographic profile of the respondents. It also reflects a total count of 286 due to the error in Questionpro, and these findings are illustrated in Table 4.2.

**Table 4.2:** Employment profile of respondents

Description		Percentage	Frequency n=286
<b>Registration category</b>	Professional Engineer	20%	57
	Professional Engineering Technologist	5%	14
	Professional Engineering Technician	5%	15
	<b>Candidate Engineer</b>	<b>35%</b>	<b>99</b>
	Candidate Engineering Technologist	19%	54
	Candidate Engineering Technician	16%	46
	Other	0.35%	1
<b>Organisational sector</b>	<b>Private</b>	<b>84%</b>	<b>240</b>
	Public	16%	45
	Tertiary	0.35%	1
<b>Level in the organisation</b>	First-line/ Junior Management	32%	89
	Middle Management	22%	64
	Senior/Top Management	10%	29
	<b>Non-management</b>	<b>36%</b>	<b>104</b>
<b>Number of subordinates</b>	<b>Below 5</b>	<b>65%</b>	<b>187</b>
	5-10	18%	51
	11-16	7%	19
	Over 16	10%	29
<b>Work experience in years</b>	Below 5	27%	76
	<b>5-10</b>	<b>46%</b>	<b>132</b>
	11-16	20%	58
	Over 16	7%	20

The majority of the respondents (35%) were registered as candidate engineer while the second highest and third highest were the professional engineer (20%) and the candidate

engineering technologist (19%) registration respectively. A smaller number of professional engineering practitioners (professional engineer, professional engineering technologist, professional engineering technician and professional certified engineer) (30%) participated in this study. These results corresponds with the ECSA 2012/2013 professional registration figures which reflect an under-representation of women in the professional engineering categories.

The majority of the respondents (84%) were employed in the private sector, 16% of the respondents were employed in the public sector. According to the SAICE (2011), the remuneration of professionals has improved in the public sector but a skills constraint still remains in this sector.

Most of the respondents (36%) held non-management positions, while 32% held first line/junior positions and only 10% held senior/management and executive positions. According to Kiaye and Singh (2013), female representation is gradually increasing at the lower and middle management levels but the “glass ceiling” metaphor is used to describe an invisible barrier that prevents women from reaching senior management positions.

The majority of the respondents (65%) had less than five subordinates, 18% of the respondents had five to ten subordinates. Forty six percent (46%) of the respondents had five to ten years of work experience, while 27% of respondents had below five years of work experience.

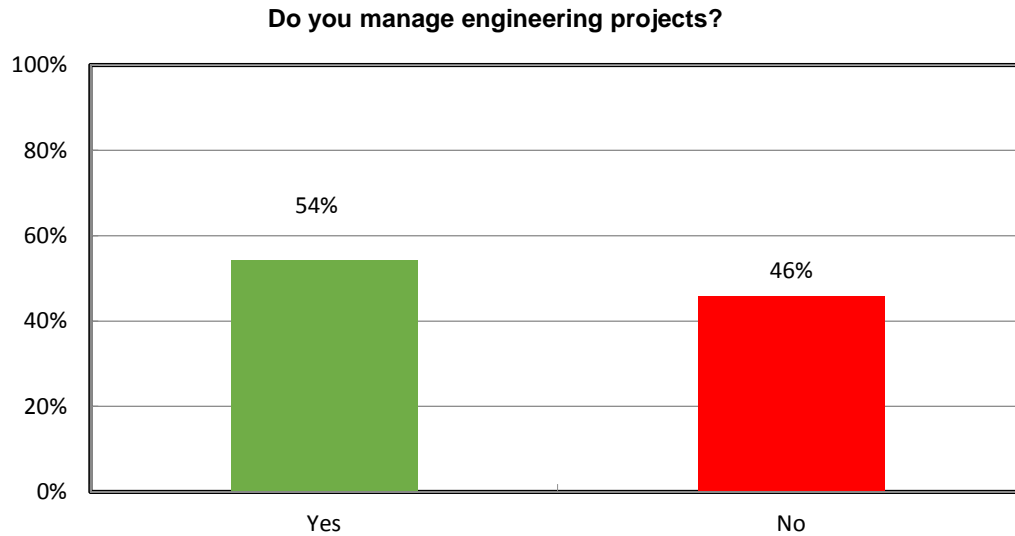
#### **4.5. Objectives related to gender discrimination**

The questionnaire was structured to capture information pertaining to the research objectives and to also ensure that the research questions were adequately answered. The results are presented and discussed below according to the three research objectives of the study.

##### **4.5.1. To determine if female engineers experience gender discrimination barriers in their profession**

The attitudes/perceptions of female engineers were investigated in order to establish if they experienced any gender discrimination in their organisations and project environments. A nominal Yes/No question was used to differentiate between female engineers who did not

manage projects and female engineers who were project managers. This is depicted in Figure 4.1 below.



**Figure 4.1:** Management of engineering projects

Figure 4.1 reveals that 54% of the respondents managed projects and 46% did not. This reveals that more than half the respondents were in project management leadership positions, however there is only a small percentage (8%) difference between those respondents who managed and those who did not manage projects. This is significant because project management is usually the commencement of a lower level management position after which female engineers can progress into more senior positions.

#### **4.5.1.1. Gender discrimination in project environments**

The fundamental component of all engineering work is the management of projects which forms part of the daily tasks of engineers in all disciplines of engineering (ECSA, 2015a). Therefore, a 5 point Likert scale was used to investigate female engineers' gender discrimination experiences related to managing projects and the results are presented in Table 4.3.



**Table 4.3:** Gender discrimination related to projects

Objective 1	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
i) I feel gender discriminated against in the allocation of project management roles	<b>14%</b>	<b>38%</b>	14%	26%	8%
ii) I am comfortable managing a multi-gender team	0.65%	10%	3%	<b>43%</b>	<b>43%</b>
iii) I have the professional capabilities to hold project management positions	0%	4%	5%	<b>35%</b>	<b>56%</b>
iv) I have to explain my rationale more often than my male counterparts for obtaining project resources	10%	34%	11%	<b>26%</b>	<b>19%</b>
v) I prefer to communicate directly with project stakeholders rather than using technology	5%	20%	26%	<b>35%</b>	<b>14%</b>
vi) I have been discriminated from managing projects because of my gender	<b>12%</b>	<b>33%</b>	22%	24%	9%
vii) If given the opportunity, I would be able to manage projects immediately	6%	11%	10%	<b>36%</b>	<b>37%</b>
viii) More male than female engineers hold project management positions in my organisation	6%	13%	6%	<b>35%</b>	<b>40%</b>

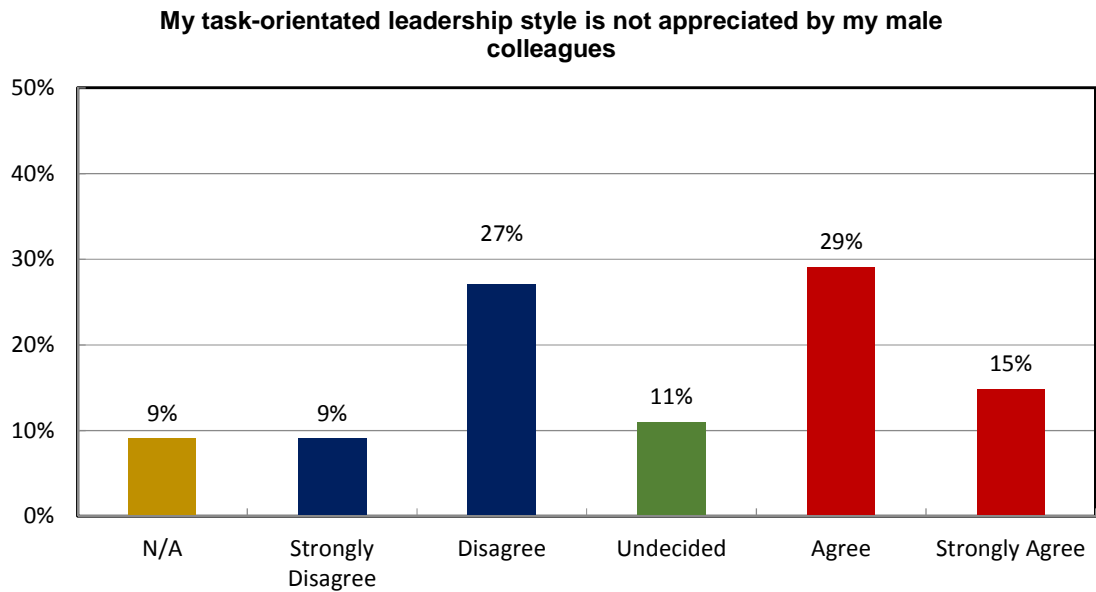
Table 4.3 illustrates that more than half of the respondents (52%) who managed projects disagreed/strongly disagreed that they were discriminated against in their allocation of project management roles. These results do not support the study by Henderson, Stackman and Koh (2013) which indicates that females are discriminated against in their roles, they are not being taken seriously, and they receive inadequate respect in general and also for their expertise, including being disregarded as leaders who have authority roles.

A multi-gender engineering team usually contains individuals that belong to different age categories and possess varying levels of expertise. Most of the respondents (86%) agreed/strongly agreed that they were comfortable managing a multi-gender team. According to Bear and Woolley (2011), both males and females have an equal level of influence in gender balanced teams which contributes to their improved group processes. Ninety-one percent (91%) agreed/strongly agreed that they had the professional capabilities to hold project management positions

The majority of the respondents (45%) agreed/strongly agreed that they had to explain their rationale more often than their male counterparts to obtain project resources, however forty four percent (44%) of the respondents disagreed/strongly disagreed to the same question statement. The slight difference in the results indicate that the respondents perceptions are so closely divided regarding whether their influence abilities as a project manager is effective in obtaining project resources. Forty nine percent (49%) of the respondents agreed/strongly agreed that they preferred to communicate directly with project shareholders than use technology. The participants in the study preferred to use verbal means to communicate. This allows women to influence others using richer media (e.g. face-to-face) that facilitates greater relationship building than using leaner technology-mediated communication (Henderson *et al.*, 2013).

Most of the respondents (45%) that presently do not manage projects disagreed/strongly disagreed that they have been discriminated from managing projects because of their gender, however, the majority of non-project managers (73%) also agreed/strongly agreed that if they were given the opportunity they would be able to manage projects immediately. It is significant that 75% of the respondents agreed/strongly agreed that more males than females hold project management positions in their organisations. This indicates that more male engineers are in the leadership pipeline since lower management positions are the initial stages from which to progress to senior management positions.

A task-orientated leadership style has traditionally been associated with male characteristic behaviour. A non-applicable (n/a) option was added to the conventional Likert scale statements to cater for those respondents who do not practise this leadership style as depicted in Figure 4.2.



**Figure 4.2:** Task-orientated leadership style

Figure 4.2 illustrates that 44% of the respondents agreed/strongly agreed, 36% of the respondents disagree/strongly disagree that they were discriminated against by adopting this leadership style and 9% of the respondents do not adopt a task-orientated leadership style. Even though there is an 8% difference in the level of agreement and disagreement, the majority of the results still comply with the role congruity theory which states that women are evaluated unfavourably in comparison to men when performing leadership roles (Eagly and Karau, 2002).

Overall, most of the project managers did not feel discriminated in their project management positions but many respondents do encounter difficulties when trying to influence various stakeholders to obtain project resources. Those respondents who are not project managers do not feel that they have been discriminated from managing projects because of their gender but they emphasized that they have the professional capabilities to hold project management positions. It is important to acknowledge that both project managers and non-project managers highlighted the fact that men still dominate project management positions in their organizations.

#### 4.5.1.2. Gender discrimination in organisations

To determine if respondents experienced direct or indirect gender discrimination in organisations, a 5 point Likert scale was used to measure female engineers' perceptions of gender discrimination, and the results are presented in Table 4.4.

**Table 4.4:** Gender discrimination in organisations

Objective 1	Strongly disagree	Disagree	Undecided	Agree	Strongly Agree
i) I am not respected by my superiors	13%	35%	15%	24%	13%
ii) I am not respected by my peers	22%	44%	11%	14%	9%
iii) I am not respected by my subordinates	26%	34%	16%	18%	6%
iv) I have to overachieve to receive recognition at work because I am female	7%	19%	14%	26%	34%
v) I am not remunerated fairly in comparison to my male counterparts based on my work experience and engineering registration category.	8%	19%	20%	31%	22%
vi) Gender discrimination in the workplace makes me feel angry	4%	13%	10%	35%	38%
vii) Gender discrimination in the workplace makes me feel undervalued	4%	15%	9%	34%	38%
viii) Gender discrimination in the workplace makes me feel depressed	7%	21%	17%	25%	31%

It is evident from Table 4.4 that most respondents (48%) disagreed/strongly disagreed that they are not respected by their superiors, 66% disagreed/strongly disagreed that they are not respected by their peers and 60% disagreed/strongly disagreed that they are not respected by their subordinates. Engineers usually work in teams where they need to interact with each other to complete projects. A strong unification of team members is crucial for positive team effectiveness (Henttonen *et al.*, 2014). It is significant to acknowledge that 60% of the respondents agreed/strongly agreed that they have to overachieve to receive recognition because they are female. Recognition and career success experiences are some of the factors that encourage females to continue working in male-dominated occupations (Martin and Barnard, 2013). Twenty-two percent (22%) of the respondents strongly agreed, 31% agreed, 19% disagreed and 8% strongly disagreed that they are not remunerated fairly in comparison to males based on their work experience and registration category. Therefore it is evident that salary inequities do exist, however, salaries are not regulated in the engineering industry. According to ECSA, both male and female engineers who belong to a specific registration category have the required educational qualifications and skills to perform tasks specified for their category. Therefore, female engineers that belong to the same ECSA registration category should be remunerated similarly to their male counterparts. Discrimination is associated with stress and negative mental health, threatens an individual's goals and their sense of value as a human being, while also adversely impacting their job satisfaction (Bowen *et al.*, 2013). More than 50% of the respondents agreed/strongly agreed that gender discrimination makes them feel angry, undervalued and depressed.

Overall, most of the respondents agreed that they receive adequate respect from their superiors, peers and subordinates. However, they feel that they have to overachieve to receive recognition at work because of their gender and they are not remunerated fairly in comparison to their male counterparts for their professional capabilities. Gender discrimination in their organizations also affect their mental health and most respondents feel angry, undervalued and depressed when subjected to various forms of gender discrimination.

**4.5.1.3. Relationship between level in the organisation and whether respondents need to overachieve to receive recognition**

A cross tabulation was conducted to determine if there was a relationship between the respondents' level in the organisation and if they needed to overachieve to receive recognition because they are female. The respondents strongly perceived that they had to overachieve to receive recognition, this cross tabulation will identify whether respondents that occupy different organizational levels encounter this form of discrimination similar to one another. The results are illustrated in Table 4.5.

**Table 4.5:** Cross tabulation between level in the organisation and whether respondents need to overachieve to receive recognition

		<b>I have to overachieve to receive recognition at work because I am female</b>					<b>Total</b>
		<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>	
<b>Level in the organisation</b>	First-line/Junior Management	2%	7%	4%	7%	11%	31%
	Middle Management	3%	5%	3%	7%	5%	23%
	Senior/Top Management	1%	3%	2%	3%	1%	10%
	Non-management	2%	4%	5%	9%	16%	36%
<b>Total</b>		<b>8%</b>	<b>19%</b>	<b>14%</b>	<b>26%</b>	<b>33%</b>	<b>100%</b>
<b>n=285</b>		<b>Chi-Square = 21.653</b>			<b>p = 0.04</b>		

In Table 4.5, the p value is 0.04 which indicates that the findings are significant and are not due to chance. Since the probability is less than 0.05, we can be 95% certain that there is a significant relationship between the respondent's level in the organization and whether they need to overachieve to receive recognition. Those respondents who occupy non-management positions (25%), first line/junior management positions (18%), and middle management positions (12%) mostly agreed that they needed to overachieve to receive recognition at work. There was a 4% agreed/disagreed split between the perceptions of

those respondents in senior/top management positions as to whether they need to overachieve to receive recognition at work. This finding reveals that respondents in the lower management positions still encounter gender discrimination barriers and they still need to work hard to overachieve in their work environments.

#### **4.5.2. Identify the factors that hinder the advancement of female engineers into senior management positions**

To determine what factors hindered female engineers from advancing in their careers, a 5 point Likert scale was used to measure female engineers' perceptions towards gender discrimination (Table 4.6).

**Table 4.6:** Factors that hinder career advancement in organisations

<b>Objective 2</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>
i) I am marginalised when trying to participate in male networks	6%	27%	19%	<b>33%</b>	<b>15%</b>
ii) There are insufficient female role models and mentors in the engineering profession to provide me with career support	2%	15%	11%	<b>34%</b>	<b>38%</b>
iii) I do not want to work overtime due to family responsibilities	10%	29%	7%	<b>27%</b>	<b>27%</b>
iv) I do not receive adequate organisational support to manage my professional and family responsibilities	8%	25%	15%	<b>23%</b>	<b>29%</b>
v) I receive fewer training opportunities for career development than my male counterparts	<b>12%</b>	<b>34%</b>	11%	28%	15%
vi) I am mainly assigned to manage smaller, low-cost projects	<b>17%</b>	<b>25%</b>	19%	22%	17%
vii) I am reluctant to relocate for international project assignments	12%	20%	18%	<b>27%</b>	<b>23%</b>
viii) I am not advancing in my career	<b>18%</b>	<b>30%</b>	12%	20%	20%
ix) My gender has an influence on my selection for promotions	4%	15%	26%	<b>32%</b>	<b>23%</b>
x) My work experience is not considered when I apply for promotions	4%	19%	18%	<b>35%</b>	<b>24%</b>



The majority of the respondents (48%) do encounter difficulties integrating into male networks. Women tend to have less effective connections and male networks provide more informal assistance and also provide more leadership opportunities (Ely *et al.*, 2011). The notion that there are insufficient role models and mentors to provide career support in the engineering profession was supported by 72% of the respondents. Women who aspired to leadership positions had inadequate social support for learning how to obtain a leader identity (Ely *et al.*, 2011). Identifying with role models is one of the methods that individuals use to gain knowledge about new roles (Ely *et al.*, 2011).

Fifty-four percent (54%) of the respondents mostly agreed/strongly agreed that they did not want to work overtime due to family responsibilities. Women are governed by societal expectations that require them to manage family responsibilities (Jain and Mukherji, 2010). However, progression of women in male-dominated professions requires them to work overtime (Martin and Barnard, 2013). More than half the respondents (52%) agreed/strongly agreed that they don't receive adequate organisational support to manage their professional and family responsibilities. A women's career advancement opportunities can be negatively impacted if organisations resist to change their outdated corporate culture that does not support women to balance their work/life challenges (Jain and Mukherji, 2010). It is also significant to acknowledge that 39% of the respondents disagreed/strongly disagreed that they do not want to work overtime due to family responsibilities and 33% of the respondents disagreed/strongly disagreed that they do not have work-life balance organizational support. A women's makes her work and personal life choices according to her individual circumstances (Gallhofer *et al.*, 2011). Therefore respondents with a single marital status or do not have dependents may not find it difficult to work overtime.

The respondent's perceptions regarding training opportunities differed slightly as 46% disagreed/strongly disagreed and 43% agreed/strongly agreed that they received fewer training opportunities than their male counterparts. The level of disagreement towards training could be attributed to companies investing in adequate training because of government initiatives. According to the skills development levy legislative requirements, employers receive a partial refund for investing in their employees' training and development. The level of agreement to training opportunities is also significant because according to ECSA, engineers also require training development opportunities to qualify

for professional registrations which affirms their capability to handle more complex tasks. Hence, organizations are not investing in female engineers skills and this lack of training hinders career advancement opportunities.

It is important to acknowledge that 42% of the respondents disagreed/strongly disagreed, while 39% agreed/strongly agreed that they are assigned to smaller-scale projects. Gender stereotypes regarding women's capabilities could contribute to women being assigned to smaller-scale projects. Allocating women with projects that involve significant risk and visibility is fundamental for project portfolio management (Henderson *et al.*, 2013). Project portfolio management has the ability to transition women from a limited career path that consists of "small versus large projects" into numerous projects that offer more span of control within their area of expertise (Henderson *et al.*, 2013). Half of the respondents (50%) agreed/strongly agreed that they were reluctant to relocate for international project assignments. However, 32% of the respondents were willing to relocate. Those respondents who are willing to relocate may have very ambitious career goals because numerous literature verifies that undertaking international assignments provide more career advancement opportunities. According to Hede and Ralston (1993 as cited in Kiaye and Singh, 2013), women who are reluctant to relocate geographically, are also reluctant to seek employment in other organisations in order to acquire a higher office. Furthermore, family commitments portray a career barrier to female executives and especially those females who have dependants.

It is significant that most of the respondents (48%) disagreed/strongly disagreed and 40% of the respondents agreed/strongly agreed that they are not advancing in their careers. There was only a small difference in the percentage between those respondents who perceive that they are advancing or not advancing in their careers. Most of the respondents (55%) that are not advancing in their career agreed/strongly agreed that their gender had an influence on their selection for promotions. Most of these respondents (59%) who were not advancing in their careers also indicated that their work experience was not considered when they applied for promotions. The B-BBEE act is strategically used in organisations to promote disadvantaged individuals into senior positions. These results could indicate that organizations still marginalize women during promotions because women's gender and not their work experiences are being considered for promotional opportunities.

It is evident that the factors that hinder career advancement in organizations can be attributed to respondents being marginalized from male networks, insufficient role models and mentors to provide career support, women’s struggle to balance her work and personal responsibilities and their reluctance to relocate for international projects. Those respondents that indicated that they are not advancing in their careers emphasized that their gender has an influence on their selection for promotions and their work experience is not considered when they apply for promotions.

**4.5.2.1. Ranking of the changes participants are willing to make to be considered for promotions**

The human capital theory states that individuals make voluntary choices to invest in their career and their choices affect the benefits that they will reap in their career. Therefore, those respondents who were not advancing in their careers were presented with the relevant job characteristics that will assist them in their upward progression to senior management positions. The respondents were requested to rank the changes that they are willing to make in order to be considered for promotions, where 1 = they were most willing and 6 = they were least willing. Their preference to be considered for promotions is illustrated in Table 4.7.

**Table 4.7:** Ranking of job characteristics to be considered for promotions

<b>Rank</b>	<b>Job characteristics</b>	<b>Mean</b>
1	Apply for promotions	2.73
2	Undergo relevant training and development	2.88
3	Participate in activities that make me visible	3.05
4	Manage larger projects	3.40
5	Work overtime	4.04
6	Relocate if required	4.91

The job characteristics in Table 4.7 have been ranked according to the median scores for each category. The respondent’s priority increased when they rated each category closer to 1. It is evident that the most favourable changes that the respondents are willing to make in order to be considered for promotions is to apply for promotions (mean score 2.73),

followed by undergoing relevant training and development (mean score 2.88) and participating in activities that make them appear visible (mean score 3.05). The less favourable changes that the respondents are willing to make in order to be considered for promotions is to manage larger projects (mean score 3.40), followed by work overtime (mean score 4.04) and lastly relocate if required (mean score 4.91).

#### 4.5.2.2. Cross tabulation between marital status and the respondents' willingness to work overtime due to family responsibilities

A cross tabulation was conducted to determine if there was a relationship between the respondents' marital status and their willingness to work overtime due to family responsibilities. Work/Life balance is one of the major gender discrimination barriers that women encounter in the engineering profession and therefore it is critical to analyse this relationship. The results are illustrated in Table 4.8.

**Table 4.8:** Cross tabulation between marital status and respondents' willingness to work overtime due to family responsibilities

		I do not want to work overtime due to family responsibilities					Total
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	
Marital status	Married	3%	10%	3%	12%	16%	44%
	Single	5%	17%	4%	12%	9%	47%
	Widow	0.7%	0.4%	0%	2%	0.4%	4%
	Divorced	1%	1%	0.4%	2%	1%	5%
Total		10%	29%	7%	28%	26%	100%
		n=285		Chi-Square = 24.114		p = 0.02	

In Table 4.8, the p value is 0.02 which indicates that the findings are significant and not due to chance. Since the probability is less than 0.05, we can be 95% certain that there is a significant relationship between the respondent's marital status and their willingness or reluctance to work overtime due to family responsibilities. However, more than 20% of the cells have counts of less than 5 and these results should be treated with caution. Regardless of this concern, the relationship between these two factors are important as an individual's responsibilities are usually proportional to their marital status and this will effect the respondents decisions to work overtime, therefore this relationship have been considered for the study. Those respondents who were married mostly agreed (28%) that they don't want to work overtime due to family responsibilities. Conversely, those respondents that were single mostly disagreed (22%) and 21% agreed that they are not willing to work overtime due to family responsibilities. The majority of the widowed (2.4%) and divorced (3%) respondents also agreed that they do not want to work overtime due to family responsibilities. Married, divorced and widowed women usually have responsibilities towards children and other dependents and therefore would be reluctant to work overtime. The slight difference in the level of agreement and disagreement by the single respondents could suggest that the majority of the single respondents do not have dependents and other major family responsibilities and therefore are more willing to work overtime. However, some single women do have children/dependents and family responsibilities and therefore were also reluctant to work overtime. The majority of the results implies that all respondents have similar perceptions regarding their work/life balance needs and this relationship is a significant barrier that is experienced by women in the engineering profession.

#### **4.5.2.3. Cross tabulation between level in the organisation and respondents not advancing in their careers**

A cross tabulation was conducted to determine if there was a relationship between the respondents' level in their organisation and their career advancement progress into senior management levels. Individuals in junior management levels are usually in the pipeline for more senior management levels. Therefore it is vital to identity if the respondents are achieving this career progression. The results are illustrated in Table 4.9.

**Table 4.9:** Cross tabulation between level in the organisation and respondents' career advancement progress

		I am not advancing in my career					Total
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	
Level in the organisation	First-line/ Junior Management	4%	10%	6%	5%	7%	32%
	Middle Management	5%	6%	2%	7%	2%	22%
	Senior/Top Management	3%	5%	0.3%	1%	0.7%	10%
	Non- management	6%	9%	4%	7%	10%	36%
Total		18%	30%	12%	20%	20%	100%
		n=285	Chi-Square = 29.867			p = 0.00	

In Table 4.9 the p value is 0.00 which indicates that the findings are significant and not due to chance. Since the probability is less than 0.05, we can be 95% certain that there is a significant relationship between the respondent's level in the organization and career advancement progress. Those respondents that are in junior management positions mostly disagreed (14%), respondents in middle management positions also mostly disagreed (11%), and respondents in senior/top management positions also mostly disagreed (8%) that they were not advancing in their careers. Respondents in non-management positions mostly agreed (17%) that they were not advancing in their careers. It is also significant to acknowledge that respondents in junior management positions (12%) and respondents in middle management positions (9%) agreed/strongly agreed that they are not advancing in their careers. This could suggest that their organizations are not recognising their talents or they are not investing on leadership and management programs to facilitate their career paths to more senior management positions. However, the majority of the results implies that respondents in management positions perceive that they are advancing in their careers while respondents in non-management positions are not advancing in their careers.

#### 4.5.3. To identify the improvements that will eliminate gender discrimination of female engineers

At face value, it may appear that women are gaining acceptance in the workforce but their progression into senior management positions is being hindered because of subtle forms of discrimination (Kiaye and Singh, 2013). This discrimination manifests through compensation, training and/or socialisation networks (Kiaye and Singh, 2013). In order for organisations to eliminate gender discrimination barriers in the work environment, the respondents were requested to rank the job characteristics that they require their organisations to implement so they would feel less discriminated against (Table 4.10).

**Table 4.10:** Ranking of preferences to reduce gender discrimination

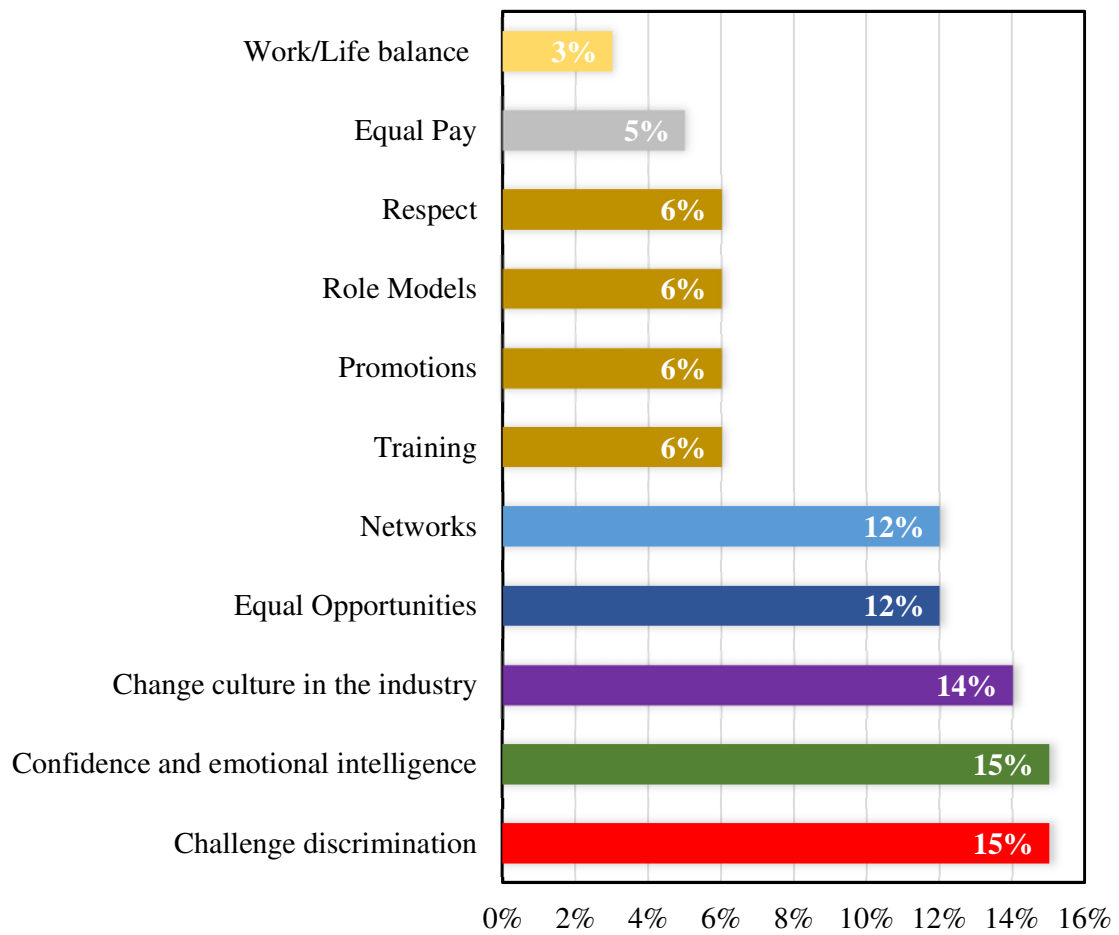
Rank	Job characteristics	Mean
1	Equal recognition	2.65
2	Equal remuneration	3.22
3	Promotional opportunities	4.44
4	Flexi-time for work/life balance	4.48
5	Assigned to large-scale projects	4.84
6	Respect from my superiors	5.00
7	Respect from my peers	5.19
8	Respect from my subordinates	6.18

In Table 4.10 the findings have been ranked according to the mean scores of each job characteristic. When comparing the scores, each job characteristic that was ranked nearest to 1, was perceived by the respondents that it is important for their organisations to implement them so they would feel less discriminated against in their work environments. It is evident that the respondents gave the most priority to equal recognition (mean score 2.65), followed by equal remuneration (mean score 3.22) and promotional opportunities (mean score 4.44). Respondents also indicated that they require their organisations to implement flexible work/life balance policies (mean score 4.48), followed by assigning respondents with large scale projects (mean score 4.84), receiving respect from superiors (mean score 5.00), receiving respect from peers (mean score 5.19) and lastly receiving

respect from subordinates (mean score 6.18) in order to feel less discriminated against. The findings in Table 4.10 indicate that both direct and indirect unfair discrimination still exists in organisations mostly through respondents not receiving equal recognition, equity in compensation and in promotional opportunities.

**4.5.3.1. Recommendations to reduce gender discrimination in the engineering profession**

An open-ended question was also posed to the respondents to state any additional suggestions that they consider will reduce gender discrimination in the engineering profession. The results of the respondents’ suggestions are presented in Figure 4.3.



**Figure 4.3:** Suggestions to reduce gender discrimination



Figure 4.3 shows that a large proportion of the respondents (15%) indicated that women must challenge discrimination. Fifteen percent (15%) also indicated that having confidence and using their emotional intelligence is the key to dealing with discrimination. A significant portion of the respondents (14%) suggested that the male-dominated culture needs to transform to accommodate women, while 12% of the respondents indicated that women should have equal access to both male and female networks and equal career opportunities.

#### **4.6. Summary**

In the discussion of the research findings, connections were made between the results and relevant existing literature. The study also portrayed four significant findings and relationships.

Almost two thirds of the participants felt that they needed to overachieve in their organisations to receive recognition. More than half stated that their career mobility to senior management positions was hindered due to the lack of organisational support to balance their personal and work responsibilities. However, the majority of the respondents did not feel discriminated against in their project management positions. The respondents ranked equal recognition, equity in compensation and in promotional opportunities as the three crucial job characteristics that need to be improved to eliminate gender discrimination in organisations.

The conclusions of this study are presented in Chapter 5. The implications of the research findings and recommendations will also be presented. Finally, Chapter 5 will indicate the limitations encountered in this study and suggest recommendations for further research.

## CHAPTER 5

### Conclusions and Recommendations

#### 5.1. Introduction

Gender discrimination is usually not overtly evident but women in this study have claimed to have experienced this prejudice in the engineering profession. This is not only a national issue but also an international trend that urgently needs to be addressed. This study attempted to establish whether gender discrimination really exists in the engineering profession. This was achieved by investigating female engineers' perceptions with regards to gender discrimination that they experienced in their work environments.

The research questions and the supporting objectives, together with the data that was obtained from female engineers were used to determine if gender discrimination exists in the engineering profession. Chapter 4 presented and interpreted the meaning of the data that was gathered for this study. This chapter discusses specific recommendations based on the conclusions derived from the study, indicates the limitations encountered during this study and suggests recommendations for further research.

#### 5.2. Key Findings and Conclusions

The key findings of gender discrimination in project environments are summarised in Table 5.1 below.

**Table 5.1:** Summary of key findings of gender discrimination in project environments

	Objective	Finding	Section
1	To determine if female engineers experience gender discrimination barriers in their profession.	<p>Female engineers that managed projects (52%), did not feel discriminated against in their project management positions.</p> <p>Female engineers that did not manage projects (45%), did not perceive that they have been discriminated from managing projects because of their gender.</p> <p>The majority of the respondents (75%) agreed that more males than females hold project management positions in their organisations.</p>	4.5.1

It can be concluded that gender discrimination in project environments is not a serious concern as most of the respondents did not feel marginalized in project related matters. The perception that men hold more project management positions than females is a critical issue because this could suggest that organizations are not recognising female engineer's talents and assigning them with project management positions. This issue is significant because project management is usually the commencement of a lower level management position after which female engineers can progress into more senior positions.

The key findings of gender discrimination in organizations are summarised in Table 5.2 below.

**Table 5.2:** Summary of key findings of gender discrimination in organizations

	<b>Objective</b>	<b>Finding</b>	<b>Section</b>
1	To determine if female engineers experience gender discrimination barriers in their profession.	<p>Respondents (60%) felt that they needed to overachieve to receive recognition.</p> <p>Respondents (53%) agreed that they were not remunerated fairly in comparison to their male counterparts based on their work experience and engineering registration category.</p>	4.5.1
2	To identify the factors that hinder the advancement of female engineers into senior management positions	<p>Respondents (48%) encountered difficulties integrating into male networks.</p> <p>The notion that there are insufficient role models and mentors to provide career support in the engineering profession was supported by 72% of the respondents.</p> <p>Respondents (52%) agreed that they were not receiving adequate organisational support to manage their professional and family responsibilities.</p> <p>Respondents (50%) agreed that they were reluctant to relocate for international project assignments</p>	4.5.2
3	To identify the improvements that will eliminate gender discrimination of female engineers.	Gender discrimination can be eliminated in organisations mostly through providing females equal recognition, equity in compensation and in promotional opportunities.	4.5.3

It can be concluded, that regardless of the equal opportunities that have been provided for women to participate in the engineering profession, they are still required to overachieve to receive recognition and salary inequities still exist in this profession. The major obstacles that prevent women from advancing in their careers are related to difficulties encountered when they attempt to integrate into male networks, insufficient role models and mentors to provide career support, not receiving adequate organisational support to manage their professional and family responsibilities and respondents were also reluctant to relocate for international project assignments. Finally, gender discrimination in organisations can be eliminated through providing females equal recognition, equity in compensation and in promotional opportunities.

### **5.3. Recommendations to overcome gender discrimination**

The recommendations presented below provide solutions to the three objectives and research questions set out in the study. These recommendations should be implemented in organisations so that female engineers can overcome gender discrimination and can advance in their careers.

#### **5.3.1. Gender equality training programmes**

It has been established in this study that engineering is still a gender-hostile working environment that causes women to experience physical and emotional stress. To overcome some of the challenges that female engineers experience, like working hard to receive recognition and mental stress, organisations should introduce gender equality induction and training programmes. The aim of the gender equality training programmes is to create awareness around gender sensitivity issues. These programmes can transform the work environment by providing employees with the knowledge and skills to change their perceptions and behaviours towards women and to overcome gender discrimination. Diversity should be the main topic that is included in this training so that organisations can rectify all forms of discrimination. Organisations should make it compulsory for all employees and management to attend this type of training at least once a month or until the aim of this training is achieved. This training should also be included in the induction training for all new employees. Employees will become more confident to report any gender discrimination behaviour they have been subjected to and subsequently organisations can objectively discipline employees for that negative behaviour.

Organisations can also adjust their policies against any gender discrimination barriers that they have identified from this training.

### **5.3.2. Improving women's participation in management and leadership positions**

The research in this study revealed that women's participation in senior management and leadership positions is unsatisfactory, and therefore immediate solutions are required to resolve this situation. Organisations can overcome this problem by giving female engineers special leadership assignments to groom them for leadership positions and also to develop succession leadership plans. These succession plans can involve identifying potential leaders from junior or middle management positions, providing them with ad hoc special leadership assignments and other sources of relevant training and eventually promoting competent female engineers into senior management positions every one or two years. To enhance their confidence, organisations can request that they speak at conferences and publish career related articles in the company newsletters and website. This will embrace women's unique talents and also empower them.

### **5.3.3. Shared leadership**

Female project managers are usually conflicted between adopting a task-orientated or relationship-orientated leadership style. Since most project teams consist of professionals that are capable of managing projects, the relatively new concept of shared leadership that has been introduced by many other authors, including Pearce and Conger in 2003, should be adopted in organisations. The notion behind shared leadership is that within a team, no single individual carries out all of the leadership functions but instead a group of individuals can jointly carry out this activity. Team performance can be improved by capitalising from all team members' strengths and this type of leadership incorporates both masculine and feminine qualities which not only empower female project managers but all individuals within the team.

### **5.3.4. Rectifying the gender remuneration gap**

The engineering discipline is structured in such a manner that engineers get remunerated differently according to their work experience, educational qualification and all these factors are considered in conjunction with their ECSA registration category. However, it is evident from this study that the occupational gender segregation that still exists in the engineering profession contributes to the pay disparity between male and female engineers.

However, the secrecy that surrounds compensation and the complex engineering remuneration structure makes it difficult for female engineers to prove any pay inequalities. Female engineers can investigate their market related salaries through salary websites and they must take the responsibility to report any pay inequalities to ensure male and female engineers get paid equally for equal work. However, employers need to acknowledge that they have a moral and legal obligation to remunerate women for work of the same value, otherwise they will contravene the South African Employment Equity Act and other legislative policies. Remunerating employees is usually very subjective but senior leaders need to change their negative perceptions regarding women's capabilities and remunerate them fairly for their skills to close the income gap.

### **5.3.5. Identifying potential role models and mentors**

Role models and mentors have significant roles that impact a female's professional commitment to the engineering profession and also their career advancement opportunities. The glass ceiling metaphor has been attributed to the lack of women in senior positions to provide these vital roles. Since more women are advancing in the lower management positions, it may be strategic for organisations to develop these younger female engineers to become role models and mentors to empower other female engineers in non-management positions. Organisations must enforce mentoring and coaching training programmes to develop these engineers. Male or female senior leaders within the organisation can act as mentors or the organisation can develop associations with other organisations to secure more mentors to assist them with this mentorship and training programme. These female engineers should attend mentorship sessions at least twice a week for a year and milestones should be established to measure their success. Once the required success levels have been achieved, then these female engineers can perform mentorship and role model positions themselves. When female engineers see their very colleagues being displayed in such vital roles, this will increase their self-confidence and they will acknowledge that they have the required assistance to advance in their careers. Female engineers can also join female professional networks such as Women in Engineering (WomEng), where they provide a platform that continuously enforces the development of women's engineering and leadership skills, provide easier access to female mentors and role models and also provide networking opportunities to other women in the engineering profession.

### **5.3.6. Flexible working arrangements and Family initiatives**

Organisations must include diversity in their organisational culture, so they can recognise that female engineers have unique requirements in terms of gender and other ideologies. Since balancing work and family responsibilities is a significant barrier that females experience in the engineering profession, organisations must make provision for flexible working hours to accommodate their work/life balance requirements. This will include adjusting traditional working hours so female engineers can co-ordinate family responsibilities while still maintaining their required level of productivity. Organisations can also incorporate other family initiatives like fully paid, longer maternity leave, investing in building or subsidising day-care and nursery facilities to help women balance their numerous roles.

### **5.3.7. Telecommuting**

Organisations can also assist female engineers to balance their work and family responsibilities through telecommuting. This will give the employee the flexibility to work from home or any other suited location. Correspondence and feedback can occur through Skype which is a software product that mainly provides communication through videos and phone calls by using computers and mobile devices, communication can also occur through emails, faxes, telephones etc. This arrangement will benefit the employee because she will have more freedom to balance her professional and family responsibilities.

### **5.3.8. Relocation**

The nature of the engineering industry involves travelling to different geographic locations to execute and oversee various projects. Engineers are usually required to be physically on a project site to conduct site inspections and to ensure all work is being constructed according to the relevant engineering standards. However many women express their reluctance to be involved in projects where they have to relocate internationally due to family responsibilities and this hinders their career advancement opportunities. Therefore, organisations need to transform their relocation policies by including more spousal and other family benefits to entice females for relocation purposes. These benefits could include securing suitable employment for spouses, sponsoring a significant portion of children's educational expenses and providing a housing subsidy. Even providing counselling would be beneficial to overcome the emotional stress caused due to relocation.

#### **5.4. Limitations of the study**

The study encountered various limitations that restricted the methodology and influenced the outcome of the findings and the conclusions. The various methods to solve these challenges are discussed under the recommendations for further studies. The limitations encountered during the investigation include the following:

- The results of the study were slightly affected when an error was encountered on Questionpro where the totals reflected 286 in the demographic section but only 285 respondents participated in the study. This occurred because some respondents clicked on the browser back button which affected the totals. This caused a minor difference to the results of the study and is negligible.
- The research methodology in Chapter 3 justified that it was appropriate to adopt the non-probability convenience and snowball sampling techniques for this study. However, this sampling technique made it impossible to confidently generalise the research findings to reflect the perceptions of the entire population of female engineers.
- The Likert scale was the preferred scale for the majority of the questions on the measurement instrument. Even though this scale is effective in measuring perceptions, it still lacks variability in its selection of options. Therefore, respondents were unable to clarify their level of agreement or disagreement to the questionnaire statements and this affected the accuracy in arriving at the conclusions.

#### **5.5. Recommendations for further research**

Specific courses of action for further research are urged, based on the findings of this study, in conjunction with the limitations identified and in response to the research questions. The recommendations for further research on female engineer's gender discrimination experiences include the following:

- The majority of the respondents had civil engineering qualifications while other respondents belonged to the main branches of engineering. Gender discrimination barriers of female engineers in other branches of engineering such as mining, computer, electronic engineering etc. should also be investigated.



- It would be significant to establish whether female engineers that occupy different management levels (e.g. junior management, senior management etc.) experience unique types of discrimination.
- The study only incorporated the sampling frame from female engineers residing in the KwaZulu-Natal region and who were registered on the ECSA database. The study should be replicated at provincial and national level in order to improve gender equality of female engineers across South Africa.
- Probability sampling techniques should be adopted for future studies to ensure that the conclusions drawn from the findings are more reliable and are accurately generalised to the entire population.
- This study only investigated gender discrimination barriers related to unequal organisational policies and practices. Other factors that contribute to gender discrimination in the engineering profession should also be investigated further. Some of these factors could include family or society's influence on females pursuing a career in engineering as this contributes to their recruitment and retention in the profession.
- Future research can identify or investigate any new initiatives that organisations are undertaking to cater for the career advancement needs of female engineers.

## **5.6. Conclusion**

The research questions and objectives presented in this study have been adequately addressed. Regardless of the limitations encountered, it indicated that to a certain extent that gender discrimination still prevails in the engineering profession. It is important to acknowledge from the findings of the study that female engineers believe that they need to overachieve to receive recognition, gender discrimination causes them to experience emotional stress, gender pay disparities still exist and women are not receiving adequate organisational support to balance their work and family responsibilities. The study provided seven relevant recommendations to overcome the gender inequalities that female engineers experience in their work environments. It is evident from the study that women's basic human rights are violated when they experience gender discrimination and organisations need to implement significant strategies and policies to promote gender equality in the engineering profession.

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**Appendix 1**  
**Informed Consent Letter and Questionnaire**

**UNIVERSITY OF KWAZULU-NATAL**  
**GRADUATE SCHOOL OF BUSINESS AND LEADERSHIP**

Dear Respondent,

**MBA Research Project**

**Researcher:** Rozeena Brijbans (0836855451)

**Supervisor:** Prof AneshManiraj Singh (031-2602675)

**Research Office:** Ms P Ximba 031-2603587

I, Rozeena Brijbans an MBA student, at the Graduate School of Business and Leadership, of the University of KwaZulu Natal invites you to participate in a research project entitled Female engineers perceptions of gender discrimination. The aim of this study is to identify if female engineers really do experience gender discrimination in the engineering profession.

Through your participation I hope to understand if gender discrimination really exists in the engineering profession. This aim will be achieved by measuring female engineers perceptions of gender discrimination

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this survey. Confidentiality and anonymity of records identifying you as a participant will be maintained by the Graduate School of Business and Leadership, UKZN.

If you have any questions or concerns about completing the questionnaire or about participating in this study, you may contact me or my supervisor at the numbers listed above.

The survey should take you about 15 minutes to complete. I hope you will take the time to complete this survey. If you consent to participating in this survey please click on the **AGREE** and **CONTINUE** button and you will be directed to the questionnaire and if you do not agree to participate then please click on the exit survey button and you will be exited from the survey.

Sincerely  
Rozeena Brijbans  
^^

**I Agree**

**1. Age \***

- Below 25     25-34     35-44     45-54     55 and over

**2. Marital Status\***

- Married     Single     Widowed     Divorced

**3. Number of dependents \***

- 1 and below     2     3     4     >4

**4. Race \***

- Black     Indian     White     Coloured

**5. Highest level of education \***

- Matric  
 Diploma  
 Bachelors  
 Honours/ Postgraduate Diploma  
 Masters  
 Doctorate  
 Other (Please Specify)

**6. Your qualification falls under which branch of engineering \***

- Civil  
 Industrial  
 Chemical  
 Electrical  
 Mechanical  
 Mining  
 Other (Please Specify)

**7. What is your registration category \***

- Professional Engineer
- Professional Engineering Technologist
- Professional Engineering Technician
- Candidate Engineer
- Candidate Engineering Technologist
- Candidate Engineering Technician
- Other (Please Specify)

**8. What sector does your organization fall \***

- Private
- Public
- NGO's
- Tertiary
- Other (Please Specify)

**9. Level in the organization \***

- First-line/  
Junior  
Management
- Middle  
Management
- Senior/Top  
Management
- Non-  
management

**10. How many subordinates do you have in your area of responsibility \***

- Below 5
- 5-10
- 11-16
- Over 16

**11. Work experience in years \***

- Below 5
- 5-10
- 11-16
- Over 16

**12. Do you manage engineering projects \***

- Yes
- No

**13. I feel gender discriminated against in the allocation of project management roles \***

- Strongly Disagree
- Disagree
- Undecided
- Agree
- Strongly Agree

**14. I am comfortable managing a multi-gender team \***

- Strongly Disagree
- Disagree
- Undecided
- Agree
- Strongly Agree

**15. I have the professional capabilities to hold project management positions \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**16. My task orientated leadership style is not appreciated by my male colleagues \***

N/A  Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**17. I have to explain my rationale more often than my male counterparts for obtaining project resources \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**18. I prefer to communicate directly with project stakeholders rather than using technology \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**19. I have been discriminated from managing projects because of my gender \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**20. If given the opportunity, I would be able to manage projects immediately \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**21. More male than female engineers hold project management positions in my organization \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**22. I am not respected by my superiors \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree



**23. I am not respected by my peers \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**24. I am not respected by my subordinates \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**25. I do not want to work overtime due to family responsibilities \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**26. I do not receive adequate organizational support to manage my professional and family responsibilities \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**27. I have to overachieve to receive recognition at work because I am female \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**28. I am not remunerated fairly in comparison to my male counterparts based on my work experience and engineering registration category \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**29. Gender discrimination in the workplace makes me feel angry \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**30. Gender discrimination in the workplace makes me feel undervalued \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**31. Gender discrimination in the workplace makes me feel depressed \***

Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**32. Rank the following job characteristics that would make you feel less gender discriminated if they were implemented, were 1 is most important and 8 is least important to you \***

- a. Equal recognition
- b. Respect from my peers
- c. Respect from my superiors
- d. Respect from my subordinates
- e. Equal remuneration
- f. Flexi-time for work/life balance
- g. Assigned with large-scale projects
- h. Promotional opportunities

Rank values must be between 1 and 8

**33. I am marginalized when trying to participate in male networks \***

- Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**34. There are insufficient female role models and mentors in the engineering profession to provide me with career support \***

- Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**35. I receive fewer training opportunities for career development than my male counterparts \***

- Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**36. I am mainly assigned to manage smaller, low-cost projects \***

- Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**37. I am reluctant to relocate for international project assignments \***

- Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**38. I am not advancing in my career \***

- Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**39. My gender has an influence on my selection for promotions \***

- Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**40. My work experience is not considered when I apply for promotions \***

- Strongly Disagree  Disagree  Undecided  Agree  Strongly Agree

**41. Rank the changes you are willing to make in order to be considered for promotions where 1 you are most willing and 6 you are least willing \***

a. Apply for promotions

b. Work overtime

c. Manage larger projects

d. Relocate if required

e. Participate in activities that make me visible

f. Undergo relevant training and development

Rank values must be between 1 and 6

**42. Do you have any suggestions to reduce gender discrimination in the engineering profession \***

Yes

No

**43. Please specify your suggestions to reduce gender discrimination in the engineering profession \***

## Appendix 2

### Ethical Clearance



27 May 2015

Ms Rozeena Brijbans (213549672)  
Graduate School of Business & Leadership  
Westville Campus

Dear Ms Brijbans,

Protocol reference number: HSS/0336/015M  
New project title: Female engineers perceptions of gender discrimination

#### Approval Notification – Amendment Application

This letter serves to notify you that your request for an amendment received on 25 May 2015 has now been approved as follows:

- Amendment to Questionnaire (Demographic Section)

Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form; Title of the Project, Location of the Study must be reviewed and approved through an amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

Best wishes for the successful completion of your research protocol.

Yours faithfully

Dr Shenuka Singh (Chair)

/ms

Cc Supervisor: Prof Anesh M Singh  
Cc Academic Leader Research: Dr M Hoque  
Cc School Administrator: Ms Zarina Bullyraj / Ms Gina Mshengu

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Humanities & Social Sciences Research Ethics Committee

Dr Shenuka Singh (Chair)

Westville Campus, Govan Mbeki Building

Postal Address: Private Bag X54001, Durban 4000

Telephone: +27 (0) 31 260 3587/8350/4557 Facsimile: +27 (0) 31 260 4609 Email: [ximbao@ukzn.ac.za](mailto:ximbao@ukzn.ac.za) / [snvmanm@ukzn.ac.za](mailto:snvmanm@ukzn.ac.za) / [mohunn@ukzn.ac.za](mailto:mohunn@ukzn.ac.za)

Website: [www.ukzn.ac.za](http://www.ukzn.ac.za)

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**Appendix 3**  
**Editors Certificate**

**Jeanne Enslin**  
**Freelance language practitioner**

17 York Close  
PARKLANDS  
7441

21 June 2015

**Proof of language editing**

I, Jeanne Enslin, acknowledge that I did the language editing of **Rozeena Brijbans'** dissertation submitted in partial fulfilment for the degree of Master of Business Administration.

The title of the dissertation is:

Female engineers perceptions of gender discrimination.

If any text changes are made to the electronic document which I sent to Rozeena Brijbans on 21 June 2015, it needs to be returned to me to check the language of the changes. Technical editing, formatting and checking of references were done by Ronel Gallie, the technical editor.



**Jeanne Enslin**  
**Language editor**  
082 696 1224



**Ronel Gallie**  
**Technical editor**  
084 7780 292

# Appendix 4

## Turnitin Report

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