# WHY NOT ACADEMIA? – THE STREAMLINED CAREER CHOICE PROCESS OF BLACK AFRICAN WOMEN ENGINEERS: A GROUNDED THEORY STUDY

By

Yeukai Angela Mlambo

# A DISSERTATION

Submitted to Michigan State University in partial fulfillment of the requirements for the degree of

Higher, Adult, and Lifelong Education - Doctor of Philosophy

## ABSTRACT

# WHY NOT ACADEMIA? – THE STREAMLINED CAREER CHOICE PROCESS OF BLACK AFRICAN WOMEN ENGINEERS: A GROUNDED THEORY STUDY

By

#### Yeukai Angela Mlambo

Black African women are grossly underrepresented as academic staff in engineering programs at South African universities. The problem is exacerbated at historically White institutions (HWI) where Black women are simply absent as engineering research and teaching staff. The absence of Black African women in the academy occurs despite Black African women enrolling and graduating with engineering postgraduate degrees making them eligible for academic jobs. Furthermore, despite Black African women representing the largest population in South Africa at 41% of the population overall, and affirmative action policies in place, engineering academic spaces remain predominantly White and male, not representative of the country's population. In fact White women are overrepresented in engineering academe and in some cases White women are the only female presence in engineering higher education employment. If Black African women are graduating with engineering degrees why are they not equally represented in engineering academe as their White female counterparts? How can the absence of Black African women engineering academics be explained?

I use Charmaz's constructivist grounded theory (CGT) to understand the career choice processes of Black African engineering alumni women in South Africa to explain why their career choices thus far have not included the academy. Approaching the research from a social constructivist paradigm, loosely guided by a conceptual framework of African feminism(s) and CGT, and borrowing from life history interview methods this study addresses the underrepresentation of Black African women in engineering academe. Findings indicate Black African women's career choices in engineering are driven by prospects of socio-economic mobility and family/community responsibilities, a product of historical circumstances during apartheid that created social inequalities with Black families relegated to lower socio-economic statuses. In this study career choices were heavily influenced by teachers in pre-tertiary schooling, student academic competencies in mathematics and science, and industry practices that included providing bursary funds to only support engineering higher education endeavors, thereby dictating to students from low income households which careers to pursue especially in cases where the absence of such funding meant one would not be able to afford university costs. The academy as made up of older White males also created the perception that it was not a place for Black women. The combination of the factors influencing career choices in school and the image of the academy as an unwelcoming space for Black women's absence in South African engineering academia.

Postsecondary institutional leaders should work on changing the image of the academy and marketing it as a career option for students in pre-tertiary and postsecondary education.

Institutional culture and representation needs to reflect the diverse student population while actively working to ensure all students, academic and administrative staff feels welcome and valued. More importantly financial resources need to be made available and leveraged to support Black African women's education in a bursary-style format to encourage more Black women to follow academic career pathways. Copyright by YEUKAI ANGELA MLAMBO 2017

#### ACKNOWLEDGEMENTS

All my accomplishments directly reflect the phrase "it takes a village." Throughout my childhood in Zimbabwe, moving to South Africa and then to the United States, every personal and professional endeavor I have been privileged to pursue has been because of the unwavering support, sacrifices, and resources put forward by the people who constitute my village of support. This Ph.D. was possible because of the time and effort put in by so many people including my family members (immediate and extended), friends, colleagues, professors, mentors, the amazing Black women who served as co-researchers in creating this work and most importantly God who has truly blessed me allowing me to accomplish everything I state and claim I will do.

I dedicate this dissertation to three important people from my village of support that I lost along this Ph.D. journey and whose home going ceremonies I was unable to attend because of my school commitments. First Mr. A (Uncle Anthony Ndoro) who was always the first to call my sister and I the moment we walked back into the house from boarding school excited to hear how the term went and to reward our hard work. You had the greatest heart and believed in me so much that I grew up knowing I could become anything I wanted because you said so. Second, Leonard Chitumba – you were a great brother and friend and I remember you being there for every graduation and all the parties you threw for me when I came home during this Ph.D. Your never ending support and brotherly pride kept me going and I hope I can be there for your children like you were for me. Finally, Dr. Elaine Salo – words cannot begin to explain how your mentorship and support was literally the reason I am where I am today. You silently fought your battle with cancer even as you were writing my reference letters for graduate school, involving

v

me in research projects, reading drafts of my work and most importantly leveraging your networks to help me get into graduate school in the United States while you were back in South Africa. This Ph.D. is for these two he-roes and my she-ro – I hope I made you proud.

To my immediate family, my father Professor Alois Mlambo, my mother Mrs. Emilia Rosemary Mlambo, my brother Brian and my BFF sister Chipo. You are my backbone and I live for you all. You allowed me to take this very selfish journey to move across the world and took over my responsibilities because you believed in me. I owe you everything. To my mother who I grew up watching doing so much in a culture of patriarchy with little recognition, you inspire my life's work. Thank you for ALWAYS being present and for fighting to make sure we have every opportunity in the world that you were not able to have. Your amazing heart, your personal sacrifices and your street smarts, hard work and support for everything we do is beyond reproach. This Ph.D. is ours – you earned this doctorate with me Dr. Amai.

To my chair Dr. Brendan Cantwell, thank you for taking over, for supporting my ideas and my work and for embracing the workaholic that I am throughout this process. Your ability to provide direction while also allowing me enough freedom to craft my own academic journey has helped me to grow as a scholar and to begin to believe in my abilities more. Thank you. To my committee members, Dr. Terah Venzant-Chambers your support outside of academic spaces is just as meaningful as the intellectual considerations you have encouraged throughout this process. You are thoughtful and sincere and the ultimate cheerleader, I am blessed to have you. Dr. Kris Renn, your ability to see the bigger narrative and your expertise on women in higher education has been invaluable in my research and I will continue to channel your ideas about brevity in writing as I continue my professional journey. Dr. Nwando Achebe, you have become a great mentor and sister-friend. I am thankful that I took your class and was able to receive your

vi

knowledge and guidance regarding researching African women. You are a brilliant scholar and person and your support does not go unnoticed. When I grow up I want to be just like you!

To my mentor Prof. Reitumetse Obakeng Mabokela – I recall being introduced to you 5 years ago. You immediately picked up your phone and called me to talk to me about applying for graduate school. You volunteered to help me with my application packets for all the other schools I was considering and asked only that I consider Michigan State University in return. Admittedly I applied out of a sense of obligation to you but when I look back – I was meant to be here. Thank you for being my pillar of strength these past 4 years, for understanding that as a Southern African Black woman who had no prior educational experience in the U.S., I would need a mentor, an auntie, a sister, a friend. You have been all these and more – you have been my family in Michigan, my confidant and my writing partner – always willing to indulge the next research project I propose – I appreciate you for trusting me. Because of your faith in me – I stand a little taller everyday and I am forever grateful.

Dr. Christa Porter – few words can describe who you have been throughout this academic journey. For always having an open door, for the non-judgmental love you gave through the highs and the lows – you are beyond amazing. You willingly reviewed my chapters and provided feedback – as the grounded theory expert at hand – I know this dissertation would not have been possible without you. Although the system did not allow you to serve on my committee – you read every word of this dissertation regardless. You are my Ph.D. MVP!

Karla Bellingar – your transcribing skills are bar none – I would not have been able to do any of this without you. Not only did you provide timely services, you also let me borrow your recording equipment all summer, sent encouraging messages along the way and continue to be a great friend.

vii

To my many friends in Zimbabwe, South Africa, the United States, and the United Kingdom – no one is as blessed as I am. God has truly blessed me with people who are always there for me, who know how to get me out of a bad space, who are so proud of me it forces me to act like I know a thing or two – and who did not let me lose myself these past 4 years. While I am thankful for everyone I would be remise if I didn't shout out a few people – my best friends Fadzai Masimba, Ngony Chikomba, Vimbayi Maswoswe, Farisai Matizamhuka & Tendai Motsi- you lot are the family I created for myself and I couldn't have picked better people. My dear friend Sapna Naik -I love you for being genuine, sincere and for seeing the silver lining in everything. You have literally read just about every draft of every thing I have written – able to calm my self-doubts and remind me that I am capable. Thank you for these past 4 years. Joy Hannibal, thank you for your support and prayers and friendship and for being my family. Finally to a person I count as my sister-friend Qiana Green – girl – this journey would have been so hard without you. Thank you for making me laugh on the worst days and for being real with me at all times. You showed me that as long as you need support – the people who care will always show up. Thank you for showing up.

To my family members in every part of the world –my uncles, aunties, cousins, sisters, sons and daughters – I am because of you. To my U.S. family you made this process of being away from my family so much better – first and foremost the Ruzvidzo's in Texas – you opened up your home to me when all I had was a suitcase (or two) and prayed with and for me - you are always going to be home for me, and my babies Bekka and Josh will always have a home with me. You have taught me the true meaning of community and that helping other people find their feet is a gift you give free of charge – I will be paying this forward. My Mainini Tsitsi and your family in Virginia – I can never thank you enough for all your support. To my Dallas crew –

viii

Star, Amanda, Linda & Lisu – you know we're forever people now. Thank you for embracing me into the fold when I was new to the area and for becoming my family. You are beautiful and strong women and I promise to always show up for you like you have for me.

Last but not least I would like to thank myself – for persevering through the hard times, for waking up everyday for so I could do this for myself. For deciding that I was worthy of the best life has to offer, for learning to trust myself again and to silence the inner voice that tries to tell me I am not good enough. This Ph.D. process has been a journey of self-discovery – there were many highs and many lows but I made it and I know that I AM ENOUGH. I am proud of myself for accomplishing what I set out to do and I know now that I am capable and NO ONE gets to define me but me. This Ph.D. is for my village and it is also for me. I am Dr. Yeukai Angela Mlambo.

Finally I thank the wonderful women who shared their stories with me. You show the world that despite our absence in academia, Black women are indeed thriving in other engineering spaces. Your stories are empowering and helped me remember that as Black woman, we exude excellence. You have paved the way for other Black African women to pursue professions we are often told we do not belong in. Your lives are living testimonies and I hope this work has reflected them appropriately.

Lastly I acknowledge the funding support I received from the Dean of the College of Education, the Department of Educational Administration (Higher, Adult & Lifelong Education program), and the Graduate School at Michigan State University to support my Ph.D. through the 5-year Dean's Scholar Award and the Graduate Assistantship, and my research through the Dissertation Completion Fellowship and other funding resources received throughout the past 4 years.

ix

# **TABLE OF CONTENTS**

LIST OF TABLES	xiv
LIST OF FIGURES	XV
Chapter 1: Introduction	1
Statement of the Problem	
Underrepresentation of Black African Women Engineering Academics	
Background to South African Higher Education	7
Current Context of Higher Education in South Africa	
Purpose Statement	
Pipeline vs. Pathway Metaphors	
Importance of Study	
Research Questions	
Definition of Terms	
STEM/SET/STI	20
Postgraduate	
Academic Staff	
Faculty	
Industry	
Career	22
Summary of Dissertation	
Chapter 2: Literature Review	
History of Race and Gender Exclusion in Engineering	
Global Underrepresentation of Women in Higher Education	
Reasons for the Underrepresentation of Women in Higher Education	
Work-life balance	
Sexual harassment	
"Paradox of visibility": Women as minority	
Lack of mentorship and networks	
Women in Higher Education in South Africa	
Socialization Factors	
Men as Gatekeepers	
Vestiges of Apartheid	
Black Women (and Ethnic Minorities) in Higher Education Globally	
Defining Minority	
Black Minority Experiences in the United States and the United Kingdom	
Unwelcoming nature of higher education	
Devaluing of minority women	
Black Women in South African Higher Education	
"Donkeys of the university"	
Intersection of Race, Gender, and Rank	
Effects of Apartheid	

Black Students in South African Higher Education	45
Limited Sense of Belonging	45
Feelings of Exclusion	46
Women in STEM Globally	47
Contextualizing Women's Underrepresentation in STEM	47
Career Decision-Making of Women in Science and Engineering	49
Workplace considerations	49
Mentorship and female role models	50
Alternative opportunities	50
Women in STEM in South Africa	51
Women Opt Out of Engineering	52
Career Barriers	53
Sexism in the workplace	53
Male discomfort and proving oneself	54
Black Women and Minorities in STEM Globally	55
Discriminatory Institutional Culture and Structures	55
Absence of Role Models and Mentors	56
Black Women in STEM in South Africa	57
Factors Influencing Black South African Student's Career Decision-making	58
Socio-cultural considerations	58
Family influence	59
Anticipated material benefits	59
Disheartened with school	60
Concluding Remarks	61
Chapter 3: Methods	63
Research Paradigm and Epistemological Framework	64
Appropriateness of Research Design	65
Research Design and Methodological and Analytical Framework	66
Tenets of Grounded Theory and Two Schools of Thought	67
Benefits and Risks of Grounded Theory	69
Constructivist Grounded Theory	69
Conceptual Framework	70
African Feminism(s)	71
Constructivist Grounded Theory and African Feminisms	75
Research Design	78
Research Sites and Sampling	79
Selection of Research Sites	79
Sampling and Recruitment	82
Purposive sampling	82
Snowball sampling	84
Engaging with institutional gatekeepers and participants	88
Data Collection Methods	89
Semi-structured Interviews	90
Life history interviewing	91
	02

Analysis	
Trustworthiness	
Credibility	
Resonance	
Originality	
Usefulness	
Researcher Positionality	
Ethical Considerations	
Ethics Approval	
Informed Consent	
Confidentiality	
Concluding Remarks	
Chapter 4. Findings	103
I Early Phase: Receiving and Internalizing	105
Pre-choice Exposure	107
Teacher Influence	
Developed Ideas About Engineering	
Selecting School Subjects	
Industry Description Drasticos	
III Middle Dhege: "Make it work" Utilizing One's Desitionality	
I. Midule Flase. Make it work - Othizing One's Positionality	121
Linking Choice to Personality	
Surviving as a minority	
Fulling industry Obligations	
Capitalizing on Job Opportunities	
Money and Family Responsibilities	
Leveraging Mentors	
Developing Ideas About Academia	
Investing in Self-development	
III. Late: Branching Out	
Switching Jobs	153
Pursuing Non-engineering Avenues	
Recognize Changes in Career Desires	157
IV: Future: Thinking Ahead	
Future Aspirations	161
Establishing a Legacy	
Academia as a Way to "Give back"	
Chapter 5: Streamlined Career Choice Model	
Summary of Streamlined Career Choice Model	
I – Early Phase: Receiving and Internalizing	
II - Middle Phase: "Make it work" - Utilizing One's Positionality	
III - Late Phase: Branching Out	
IV- Future Phase: Thinking Ahead	
Concluding Remarks	

Chapter 6: Discussion, Implications and Conclusion	
Current Socio-political Context	
Discussion Of Emerging Theory In Relation To Research Questions	
How Did the Women Make Career Choices?	
What Factors Have Influenced Their Career Choices?	
Why Have Their Career Choices Not Included Academia?	195
Relationship Of Grounded Theory Findings To Literature	
Factors Influencing Career Choices of Black Women	
Industry Bursaries Streamlining Careers in Industry	
Career Choice as Strategically Constrained Individual Agency	
Why Not Academia?	
Implications	
Implications for Theory	
Implications for Practice	
Career planning programs	
Higher education career planning	
Socialization in higher education	
Funding higher education	
Implications for Future Research	
Study Constraints and Considerations for Future Research	
Strengths Of The Study	
Conclusion	
APPENDICES	
Appendix A: Interview Agendas and Recruitment Letters	
Appendix B: Gatekeeper Letter	
DEEEDENCES	224
KEFERENCES	

# LIST OF TABLES

Table 1: Enrollment figures, Bachelor's degrees in engineering (BEng/BSc Eng), 2007	3
Table 2: Categories of public universities in South Africa	9
Table 3: Staffing composition at South African public higher education institutions, by race and gender and rank	l 9
Table 4: Participant provincial research site affiliation         8	30
Table 5: Summary of participant demographics    8	31
Table 6: Participant demographics	36
Table 7: Axial-coding categories organizing scheme    9	<del>)</del> 6
Table 8: Themes and sub-themes	57

# LIST OF FIGURES

Figure 1: Female Engineering Undergraduate and Postgraduate Graduating Students, by Race/Ethnicity (2010-2014)
Figure 2: Female Engineering Graduates With Postgraduate Qualifications, By Race/Ethnicity (2010-2014)
Figure 3: Pipeline Representation for STEM Eligible Students from Matric to University 13
Figure 4: Pipeline Representation of Math and Science Matric Students Eligible for University Entry
Figure 5: The Link Between the Different Frameworks Constituting the Conceptual Framework
Figure 6: Illustration of Grounded Theory Research Process
Figure 7: Model of Streamlined Career Choice Process of Black African, South African Women Engineers
Figure 8: Model of Streamlined Career Choice Process of Black African, South African Women Engineers - Model Summary
Figure 9: Interaction Between Events, Considerations, and Consequences in the Early Phase of Career Choice
Figure 10: Interaction Between Events, Considerations, and Consequences in the Middle Phase of Career Choice
Figure 11: Interaction Between Events, Considerations, and Consequences in the Late Phase of Career Choice
Figure 12: Interaction Between Events, Considerations, and Consequences in the Future Phase of Career Choice

## **Chapter 1: Introduction**

Black African women are noticeably absent among engineering academic staff in South Africa (Onishi, 2015). Despite representing 91.5% of the female population in South Africa and graduating with postgraduate engineering degrees at twice the rate of White women, Black<sup>1</sup> women collectively are absent in engineering academe, while White women are relatively overrepresented (Academy of Science South Africa [ASSAf], 2010; Statistics South Africa, 2014). In 2015 student protests began at the University of Cape Town and spread to other South African institutions under the trending social media hashtag "#RhodesMustFall" (Onishi, 2015). The protests were driven by student discontent at the lack of faculty diversity South African postsecondary institutions, continued low Black student gross enrollment representation among the student body, and the continued use of a Eurocentric curriculum in South African higher education (Onishi, 2015). The slow transformation in South African higher education remains an issue of contention, and engineering departments remain primarily White male spaces, an eerie resemblance of the apartheid era where engineering courses were reserved for White people (Case & Jawitz, 2004; Cruise, 2011; Moshupi, 2013).

Empirical data on Black women in engineering are lacking but a perusal of institutional websites and conversations with engineering students within academic spaces confirm the underrepresentation of Black African women. Over twenty years after the end of apartheid, engineering departments at historically White universities<sup>2</sup>, such as the University of Pretoria and the University of Cape Town, still do not have any senior Black South African, women

<sup>&</sup>lt;sup>1</sup> Black in South Africa refers to those of African, Indian, and Colored descent as used by the South African government. The use of these labels in no way intends to replicate apartheid era oppression from which these labels were created. Black African is used to refer to those of African descent in this study while Black refers to all non-White people in the South African context. Black in other contexts is used to refer to those of African descent in other contexts.

<sup>&</sup>lt;sup>2</sup> Historically White Institutions refers to institutions that were reserved for white students during apartheid and as a result had primarily White students and institutional leaders.

academic staff members (Mlambo, 2011; Mlambo & Mabokela, 2016; Onishi, 2015). This lack of representation in engineering academic spaces is alarming in South Africa where Black African women represent the largest demographic group at 41% of the overall population (Statistics South Africa, 2014). The gross underrepresentation of Black women academic staff in engineering remains even though institutions are required to aggressively pursue transformation initiatives (Badat, 2010; Department of Education, 1997) and despite the presence of affirmative action policies (Republic of South Africa, 1998). Given these safeguards, how can the absence of Black African women engineering academics be explained?

#### **Statement of the Problem**

South African experts warn that should South Africa fail to broaden the academic workforce to include more Black and female academics, the country will continue to lag behind in publications and the regeneration of the academic workforce (City Press, 2014). In addition, the absence of Black women in engineering perpetuates apartheid era policies that excluded Black people and women from spaces of knowledge creation, further contributing to the disenfranchisement of the majority Black population in South Africa. The continued absence of Black African women in engineering academia will deter other Black African women from academic careers hindering the transformation of engineering towards better reflecting the South African population.

This study addresses Black African women's absence in engineering academe. As important sites of knowledge production influencing the direction of any country, the absence of Black people and Black African women among the South African professoriate is worrisome for equity in development and requires immediate attention (Mangcu, 2014a). Failure to understand Black African women's career choices will likely perpetuate existing stock narratives and

unsuccessful strategies to attract Black women to academe, which "has considerable significance for the present and future profile of the professoriate" (Jaeger, Haley, Ampaw, & Levin, 2013, p. 2), knowledge creation, and national development.

Most recent government data from 2014 show Black people and women account for 48% and 46%, respectively, of the overall number of all 18,233 academic staff in South African higher education (Department of Higher Education and Training [DHET], 2016). These overall figures mask the fact that Black Africans represented only 4% of professors, with Black African women accounting for 0.85% of all South African professors (Mangcu, 2014b). In terms of certain faculties like engineering, Black African women in particular are noticeably absent. The absence of Black African women in engineering is juxtaposed against the increasing presence of Black African women enrolling and graduating with engineering undergraduate and postgraduate qualifications. Table 1 shows 2007 Bachelor's degree enrollment figures of students in engineering in South African public universities.

	Black African	Coloured	Indian	White
Male	3547	412	2547	5268
Female	1028	187	978	1126
Total	4575	599	3525	6394

Table 1: Enrollment figures, Bachelor's degrees in engineering (BEng/BSc Eng), 2007

 (Adapted from Fisher, 2011)

The table shows that despite engineering continuing to be a White male dominated field, Black African women enroll in engineering undergraduate degrees at relatively the same rate as White women. When graduation rates are scrutinized, over a five-year period (2010 - 2014) more Black African women graduated with both undergraduate and postgraduate qualifications than White women (see Figure 1).



Figure 1: Female Engineering Undergraduate and Postgraduate Graduating Students, by Race/Ethnicity (2010-2014) *Source: Personal communication, 2015* 

A focus on postgraduate level rates show that in the same five year period Black African

women accounted for 48% of all female postgraduate engineering qualifications, with White

women making up 37% (Personal communication, 2015; see Figure 2).



Figure 2: Female Engineering Graduates With Postgraduate Qualifications, By Race/Ethnicity (2010-2014)

Despite higher graduation rates compared to White women, Black African women are noticeably absent among academic engineering staff. For example, in the case of the University of Pretoria, a prestigious traditional historically White institution, White women are the only female presence in engineering academic employment (Mlambo, 2011). The question arises, if Black women are enrolling in and graduating from engineering degrees, why are they not represented as academic staff?

#### **Underrepresentation of Black African Women Engineering Academics**

Institutional administrators attribute the absence of Black women in academia to the lack of qualified Black women eligible for academic staff positions (Mabokela, 2000; Portnoi, 2003; Price, 2014; Salo, Liersch, Mohlakoana-Motopi, & Maree, 2014). The idea of unqualified Black women appears in research highlighting beliefs about Black students as academically incapable of completing doctoral programs (Herman, 2011). In terms of their absence in science, technology, engineering and mathematics (STEM) fields, institutional administrators say their institutions are ill equipped to compete with the high salaries Black people desire as offered by the private sector (ASSAf, 2010; Salo et al., 2014). Critical race theory scholars describe such explanations as stock narratives (Martinez, 2014), which are the stories

People in dominant positions collectively form and tell about themselves. The stories choose among available facts to present a picture of the world that best fits and supports positions of relative power. Stock stories feign neutrality at all costs and avoid any blame or responsibility for societal inequality (p. 38).

Stock narratives are problematic because they perpetuate deficit perspectives about Black women while absolving institutions and institutional actors of responsibility to change the inequitable status quo in higher education.

As highlighted in terms of qualifications, collectively Black women receive more STEM postgraduate degrees than White women (ASSAf, 2010). Research also shows most historically disadvantaged students, including Black African women, are not motivated by high salaries in industry as a prominent factor when considering careers in the academy (Portnoi, 2009a). A 1998 (Jawitz & Case) study to determine the reasons South African students give for studying engineering found that collectively Black women were motivated more by social identity than the financial rewards of the job. Social identity was defined as "making contributions to the community or country" (Jawitz & Case, 1998, p. 237). While the findings are dated, with choice of engineering major used as a proxy for career choice, they reflect the way some Black women were thinking about careers in the few years after the end of apartheid. Arguably, the immediate years after the end of apartheid would result in a greater desire for well-paying occupations for people who had been previously denied such opportunities.

In light of this, alternative explanations need to be explored to better understand the absence of Black women in engineering academe today. Salo et al. (2014) provide one explanation linking the underrepresentation of Black women in science, engineering, and technology (SET)<sup>3</sup> to the post-apartheid South African socio-political context and the vestiges of apartheid racism and sexism that permeate both SET and higher education spaces. As this study is guided by a social constructivist paradigm, which is discussed in Chapter 3, the socio-political, cultural, and economic contexts of South African society are important. Therefore an understanding of the history of higher education in South Africa is an insightful place to begin to understand Black African women engineer's career choices.

<sup>&</sup>lt;sup>3</sup> SET majors include majors in Engineering, Health Sciences, Life Sciences, Physical Sciences, Computer Sciences and Mathematical Sciences.

# **Background to South African Higher Education**

Prior to 1994, under the apartheid government's Extension of University Education Act of 1959, access to higher education was segregated with each racial and ethnic group having designated postsecondary institutions they could attend (Reddy, 2004). Black students could only attend institutions reserved for Whites with special permission from the Minister of Education (Reddy, 2004). The Extension Act also instituted separate and unequal governing, funding, administrative and racially defined departments of education to manage the universities and technikons (postsecondary institutions providing technical education) (Menon, 2015). In the same way the Bantu Education Act of 1953 limited the educational opportunities of Black South Africans in pre-tertiary schooling, the Extension Act ensured racial divisions in the higher education sector. As I will elucidate in the chapters to follow, racism and sexism have hindered the participation of Black people and Black African women in engineering fields in particular.

The end of apartheid in 1994 marked the beginning of transitions in the education system to a situation where education policies sought to unite the previously divided system in an effort to redress the racial discrimination of apartheid education (Thomas, 1996). Immediately before the 1994 elections the African National Congress (ANC) compiled a comprehensive policy framework for education (ANC, 1994). Among some of the key issues presented was the unequal access for staff and students in relation to race and gender (Odhav, 2009). Subsequent higher education policies including the Education White Paper 3 (Department of Education, 1997) and the National Plan for Higher Education (Ministry of Education, 2001) articulated more directly the issues of women and Black people's access to higher education (Mabokela & Mlambo, *inpress*).

The White Paper (Department of Education, 1997) highlighted inequalities in access for students and academic staff in terms of race, class, gender, and the geographical location of rural dwellers. The White Paper stated, "unlike the changing student profile, especially in undergraduate programmes, the composition of staff in higher education fails to reflect demographic realities. Black people and women are severely underrepresented, especially in senior academic and management positions" (Department of Education, 1997, Section 2.94).

The National Plan for Higher Education (Ministry of Education, 2001) served as an implementation framework for the ideas of transformation articulated in the White Paper. The National Plan addressed five policy goals including to "promote equity of access and redress past inequalities through ensuring that the staff and student profiles in higher education progressively reflect the demographic realities of South African society" (Ministry of Education, 2001, p. 12). South African higher education policies clearly value the need for higher education to be representative of the general South African population (Mabokela & Mlambo, *in-press*).

Although progress has been made in student representation in higher education, change to staff compositions in academic leadership is slow (Onishi, 2015). The issues identified with regards to staff composition in South African higher education in the early post-apartheid years continue to plague the academy more than twenty years later.

# **Current Context of Higher Education in South Africa**

South African higher education consists of 26 public universities, 3 of which were opened since 2014 (Mabokela & Mlambo, *in-press*). The 26 universities are grouped into 3 categories of traditional universities, comprehensive universities and universities of technology. The categories are based on the function of the institutional type as shown in Table 2.

Institutional Type	Number of	Function	
	Universities		
University of technology	6	Vocationally oriented (mostly diplomas,	
(mostly previously technikons)		some degrees)	
Comprehensive university	9	Academic and vocational education	
		(diplomas and degrees)	
Traditional university	11	Theoretically-oriented university degrees	

Table 2: Categories of public universities in South Africa. Source: DHET, 2016

The 26 public universities service almost 970,000 students with about 596,824 being inperson students and 372,331 students engaged in distance (correspondence) education (DHET, 2016). Black African students represent 68% of contact students, White 19%, Coloured 7% and Indian 5% (DHET, 2016). Women comprise 54% of the overall in-person students, with men making up 46% (DHET, 2016).

Although the higher education racial and gender composition overall favors Black Africans and women, most institutions have retained as a majority the race group the university historically served (Reddy, 2006). In addition to the racial composition of the majority student body remaining noticeably unchanged, academic staff compositions remain predominantly White with Black people largely occupying support staff positions as administrators or service staff (DHET, 2016). Table 3 shows the distribution of academic, administrative, and service staff who are Black and who are female in South African public universities. In a majority Black country academic staff is predominantly White.

	Academic Staff	Administrative Staff	Service Staff*
Total Permanent Staff	18,233	27,142	4,456
% of Black Staff	48%	69%	98%
% of Female Staff	46%	60%	43%

Table 3: Staffing composition at South African public higher education institutions, by race and gender and rank. *Source: DHET, 2016* 

\*Service staff includes cleaners, gardeners, security guards, and messengers who are not engaged in supervisory or administrative functions linked to an office.

In terms of STEM, 287,221 students are enrolled in SET<sup>4</sup> fields at South African public universities (DHET, 2016) representing the highest enrolled field of study nationally. The DHET does not disaggregate SET enrollment and graduation rates by race or gender. However, World Bank data show females represent 29% of graduates in engineering, manufacturing, and construction in South Africa higher education (World Bank, 2016). I argue that the number of females studying in these fields could be greater but require changes within the educational system to affect the pipelines and pathways into SET. Addressing higher education faculty composition is one way of responding to female underrepresentation in SET.

The South African higher education system is divided into undergraduate education (between 3-5 years in SET fields, depending on the program and institution) and post-graduate education comprising the Honors, Master's and, Doctorate degrees. Similar to other countries, doctoral degrees in South Africa are viewed as part of an individual's training for academic careers (Herman, 2010). However, in some disciplines in South Africa, including engineering, an Honors or Master's level degree is sufficient for one to be hired as a junior level lecturer (Mlambo, 2011). This means that socialization for academic careers extends to all postgraduate qualifications.

Scholars (Watson, Foxcroft, Horn, & Stead, 1997) explain the lack of younger and diverse faculty as a direct result of the apartheid years, which limited Black students' access to quality education. In 1993, Black students represented only 6.3% of higher education enrollments (Watson et al., 1997). In the same year, the ratio of Black to White students in engineering faculties was 1 to 148 (1:148) (Watson et al., 1997). Similar figures were apparent in

<sup>&</sup>lt;sup>4</sup> Mlambo & Mabokela (2016) note that SET fields include professional scientists, engineers, and computer analysts. In South Africa the Department of Science and Technology uses the acronym STI – Science, Technology, and Innovation to refer to fields of science, mathematics, innovation, and technology. SET is used interchangeably with STEM in this study.

the sciences as a whole, where White students occupied 67 enrollment positions for every single Black student (Watson et al., 1997).

Government policies to increase access and persistence of women in higher education have been successful in increasing women's enrollment in SET fields. Women's enrollment representation in science and engineering (S&E) fields has risen slightly from 45.1% in 2009 to 45.8% in 2013 (Council on Higher Education, 2016). Despite the growing numbers of women enrolling in, and graduating from STEM courses, few women pursue postgraduate degrees compared to their male counterparts (Perna, 2004). However, for the women who successfully pursue postgraduate degrees, the low representation in STEM academic fields like engineering indicates that postgraduate degrees do not necessarily lead to academic careers.

## **Purpose Statement**

The overarching purpose of this study is to understand the absence of Black African women as engineering academic staff. If South African institutions truly wish to transform, attracting and retaining Black women in higher education spaces is important. As engineering remains primarily White and male, the insights provided by Black African women in this study adds to knowledge creation in engineering higher education, contributing to overall country development. This study also contributes to scholarship on the raced-gendered nature of the leaky pipeline in STEM.

#### **Pipeline vs. Pathway Metaphors**

The leaky pipeline refers to the students lost at various stages along the STEM education to career path often beginning in "secondary school through university and on to a job in STEM" (Blickenstaff, 2005, p. 369). The low transfer of Black African women engineering graduates to the academic workplace is one component of the leaky pipeline. Students leak out of the pipeline

for a number of reasons, including losing interest in STEM while applying for university, changing majors once enrolled in STEM programs, or changing careers after graduating with a STEM degree (Blickenstaff, 2005).

The leaky pipeline is significant in South Africa, given the persistently low pass rates in mathematics and science in high school that influence eligibility into SET related university majors like engineering. In 2014, of the 532,660 students who wrote the Grade 12 Matric examination (South African high school exit exam), only 150,752 (28%) passed with the minimum requirements for a Bachelor's degree (Equal Education, 2015). When disaggregated further by race, 66.7% of White Matrics qualified to pursue university degrees and only 23.8% of Black Matrics achieved similar qualification (All Africa, 2016).

Figure 3 shows a simplified breakdown of those eligible for STEM by race/ethnicity as they progress through the pipeline from matric to university. Out of 100 students who wrote the Matric exam, 28 students passed with enough scores to apply for university entry. When disaggregated by race, of the 28 eligible students, 18.7 were White and 6.7 were Black (Black African, Indian, and Coloured) students. Clearly the number of Black students (African, Coloured, Indian) qualifying for higher education in South Africa is significantly smaller than White students.



## Figure 3: Pipeline Representation for STEM Eligible Students from Matric to University.

Closer analysis shows that the number of students who register for Matric examinations in mathematics and physical sciences subjects specifically – both required for pursuing engineering university degrees in South Africa has declined. Of the overall number of Matric examination takers (532,660) in 2014, 42% registered to write the mathematics exam with 31% registered to take the physical science exam (Equal Education, 2015). An estimated one in seven students passed mathematics with a 40% score or more, and about one in ten students passed physical science with a 40% score or more (Bisseker, 2015). Figure 4 shows a simplified breakdown of students registered for STEM required subjects eligible for university entry.

Universities set STEM entry requirements at a minimum of 50%, with some institutions requiring at least a 70% matric score in mathematics, and a 60% for science (O'donnell, 2011). Overall the number of students passing both mathematics and physical science with a 40% or more is miniscule (Bisseker, 2015). In addition to a significantly lower number of Black students

qualifying for university entry the low numbers of students eligible for STEM degrees overall means the number of potential future non-White academic staff is limited from the onset.



# Figure 4: Pipeline Representation of Math and Science Matric Students Eligible for University Entry.

In addition to the general racial disparities in qualifying for STEM-related university degrees, the leaky pipeline metaphor has also been described as a sexed process where women, in general, leak out more than men do, resulting in the sex imbalance in STEM (Blickenstaff, 2005). The metaphor also explains the underrepresentation of women of particular races. The pipeline metaphor assumes that the solution to underrepresentation is to increase the supply of Black women, which will ensure that a sufficient number of qualified Black women are available for hire (Blickenstaff, 2005). Although the pipeline metaphor remains the most widely used, not all researchers endorse the argument it puts forward. Fealing and Myers (2012) criticize the pipeline metaphor for focusing on increasing the supply of underrepresented groups while not

addressing the barriers imposed by environmental and institutional structures and cultures. Therefore, an alternative pathway metaphor exists.

The pathway metaphor states that women and minorities follow multiple routes towards STEM careers, and "the underlying problem is not the under-supply of graduates in science but barriers that undervalue these alternative routes taken by women and minorities" (Fealing & Myers, 2012, p. 9). Instead of pitting the two explanations against each other, I argue in order to achieve equity in engineering, both metaphors are useful. The pipeline metaphor alone is insufficient to understand the underrepresentation of Black African women in engineering academe. In order to have more Black African women, a sufficient recruitment pool is required, but in order to attract and retain them, an encouraging socio-political context and welcoming academic environment are essential. Understanding the experiences, thought processes, actions and meaning making of Black African women who graduated with engineering degrees and work in industry provides insights into career decision-making regarding the academy as a career option.

#### **Importance of Study**

An African proverb says, *if you educate a man you educate an individual, but if you educate a woman you educate a nation*. African communities' valuing of women stems from the view of women as caregivers and educators of children in their most formative years (Nyamidie, 1999). The education of girls and women has become a guiding narrative for discussions on development as is evidenced by Goal 3 of the United Nations (UN, 2015) millennium development goals (MDGs). The same goal of achieving gender equality through empowering all women and girls remains significant in the newly formulated Sustainable Development Goals (SDGs) (UNDP, 2015). Central to both goals is the persistence of inequalities in access to paid

employment and participation in public decision-making (UNDP, 2015). Ultimately discrimination against women and girls has detrimental effects for development (UNDP, 2015).

Increasing scientific innovation is important for national development and economic competitiveness (Department of Arts, Culture, Science and Technology [DACST], 1996; Kerby, 2012). The South African government's White Paper on Science and Technology (DACST, 1996) articulates the importance of innovation for the country to prosper. Gender scholars argue that increasing African women's participation in STEM fields can increase the continent's productivity (Choongo, 2014). The United Nations predicts that 2.5 million engineers are required in sub-Saharan Africa to achieve the millennium development goals of access to clean water and sanitation (UNESCO, 2013). However, women in Africa represent less than 20% of scientists and engineers, and "unless women are encouraged to pursue science-oriented disciplines, Africa will still lag behind over developing regions in terms of education, research and technology, since science can solve many economic, ecological and health problems faced by Africa" (African Women in Science and Engineering, 2015, para. 3). If STEM is a necessary tool for development, Black African women represent the underutilization of a valuable and available developmental resource (Ogude, Nevhutalu, & Reddy, 1997).

In South Africa and around the world, non-White women are "disproportionately represented and remain an untapped source of talent" in science and engineering (Reid, 2009, p. 4). Therefore, getting more Black African women into STEM knowledge creation spaces will contribute immensely to national advancement (Ong, 2010). It is important to note that, while useful, arguments for the inclusion of women and Black people in science presenting Black women as "a reserve labor force" (Luke, 2001, p. 103) are problematic. In such productivity-focused arguments, issues of Black women's inclusion are based in the overall potential value

accruing to the state. The value of Black African women as citizens of South Africa is presented as resting on their labor capabilities and contributions. Luke (2001) argues that through such narratives, there is no questioning of the historical or contemporary raced-gendered politics controlling educational institutions and society at large. Productivity-focused arguments shift the conversation away from the importance of empowering and recognizing Black African women as citizens of the state equally deserving of opportunities in environments free from racism and sexism.

In addition, the need to ensure that South Africa's development keeps up with global trends reflects Western neo-liberal ideals of international competitiveness impacting developing countries. The World Economic Forum (2014) defines international competitiveness as "the set of institutions, policies, and factors that determine the level of productivity of a country" (p. 4). International competitiveness promotes country comparisons, which lead to competition among nations to obtain and maintain relatively high levels of productivity. As a result of globalization, developing countries like South Africa are under pressure to be comparably the best (Johnson, 2015). However a productivity-focused agenda relegates a country's more immediate needs, such as growing unemployment and gender inequalities, to secondary status. There is no doubt that the final outcome of increasing participation of Black women in STEM fields is achieved regardless of the argument. However, the means do not necessarily justify the end goals when Black women are further dehumanized and advocated for as labor with no efforts to dismantle the raced-gendered injustices of social systems, structures of STEM fields, and higher education broadly.

Instead, research on Black African women in South African engineering is important because Black African women are often clustered into the groups of either 'women' or 'all non-

White' with their unique experiences as a distinct group not being sufficiently interrogated. In furthering the dehumanizing agenda, Black men and White women are often regarded as the universal racial and female subjects, respectively (Reid, 2009). The experiences articulated by White women in engineering (Mlambo, 2011; Mlambo & Mabokela, 2016) are not reflective of the lives of Black African women with intersecting identities in engineering academia where they are virtually non-existent (Crenshaw, 1989). Thus, research focusing on Black African women as a separate but also the largest racial group in a post-apartheid society is important.

Finally, there is a dearth in literature looking at the experiences of engineering graduates and alumni in relation to the academy as a career choice consideration. Most research on career choice or aspirations from South Africa use student selection of engineering majors in higher education as representative of career choice (Jawitz, Case, & Tshabalala, 2000; Reed & Case, 2003). Where women working in engineering were interviewed, conversations did not explore the women's higher educational experiences nor did they explore how those experiences influenced their current career paths (Du Plessis & Barkhuizen, 2015).

One study interviewed postgraduate students designated as special groups by the Employment Equity Act<sup>5</sup> about their experiences and vocational decisions while they were still enrolled in school (Portnoi, 2009b). While the pursuit of postgraduate studies was not directly viewed as a definite selection of a career path, the study assumed students were well informed of their future career considerations even before entering the workforce (Portnoi, 2009b). In addition, the study did not focus exclusively on Black African women in engineering, as it included Black males, White women, and students from various disciplines. Research shows that students in shortage specialties such as medicine (and arguably in engineering) change their

<sup>&</sup>lt;sup>5</sup> The South African Employment Equity Act designates Black people, women and those with disabilities as part of special groups (Republic of South Africa, 1988).

career intentions between undergraduate studies and graduation (Mahoney, Katona, & McParland, 2004). Thus it is inaccurate to assume that students who select particular areas of study when entering higher education are fully aware of their choices.

My study furthers the work by Portnoi (2009b) by addressing the gap on the experiences of Black African women engineers who are currently working in industry and the decisionmaking processes of this population. My study is particularly important because it serves as the first South African-based engineering alumni study highlighting the career choices of Black African women engineers with the purpose of explaining their absence in academia. My study provides a necessary counter-story challenging existing stock narratives that discount the sociohistorical, political, and economic contexts Black African women in South Africa navigate in making career and life decisions. The next section provides a brief description of the intended research design, methodology, methods, and sampling procedures used in this study.

## **Research Questions**

The purpose of this study was to understand why Black African women are absent in engineering academe in South Africa. Given the absence of Black African women engineers in the academy, alumni working in industry provided the closest opportunity to understand how and why Black African women engineers choose careers outside of the academy and why entering the academy has not been an option thus far. Focusing on engineering alumni working in industry provides new insights into the career decision-making processes of Black African women engineers. The following questions guided this study:

- 1. How did Black African, South African women engineering alumni make career choices?
- 2. What factors have influenced their career choices and how have they engaged with these factors in deciding about their careers?

3. Why have their career choices not included pursuing an academic career thus far?

This study utilized Charmaz's (2014) constructivist grounded theory (CGT), loosely framed by a conceptual framework of African feminisms. CGT is a methodological and analytical framework that guided the collection, coding, and analysis of data. Constructivist grounded theory is an iterative process where the researcher and participants co-create theory grounded in data (Charmaz, 2014). A Supportive framework of African feminisms centralizes African women's lived experiences as unique vantage points to view social inequalities with African ways of knowing being presented as legitimate forms of knowledge. Through the collection of rich data, CGT "reveals participants' views, feelings, intentions, and actions as well as the context and structures of their lives" (Charmaz, 2006, p. 14).

A constructivist grounded theory approach was necessary given that existing career theories are not representative of the unique lives of Black African women in a post-apartheid South Africa. Existing theories such as Holland's typology (1996), and Super's (1980) theory of career choice offer useful explanations for the individualistic nature of career decision making but ignore the communal nature of women's career choices especially in an African context (Bimrose, Watson, & McMahon, 2014). Therefore, a grounded theory approach allowed for a contextually relevant model to emerge from the articulated experiences of Black African women engineers in South Africa.

## **Definition of Terms**

#### STEM/SET/STI

This acronym refers to the fields of science, technology, engineering and mathematics. In the South African context the acronyms SET (science, engineering and technology) and SIT (science, technology and innovation) are used in government documentation. These will be used

interchangeably in the study with a greater reliance on the STEM acronym as it is widely used in literature (Mlambo & Mabokela, 2016). STEM fields are defined broadly to include mathematics, physical sciences, biological and life sciences, computer and information sciences, and engineering (Chen, 2015).

#### Postgraduate

Equivalent to graduate education in other countries, in South Africa postgraduate studies refers to any post-baccalaureate qualifications. In South Africa postgraduate studies include Honors degrees, postgraduate certificates or diplomas (equivalent to the 4<sup>th</sup> year of undergraduate education in the United States), Master's degrees, and Doctoral degrees.

# Academic Staff

Also used in this study and in South African Department of Higher Education and Training report to refer to research and teaching/instruction staff. The term academic staff is similar to the terms faculty, lecturers, or professors as used in other parts of the world to describe higher education research and teaching staff. In South Africa academic staff are ranked from entry to senior levels in the following order: junior lecturer, lecturer, senior lecturer, associate professor, full professor. Each rank has minimum requirements related to research publications, teaching experience, and local and global recognition.

In engineering, minimum requirements for a junior lecturer position include that the person be in the process of obtaining a Master's degree, with no requirement to have research experience. The junior lecturer level is being phased out at traditional universities with the lecturer position representing the new entry-level position, requiring the candidate to have a Master's and be in the process of obtaining a Doctoral degree. Progression from junior lecturer to full professor can take up to 20 years (Mangcu, 2014b).
# Faculty

The term faculty refers to the school that houses the different departments within a higher education institution. In this study, faculty refers to the Faculties of Engineering and Built Environment at South African universities. This differs from the meaning of the term 'faculty' as used in countries like the United States where it refers to academic staff.

# Industry

Industry refers to engineering careers in the private sector and government employment, which are viewed in this study as separate from higher education occupational places. While one can argue that government jobs and higher education jobs both fall in the public sector, I operate from the understanding that higher education is a unique place of work where government work is also viewed as separate from the higher education arena. The participants in the study also made a distinction between the work they do in government jobs and the work of academics further supporting my assertion of the differences between the two. In this study industry represents anything other than an academic job.

## Career

In this study a career refers to both an occupation one engages in to accrue some income and the progression through different roles or jobs one takes on. The different roles may involve one's education, volunteer experiences, and internships contributing to the development of an occupation, which will hopefully bring in some monetary benefits (McKay, 2016).

#### **Summary of Dissertation**

This chapter provided a brief introduction on the proposed research topic. The relative absence of Black African women in engineering higher education departments and the general underrepresentation in engineering academic spaces is alarming. Understanding the educational

experiences of these women, and how the experiences influenced their career choices, can help to address the pipeline and pathway problems that result in few Black African women engineering scholars. This qualitative study utilized a constructivist grounded theoretical approach to create a model of Black African, South African women engineers streamlined career choice process.

Chapter 2 reviews literature on the global and local explanations provided for the underrepresentation of women and non-White women in academe and STEM. The review provides a context for my study highlighting the scholarly conversation within which my study is located and makes a contribution. Chapter 3 provides an overview of constructivist grounded theory framework and methods used. The conceptual framework African feminism(s), and constructivist grounded theory, is discussed as it loosely frames the study.

Chapter 4 presents the findings of the study with direct quotes from the interviews provided as supporting evidence for the main themes that emerged from the data. The main themes represent the main aspects of the career choice model created as an outcome of this grounded theory study. The model is described in detail in Chapter 5. Chapter 6 concludes the dissertation with a discussion of the findings in relation to the research questions, the implications of the study and the streamlined model of Black African women engineers' career choice process, including future research implications and considerations.

#### **Chapter 2: Literature Review**

This chapter presents a review of the literature highlighting the experiences of Black women in both STEM industry and the academy, with a focus on engineering where available. I approach this review with an assumption that Black African women in South Africa exercise agency in their career choices, despite the historical, institutional, political, and social constraints of their context. This review helps to build an understanding of the discourse surrounding women and Black African women in STEM and higher education broadly and to provide background information on some of the explanations available for the underrepresentation of Black women in STEM academia.

Historically in South Africa, access to engineering was both raced and gendered. This review begins with a historical discussion of race and gender in engineering in South Africa. The remainder of the chapter includes a review of literature on the global underrepresentation of women and Black women in higher education, the status and experiences of women and Black women and Black Africa. A summary concludes this chapter.

# History of Race and Gender Exclusion in Engineering

Engineering in South Africa has a notable history of exclusion. During apartheid only White males could easily enroll in science and engineering higher education courses (Case & Jawitz, 2004; Cruise, 2011; Martineau, 1997; Moshupi, 2013). In contrast, Black people required special permission to attend the White universities offering engineering courses or were forced to pursue these particular degrees abroad. For example, in the mining sector, legislation explicitly barred women from being employed underground. The Mines and Works Act of 1911, Section 8(1) stated, "No person shall employ underground on any mine a boy apparently under the age of

sixteen years or any female" (as cited in Cruise, 2011, p. 218). Non-Whites were also restricted in their participation in mining. Through legislation they were barred from becoming certified miners thereby ensuring that "the upper echelon of mining was an 'all-white' bastion" (Cruise, 2011, p. 217). Black mineworkers were "kept to the position of labourers, whereas White(s), in the mine, were able to rise through the ranks to manager status" (Cruise, 2011, p. 218).

Although educational institutions did not officially discriminate according to race or gender, women and Blacks were effectively discouraged from pursuing mining engineering degrees because legislation prevented any significant career progression in this sector; therefore, "it is not surprising that all South African graduates in mining engineering for nearly a century were White males" (Cruise, 2011, p. 218). This history of exclusion is useful in understanding why Black women were underrepresented in engineering academia and industry during and immediately after apartheid. However, more than twenty years into a post-apartheid South Africa in which a significant number of Black people and Black African women are graduating from engineering, their continued underrepresentation warrants investigation.

Post-apartheid government initiatives set in motion transformation processes in mining and other engineering sectors. Through the government's affirmative action policy (Republic of South Africa, 1998) and the Broad Based Black Economic Empowerment Act in 2003, aimed at redressing apartheid inequalities, engineering companies began to hire more women and Black people (Cruise, 2011; Moshupi, 2013). While Black people and Black African women in particular are growing in numbers in industry, with previously closed spaces like mining and engineering showing slow but steady signs of transformation, the same transformation has not occurred in higher education spaces. How are Black women making inroads into industry, which

is described as more hostile than the academy (Mlambo, 2011; Mlambo & Mabokela, 2016), but remain noticeably absent in the academy?

Literature on race and gender highlights systemic factors (contextual, social, cultural, historical, institutional, and economic) to explain the underrepresentation of women in higher education and STEM fields in particular. While research on Black women as students, administrators and academic staff exists all around the world, there is a dearth in research specifically examining Black women engineering academic staff. The absence of such literature is not surprising given the noticeable absence of Black women in engineering academic positions around the world.

## **Global Underrepresentation of Women in Higher Education**

Among the 400 institutions that participated in the 2010 Times Higher Education's World University Rankings, women made up 50.3% of the student population but occupied only 33.7% of academic staff at the top 400 higher education institutions (Grove, 2013). Japan reported the highest rate of gender disparities with women accounting for only 12.7% of academic staff at all levels (Grove, 2013). In the same academic year of 2010-2011 in the United States women held only 41.8% of full-time faculty positions, compared to men at 58.2% (Curtis, 2011).

On the African continent women's underrepresentation among academic staff and senior administrators is equally visible. Among the fifteen Southern African Development Community (SADC) countries<sup>6</sup>, which include South Africa, of the 1.3 million students enrolled in public higher education, women account for 51% of the total student population, but academic staff composition remains male dominated. With exception for Mauritius where women represent 92.3% of academic and research staff, in all other SADC countries women are below 50% of

<sup>&</sup>lt;sup>6</sup> SADC countries include Angola, Bostwana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, United Republic of Tanzania, Zambia and Zimbabwe (SADC, 2016).

staff numbers (Wilson-Strydom & Fongwa, 2012). The overrepresentation of women academic staff in Mauritius masks the fact that women are mostly located in lower ranks (Wilson-Strydom & Fongwa, 2012).

While quantitative data provide a numerical snapshot of the status quo in higher education, the underlying systematic and socio-cultural forces contributing to the low representation of women in the academy remain unexplained. This study aimed to understand some of these forces as they interact with individual career choices of women that have not included the academy, contributing to the underrepresentation of Black women in engineering higher education. To begin to understand the underrepresentation of Black women, an understanding of women's overall experiences in the academy offer some insights. The next section highlights some of the reasons for women's underrepresentation in higher education as provided in international literature on this topic.

## **Reasons for the Underrepresentation of Women in Higher Education**

Women in higher education experience a myriad of structural, economic, organizational, and social barriers to participation (Petersen & Gravett, 2000). Prominent challenges discussed in the literature relate to issues of balancing work and home responsibilities, women as a numerical minority within the academy, and issues of sexual harassment experienced by women in maledominated spaces.

#### Work-life balance

There is a growing body of research focused on the challenges women with children have in balancing work and life responsibilities (Armenti, 2004; Karikari, 2008; Mlambo, 2016). In a Canadian study examining childbearing decisions of women professors in pursuit of tenure, the women reported that having children before obtaining tenure was detrimental to their career

prospects (Armenti, 2004). As a result, the women who chose to have children while working learned to schedule the time they gave birth to occur during summer months when they did not have to be at work (Armenti, 2004; Karikari, 2008).

In a review of the barriers to women's participation in higher education leadership in Southeast Asia, participants revealed that socio-cultural belief systems in most of Southeast Asia define a woman's role as largely domestic (Morley & Crossouard, 2014). As such, women are primarily responsible for child rearing and tending to the family. The women in the study recognized that these socio-cultural belief systems perpetuated stereotypes that hindered women's pursuit of academic careers (Morley & Crossouard, 2014). In the United Kingdom academic women reported how cultural assumptions about womanhood influenced their engagement with the institution. For example, research seminars scheduled in the evenings meant that women with children were often unable to participate, as they had to tend to their children after work. As a result women felt excluded from networking opportunities those events may have provided.

In most African countries childbirth is an obligation for married women (Karikari, 2008). These social gender norms impose expectations on women's bodies and time that can be problematic for women who are both married and career oriented. In studies on the experiences of academic women in Ghana some women reported the incompatibility of academic work and motherhood (Karikari, 2008; Mabokela & Mlambo, 2015). The women in Ghana struggled to manage their multiple roles as mothers, wives and academic workers often interrupting their careers to bear children and falling far behind compared to their male counterparts who remained at work (Karikari, 2008). Socially prescribed gender roles result in women being unable to

devote as much time to their academic work as their male counterparts, which then hinders their career progression (Mabokela & Mlambo, 2015; Mlambo, 2011).

Karikari (2008) notes, "the sense that women academics were caught between two greedy institutions, the family and the university was a recurring theme" (p. 97). The description of family and higher education as both greedy institutions requiring all of a woman's time leaving little room for rest or personal time appears to be a universal situation for women academics in different parts of the world (Wolf-Wendel & Ward, 2006). Given assumptions about productivity being linked to one's presence within the office, any time taken away from the workplace for family responsibilities, including childbirth, diminish women's ability to successfully compete in the workplace (Armenti, 2004). The gendered nature of higher education imposes gender expectations on women, "consequently, women are expected to adapt to institutional norms that do not accommodate their differences" (Armenti, 2004, p. 226), which further marginalizes them within a space built on male norms (Dunn et al., 2014).

In all these studies women had already selected academic careers and were dealing with the challenges of work-life balance while on the job. While inferences can be made about how these findings may be relevant for explaining the career choices of women who have not entered academia thus far, empirical research is required to substantiate these claims. By understanding how Black African women make career choice, my study provides useful data to begin to explain this phenomenon.

## Sexual harassment

According to Morley (2005) women are reluctant to enter the academic space as either students or staff because of concerns of sexual harassment. In recent years institutional actors have recognized the problem of sexual harassment in higher education. Although in the United

States institutions have been held accountable for the safety of those living and working within institutional spaces (U.S. Department of Education, 2015), higher educational institutions globally still do not accept responsibility for incidents occurring under their charge. For example in Pakistan, "sexual harassment in education remains a 'forgotten secret'" (Shaikh, Shaikh, & Khan, 2015, p. 442), in which educators and administrators refuse to acknowledge it as a problem, and victims of sexual harassment do not report occurrences. Some reasons for victims underreporting in Pakistan included family and peer pressure and lack of trust in the police. Shaik et al. (2015) highlight how in Pakistan "although all women know it [sexual harassment] and experience it, nobody cared or dared to report it because throughout their lives, they had been discouraged to speak about such incidences" (Shaikh et al., 2015, p. 442). Family and cultural socialization contributed to the silence around sexual harassment.

In a Zimbabwean study on gender in higher education, all interviewed female staff members were aware of sexual misconduct by some male professors but they had not reported it nor were they aware of any incident where perpetrators had been reprimanded (Morley, 2005). In a study to determine contributing factors to low female participation in higher education in Uganda, parents highlighted the vulnerability of female children to sexual harassment as being a reason for females dropping out of school (Kasente, 2012). The prevalence of sexual harassment within institutions creates perceptions of a hostile environment, potentially deterring women from entering and staying in the academy (Kasente, 2012).

## "Paradox of visibility": Women as minority

Explicit imprints of hostility on female bodies through denial of sexual harassment are accompanied by subtle culture, which treats women as invisible in institutional decision making due to their numerical minority status. The numerical minority status of women in higher

education has been well documented (Karikari, 2008; Mabokela & Mlambo, 2015). In Ghana women reported the disadvantages of being few in number including the inability to acquire sufficient votes for women's participation on different committees (Karikari, 2008). In cases where only two women were present in a department with mostly men, the men tended to vote for and with other men. As a result, with little to no representation on strategically important committees, women's issues were not heard within these forums (Karikari, 2008). In addition to low statistical representation, the institutional culture continues to value masculinity leading to a "paradox of visibility" (van den Brink & Stoobe, 2009, p. 452), where "women are perceived to be less employable despite their over representation, and higher achievement at undergraduate and graduate level" (Savigny, 2014, p. 796).

While the institutional adoption of the paradox is clear, what remains to be explored is how this view is experiences and interpreted by these women. The psychological concept of stereotype threat refers to a self-evaluative threat where one is "at risk of conforming, as self characteristics, a negative stereotype about one's group" (Steele & Aronson, 1995, p. 797). The paradox of visibility perpetuates negative stereotypes about women's capabilities as employable academic staff potentially contributing to stereotype threat deterring women from pursuing academic careers.

In addition, negative stereotypes and the lack of women's voices and contributions are also discounted in meetings where women experience feeling invisible (Savigny, 2014). The message they receive from the body language of their male counterparts when contributing an idea is that women's ideas are not worth listening to (Mabokela & Mlambo, 2015; Savigny, 2014). Perumal (2003) refers to this active ignoring of women's voices as "male-deafness" where women's contributions in meetings are ignored but the same idea is praised when

presented by a man. As a result of being rendered invisible, women internalize their marginalization and withdraw from participating in meetings and other institutional processes, including not putting themselves up for promotion (Perumal, 2003; Savigny, 2014). Savigny further argues that the women's marginalization becomes an institutional cultural norm thereby indoctrinating all academics to believe that women do not (and should not) progress or play a full role in academia. The paradox of visibility and male-deafness effectively create a cycle of hostility toward women in academic spaces.

## Lack of mentorship and networks

Due to the underrepresentation of women academics in higher education, younger academic professionals do not have access to other women mentors or the informal support systems that men have at their disposal (Karikari, 2008). In addition to serving a socialization purpose, mentoring is an important component in the retention of academic staff in higher education (Thomas, Bystydzienski, & Desai, 2015). In a study by Mabokela and Mlambo (2015) on the factors contributing to the career progression of women academics in Ghana, participants indicated the importance of mentoring and personal networks for professional success. While some women were able to find mentors amongst other male and female academics, most women highlighted the lack of support by other women. Senior women who were looked to for mentorship had become part of the male norms of the institution and did not assist younger women in the academy (Mabokela & Mlambo, 2015). Powell, Bagihole, and Dainty (2009) note similar characteristics among UK women engineers who adopt an anti-woman approach behaving like one of the boys. How mentorship and support influences the career choices of potential Black African engineering academics specifically, has not been explored. Global literature on the reasons for women's underrepresentation in higher education is useful for thinking about alternative reasons applicable to the South African context. The issues discussed thus far are applicable to women in higher education around the world. Nevertheless a nuanced analysis of the experiences women in higher education in the South African context in particular is useful in understanding their absence in South African engineering academia. The next section focuses on the higher education experiences of women in South Africa in particular.

# Women in Higher Education in South Africa

As highlighted previously, South African research on women in higher education reveals similar reasons for women's underrepresentation in the academy as experienced by women in higher education globally. However, a few reasons unique to the South African context include issues of socialization, males operating as institutional gatekeepers, and the continued influence of apartheid on women's experiences in academic spaces.

## **Socialization Factors**

The work-life balance conflict is also a salient feature for South African academic women. In particular South African women note that their decision to priorities their families has an adverse impact on their research productivity (Obers, 2014). In addition to the expectation of performing gender roles (Zulu, 2003), South African women revealed how gender socialization impacts their ability to perform at their optimum within higher education. Specifically the combination of gender, class, and race-based socialization where deference to masculinity is espoused in all social interactions results in them withdrawing "voluntarily into a web of self-silencing and censorship" in academia (Perumal, 2003, p. 77).

In cases where women tried to speak up for themselves against what they perceived to be patriarchal norms in the academy, other women colleagues would undermine them in order to

gain favor with the men. Perumal (2003) remarks that the implicit message in this undermining was that defiance of patriarchally prescribed roles of women as submissive and silent was neither acceptable nor tolerated in the academy. Thus, women who fail to conform to gendered social norms will struggle to exist in South African higher education.

### Men as Gatekeepers

The idea of some women wanting to gain favor with male colleagues is linked to the perception that men serve as gatekeepers in the academy in South Africa (Mlambo, 2011; Petersen & Gravett, 2000). In academic spaces women reported feeling like they had to prove their competency only gaining legitimacy as academics and engineers upon obtaining approval from their male colleagues (Mlambo, 2011). The social power held by men in South African higher education to legitimize women's participation in organizational spaces mirrors the patriarchal structure of South African society writ large. As a result male gatekeepers have the power to keep "women 'outside' of the normative representation of 'inside' within academia" (Petersen & Gravett, 2000, p. 171). Women remain outsiders in the academy until male counterparts who are normatively academic insiders grant them entry. The academy becomes an unwelcoming space requiring unchallenged deference to masculinity for one to excel, let alone gain entry.

### **Vestiges of Apartheid**

Finally, the impact of apartheid on women's participation in higher education continues to be present today. While Black women are perceived to be incompetent, White women view affirmative action policies as a hindrance to their career progression. White academic women at

Rand Afrikaans University<sup>7</sup> indicated that due to affirmative action policies prioritizing the hiring of Black people, the opportunities for career advancement of White people were limited if not halted (Petersen & Gravett, 2000). The history of apartheid and the transformation-focused post-apartheid political landscape both influence institutional decisions about hiring and promotion. However, Black women, whom such policies should serve, continue to be underrepresented at more senior levels and noticeably absent in particular academic STEM disciplines like engineering.

While these findings are useful in beginning to understand the overall nature of the underrepresentation of women in higher education, often these experiences reflect those of White women (Petersen & Gravett, 2000). In most South African literature the racial composition of the women involved in the study is seldom noted (Obers, 2014; Petersen & Gravett, 2000). As a result, the experiences of Black women are often conflated with minority groups or women broadly, failing to capture the unique experiences of Black African women (Moses, 1989). It is important to also understand some of the experiences of Black African women, and other distinct ethnic minority groups around the world in understanding the underrepresentation of Black African women in the academy.

#### Black Women (and Ethnic Minorities) in Higher Education Globally

Race, gender, and class play a role in shaping the demographic profile of the South African professoriate (Soudien, 2008). Therefore, providing some context for the race-gendered representation of women in higher education academe is important in understanding the pervasive underrepresentation of women, Black women, and other minority women groups in academia around the world.

<sup>&</sup>lt;sup>7</sup> RAU; was a historically White institution which was merged with Technikon Witswatersrand and Vista University in 2004 into the current University of Johannesburg.

# **Defining Minority**

The term *minority* holds different meanings in different contexts. In the United States and many other countries with a predominantly White population, minority refers to people of color who make up a smaller part of the population. In the Australian and Canadian contexts, aboriginal people along with people of color are labeled as minorities. In both these situations a White majority determines the labeling of other representatively smaller racial groups. It should be noted that the term minority is not limited to racial categorization but can be used to describe individuals and groups based on a myriad of social, cultural, financial, and physical attributes. However, throughout this research the term minority will be used primarily in relation to race/ethnic and sex (gender in South Africa) categories.

In South Africa, Black people, broadly defined to include all non-White people, make up the majority of the population. Black Africans in particular represent the majority population group in relation to all other racial groups with White people in the minority. However, in higher education and other places of employment, Black people are the numerical minority such that White people in these spaces are referred to as the 'majority-minority'<sup>8</sup>. The differences in definitions of minority status are important when thinking about the experiences of Black people in different countries and the limited transferability of ideas about Black women's status in higher education across different contexts. For the purposes of this literature review findings related to countries where Black people are the minority will be discussed first with literature on the experiences of a Black majority population in South Africa discussed thereafter.

<sup>&</sup>lt;sup>8</sup> In South Africa the term majority-minority describes Black people who are the majority population in the country but who do not hold economic and social power such that they continue to be treated as minority individuals with limited opportunities despite Black people holding political offices.

### Black Minority Experiences in the United States and the United Kingdom

Most research on Black women in the academy comes from the United States where African American women are considered a minority group. In fall of 2013, White people overall represented 79% of full-time faculty in U.S. higher education institutions with Black people representing only 6% of faculty (National Center for Education Statistics, 2015). In the United Kingdom, where Black academics in total account for just 85 professors compared to White professors who occupy 15,905 of academic positions, Black women in particular hold only 17 of these positions (Shilliam, 2015). Within the academy Black professors in the UK report "experiences of isolation, exclusion, marginalization and discrimination" (Shilliam, 2015, p. 32). In addition, Black academics report being overly scrutinized by their White colleagues who hold negative stereotypes about the competencies of Black people (Shilliam, 2015).

The experiences of isolation and exclusion reported by Black academic staff in the United Kingdom are similar to the experiences of African American faculty as captured by Moses in a 1989 study. An excerpt from the study reads as follows (Moses, 1989):

Once Black women get to campus they are members of a community that tends to treat them differently than it does Black males, White males, and White females. Isolation, invisibility, hostility, indifference, and lack of understanding of Black women's experiences are all too often part of the climate that Black women may face on campuses. (p. 3)

The difference in treatment experienced by Black women in 1989 captures Patricia Hill Collins's (2000) description of Black women in higher education as "outsiders within" the academy (p.15). This metaphor refers to the ways in which Black women by virtue of their

intersecting race and gender identities are outsiders within oppressive institutional spaces espousing White dominant narratives (Henderson, Hunter, & Hildreth, 2010),

African American women as 'outsiders within' the academy is a metaphor that not only evokes transformative promise but also exclusion, isolation, and subordination where one's work and contributions are viewed as less valued, less critical, and less deserving of compensation and recognition. (p. 29)

The position of outsider has implications for the experiences Black women have in higher education spaces. As already discussed, less than positive experiences create the perception that higher education is an unwelcoming space.

# Unwelcoming nature of higher education

Higher education institutions in the United Kingdom and the United States remain "overwhelmingly, administratively, normatively, habitually, and intellectually White" (Shilliam, 2015, p. 33). In addition, these spaces are unwelcoming to Black scholars such that "those in the pipeline seek employment in government or industry, rather than pursue an academic career" (*The Journal of Blacks in Higher Education*, 2007, para. 18). In the United Kingdom, the compounding effect of negative experiences in higher education is that Black minority and ethnic (BME) "academics as a whole leave their current institution at a higher rate than their White counterparts and subsequently enter into unemployment" (Shilliam, 2015, p. 32). While the doors have opened to minority groups, the infrastructure of the higher education space remains exclusionary and predominantly White. The fact that capable Black scholars opt out of academic careers including willing to be unemployed rather than continue to work in higher education indicates how negative experiences in the academy prohibit efforts to increase the representation of Black women in academia. Thus making sense of the ways Black women

experience the academic space as students, faculty, and administrators, respectively, is imperative to addressing their underrepresentation in academia.

## Devaluing of minority women

A study in the United States examined the levels of Black women in higher education administration careers obtaining leadership positions (Miles, 2012). Levels of leadership positions and success were defined according to the highest degree earned, years of service, availability of social support, and current career title (Miles, 2012). Through self-reported data collected in a survey, the study also aimed to compare the work experiences of Black women, White women, and men higher education administrators. Guided by a conceptual framework of Black feminist theory (Collins, 2000) and symbolic interactionism (Charmaz, 2014), unsurprisingly the study revealed that Black women administrators are over-represented in midlevel positions with very few Black women occupying senior level jobs (Miles, 2012).

Even in cases where Black women had obtained doctoral degrees, they remained underrepresented in senior level positions compared to their male and White female counterparts. Participants reported stereotypes of Black females being "poor leaders, less capable, and not working well with others" (Miles, 2012, p. 39). For these women, these stereotypes served as justifications by those in decision-making positions for the lack of promoting senior Black women into senior level administrative jobs. In the United States, as in South Africa, the defense by those in power in higher education are stock narratives stating that there are "no blacks in the academic pipeline," which scholars argue is "simply a lame excuse used by universities across the nation to deflect criticism of a deeply entrenched unwillingness to seek out black faculty" (*The Journal of Blacks in Higher Education*, 2007, para. 18). Although institutional level

explanations are provided in the literature, how Black women experience and perceive the status quo is unexplored.

An example of differences in perception can be found in a study by a woman of color faculty member in the United States recalling her experience of being discouraged to pursue graduate school by an admissions officer (Turner, 2002). The admissions officer determined that because of the woman's multiple identities as a minority, a woman, and a single parent, she would neither fit in nor succeed in graduate school. Through this encounter the woman of color faculty was "defined out" rather than being "defined in" to postgraduate education (Turner, 2002, p. 74). Factors for success in graduate school in the United States were predicated on White, middle-class, and male norms so women of color like her who did not fit a particular description were 'othered' and prematurely viewed as incapable.

Institutional leaders reiterate stock narratives distancing their actions (or inaction) as responsible for the absence of Black scholars. However, the experiences of minoritized people reveal direct influences hindering and discouraging the pursuit of postgraduate studies and academic careers. In the United Kingdom, institutions of higher education also view Black people from a deficit perspective, instead of looking at Black people and the knowledges they bring as alternative ways of knowing that are equally valuable in their own ways (Shilliam, 2015). The 'defining out' of higher education that minorities are subject to deters people of color from pursuing higher education as a postgraduate student, which limits the potential to become career academics.

While unacceptable, the underrepresentation of Black women in academia is understandable in contexts where Black people are in the minority. The same cannot be said about contexts like South Africa where Black people and Black African women represent the

majority relative to the overall population. Identifying the reasons Black African women in Black majority contexts are absent in academe provides insights into the global and crosscultural nature of Black women's underrepresentation in STEM.

#### **Black Women in South African Higher Education**

As mentioned previously in other parts of the world Black women are numerical minority groups and their marginal status in society manifests within the higher education space. In South Africa, the minority status of Black women in higher education is juxtaposed against their numerical majority status in broader society. The positioning of Black women in higher education in South Africa as the majority population provides a unique perspective compared to the United States and Europe where Black women are minority populations.

In 2014, a South African newspaper article asked, *"Why are there so few Black professors in South Africa?"* (The Guardian, 2014). The question was prompted by the release of Department of Higher Education and Training statistics showing Black African professors represented only 14.5% of research and teaching staff in South African universities, compared to Whites who represented 73.2% (The Guardian, 2014). When analyzed further, the data revealed that Black African women in particular represented only 1.9% of university professors<sup>9</sup> (The Guardian, 2014). The low representation among academic staff needs to be understood in relation to the number of qualified Black African women capable of occupying academic positions. As shown in Chapter One, between 2010-2014 Black African women represented 48% of postgraduate graduates, with White women representing 37%, Indian 11%, and Coloured 4%, respectively. Numerically Black African women are graduating at a higher rate with the combined Black (non-White) rate at 63%, almost double that of White females. In addition to the

<sup>&</sup>lt;sup>9</sup> Mangcu (2014b) provides data showing Black African women represent 0.85% of professors in South Africa. Sources of data are unclear, but there is consensus between this reporting and Mangcu that Black African women are below 2% of professors.

significant underrepresentation of Black women professors, women and Black women remain grossly underrepresented in other senior administrative positions and their standpoints expose them to unique challenges and experiences.

## "Donkeys of the university"

In one South African study Black women administrators in senior positions described themselves as "donkeys of the university," meaning while their status within the institution seemed prestigious to outside observers, in reality Black women were the undervalued workers who did all the work and received little recognition (Mabokela, 2003, p. 129). In another study, doing "donkey work" (Perumal, 2003, p. 78) was linked to women feeling like they needed to prove themselves in the academy by doing more work, usually around service such as helping students, which did not benefit their career progression. Mabokela (2003) describes this feeling of additional pressure and scrutiny as linked to tokenism. Tokensim negatively influences performance of minoritized individuals in group settings (Steele & Aronson, 1995). Although the women did not describe themselves as tokens they remained aware that "their chronic underrepresentation places them in the spotlight where they are under scrutiny by their male colleagues in particular, but also by other women" (Mabokela, 2003, p. 137).

While informative of Black women's experiences in higher education institutions, the women in Mabokela's (2003) study held primarily administrative roles and were not identified as participating in research and teaching duties at the time of their interviews. Furthermore, the women were not identified as being affiliated with engineering specifically, or STEM disciplines broadly, as my study does.

# Intersection of Race, Gender, and Rank

In contrast Mabokela's (2002) earlier study on the experiences of Black women academic staff in South African universities and technikons revealed that Black females in the academy were mostly relegated to lower academic ranks and experienced racial and gender discrimination in trying to move up the ranks. As lower ranked faculty, they were over burdened with teaching responsibilities, leaving little to no time for research and publications, both essential for promotion. As a minority group within the academy, Black female academic staff also lamented that they were not aware of the rules of the game to help them navigate the academic space, and as perpetual outsiders they had no access to the useful mentorship to learn the rules (Mabokela, 2002). Furthermore, they experienced subtle and overt discrimination and blatant disrespect for their contributions and achievements (Mabokela, 2002).

In another study of Black academics and administrators in South Africa (Mabokela & Mawila, 2004), the women reported not having received any mentorship within their respective departments, the negative impact of a culture marginalizing women's ways of knowing, difficulties with interethnic and interracial work relationships, and the continuing influence of race such that Black African women were not afforded the same respect and deference as their White, Indian, and Coloured counterparts. At one institution with a strong Indian representation, although all women were under constant scrutiny to perform and prove themselves in ways that their male counterparts were not, Indians treated Africans and Black African women in particular as unqualified and a threat to the school's standards (Mabokela, 2002). Discrimination was not only gendered but also raced, even among non-White populations.

In a study to understand the experiences of women academic sociologists in South African higher education, while older White women highlighted gender as a challenge, young

Black women noted race as the most salient barrier (Rabe & Rugunanan, 2012). The importance of understanding the racialized experiences of women within the South African context is integral to comprehensively addressing the underrepresentation of Black women in higher education academe in this country. Rabe and Rugunanan (2012) note, "a minority status in academic departments contributes to experiences of racial or gender discrimination" (p. 553). I argue for Black women, it is not an either/or situation. De la Rey (1999) notes that gender discrimination was evident in the South African university system, but "the impact thereof on women was filtered through a rigid system of race discrimination such that White women would have been negatively affected, but Black women would have been subjected to the combined negative impact of both gender and race discrimination" (p. 19). The intersectionality of their identities exposes them to discrimination on both fronts, and while race may be noted as more salient, their gender identities equally pose a challenge to their participation in higher education spaces (Turner, 2002).

### **Effects of Apartheid**

Black African women and Black African people in higher education report various feelings of fear, powerlessness, and bitterness within their academic workplaces, linked to their race, gender, and the vestiges of apartheid in higher education institutions (Nel, 2012). Nel concludes that such historical links exist because "the distribution of power in [institutions] still mirrors the apartheid-era racial configuration" (p. 7). Institutional spaces hold not so distant memories of the legacy of apartheid when these institutions were unwelcoming to Black people. Therefore, while industry is transforming (Cruise, 2011), higher education spaces in engineering continue to be perceived as White only spaces, an unlikely career choice for young Black women for whom race remains salient (Rabe & Rugunana, 2012).

The literature discussed thus far has focused heavily on the experiences of women and Black women who have already made career choices that included the academy. The experiences and challenges noted among this population are informative but are not useful in understanding the considerations made by the Black African women who made other career choices that have thus far not included the academy. My study fills this gap in knowledge contributing to scholarship on Black women in higher education globally and in South Africa specifically.

## **Black Students in South African Higher Education**

In addition to an emphasis on the experiences of academic and administrative staff, literature also focuses on the student higher education experience. Inferences can be made from student-centered literature about considerations of the academy as a place of work but empirical research is necessary to ground such claims in data. Student experiences in South African higher education include issues of sense of belonging and feelings of exclusion in institutional spaces.

### Limited Sense of Belonging

In a study exploring why there are relatively few Black South Africans pursuing or completing doctoral degrees, a number of explanations were provided. Some of the reasons included the belief that Black students are not academically capable of completing PhD programs, the perception that academic careers are not financially attractive, and the presence of more lucrative career options in industry (Herman, 2011). Additionally, Herman (2011) highlights, "there is an impact of institutional culture as well as overt and covert expressions of racism" (p. 180). African, Indian, and Coloured students drop out of PhD programs at historically White universities (HWUs) because they do not feel like they belong within these institutional spaces. The feelings of alienation and discomfort are associated with the fact that "they cannot identify with the university and what it stands for, they resent what is taught, how it

is taught and by whom" (Soudein, 2010, p. 125). Unwelcoming higher education spaces result in Black students wanting to leave the institution once they receive their degrees (Soudein, 2010). Because doctoral programs are inextricably linked to possible careers in universities (Herman, 2011), negative educational experiences may influence the consideration of the academy as a place of work.

## **Feelings of Exclusion**

During apartheid, segregation policies meant that not all students could access higher education (Higham, 2012; Martineau, 1997). While the transition to a post-apartheid era brought government mandates of transformation with Black students entering historically White institutions, entry did not necessarily translate into students feeling included within their institutions (Higham, 2012). In an exploration of the experiences of students of all races at the University of Cape Town (UCT) and the University of the Western Cape (UWC), historically White and historically Coloured serving institutions, Black African students reported feeling marginalized (Higham, 2012). At UCT in particular the students reported feeling like the institutional culture did not match their interests and needs in the same way they perceived they did for the White students. The students also linked their current experiences with the histories of the institutional spaces they were operating within, evidence that the vestiges of apartheid influence Black student experiences as they do for staff (Nel, 2012). Feelings of exclusion were also associated with the racial composition they saw among the student body, faculty, and administrators whom they perceived to play favorites with those who looked most like them (Higham, 2012).

Black women's overall experiences in higher education institutions in South Africa present one explanation for the underrepresentation of this population among academic staff. The

lived experiences of Black African women in STEM, and engineering departments in particular provide another standpoint to understand Black women's underrepresentation broadly.

### Women in STEM Globally

South African scholars argue, "gender is not the only factor responsible for the low numbers and status of women in science" (Ogude et al., 1997, p. 21). Race and class are essential components of the individual's experiences and should be taken into account (Ogude et al., 1997). As has been discussed, the underrepresentation of women, and sometimes the absence of Black women in science and engineering, is indeed a global phenomenon. There is a dearth in literature on Black African women in science and engineering in South Africa. In contrast, there is a large amount of research coming from the United States and other parts of the world. This international scholarship is helpful in framing other research, providing supporting evidence for the need for South African-based research.

### **Contextualizing Women's Underrepresentation in STEM**

A United Nations Education and Scientific and Cultural Organization (UNESCO, 2012) report shows males constitute the majority of engineering, manufacturing and construction graduates in 84 out of the 85 countries surveyed. The report notes that even in countries such as Germany, Switzerland and the United States where a degree of gender parity has been achieved, women are still underrepresented in STEM fields accounting for "less than a fifth of graduates in engineering, manufacturing and construction" (UNESCO, 2012, p. 83). In comparison, other low-income countries, namely Lesotho and Myanmar, have the largest number of women scientists, at 85% and 76% respectively, of all scientists in each country (UNESCO Institute for Statistics [UIS], 2007). While more women are enrolling in STEM undergraduate degrees, women represent only 28% of science and engineering researchers globally, and 30% in sub-

Saharan Africa (Huyer, 2015). Such global data highlight the pervasive nature of women's low representation in STEM fields.

In the United States women hold only 24% of STEM jobs (Beede, Julian, & Langdon, 2011). In Australia, despite the higher number of female STEM graduates, only 22% of STEM professionals are women and the rate of unemployment among those in STEM is twice as high for women compared to men (Department of Further Education, Employment, Science and Technology, 2013).

In Latin America, despite over 60% of women graduating from various programs only 11% of females work in STEM fields (Castillo, Grazzi, & Tacsir, 2014). In the United Kingdom women hold only 14.4% of all STEM jobs, including health occupations, with only 8.2% of the STEM professionals working as engineers (Women in Science and Engineering, 2015). What are the reasons for such low participation in STEM occupations by women?

Given limited local South African research, research from other parts of the world provides a useful reference for understanding the possible experiences of Black African women in engineering in South Africa. Indeed it is problematic to transplant experiences from one country to another as the context of gender, race, and class differs. It is for this exact reason more research focusing on the South African context specifically is required and necessary. However, in order to substantiate the need for research on the career choice processes of Black African, South African women engineers, I discuss all available literature. The next section begins with a discussion of factors influencing women's career decision-making in science and engineering globally followed by a review of some South African focused literature to which my study expands on.

## **Career Decision-Making of Women in Science and Engineering**

Research on women in STEM provides various reasons to explain women's underrepresentation in these fields. This section explores some of the reasons provided by other studies that have broadly explored the topic of career decision-making in STEM-related fields. The reasons are both extrinsically and intrinsically motivated and include workplace considerations, mentorship and female role models, and the availability of opportunities in other fields or places of work.

### Workplace considerations

Early research on minority postgraduate students in the U.S. found that work-related factors influencing the decision to pursue engineering included influences such as expected salary and intrinsic-related influences such as the perceived challenge of the job, and the ability to be creative and solve problems (Jagacinski, LeBold, Linden, & Shell, 1985). Salary as a motivator also appeared in another study exploring the impact of student loans on early career choices (Rothstein & Rouse, 2007). The study found that debt discouraged the pursuit of an academic career as postgraduates strategically chose jobs that paid higher salaries in an effort to avoid further fiscal loses (Rothstein & Rouse, 2007). The study implied that low-paying academic careers are generally not a first career-choice for students already in debt. Thus there is a need to explore how the socio-economic backgrounds of Black African students in South Africa influence their career considerations, especially given the high cost of accessing higher education and the limited availability of government subsidies to meet all student needs (Firefirey & Carolissen, 2010; Wangenge-Ouma, 2012).

# Mentorship and female role models

The absence of female role models deters women from pursuing STEM related careers (Castillo et al., 2014). Research finds that the amount and quality of faculty mentoring of students predicts the likelihood of enrollment in STEM graduate programs (Schuurman, Pangborn, & McClintic, 2005). When considering academic careers, "faculty [are] the primary institutional agents who socialize STEM students into the culture of their disciplines" (Schuurman et al., 2005, p. 10). Socialization helps in understanding career expectations and informs career choices.

Further studies have shown that women in STEM fields are more likely to select career fields where other women who are similar in race and ethnicity are present and excelling (Lewis & Collins, 2001). Given these findings, the absence of Black female academic staff in engineering academia in South Africa reduces the opportunities for Black African women to obtain encouraging information about academic careers. Furthermore, the absence of Black role models may reinforce feelings of isolation in higher education and may deter young Black females from choosing academia as a career. Given the negative experiences in higher education institutions, Black females who feel discriminated against may leave and pursue careers in other sectors where they perceive (or hope) their experiences as women of color will be more positive (Netswera, Rankhumise, & Mavundla, 2005). The negative experiences in higher education provide the impetus for Black African women to seek out alternative opportunities outside of higher education.

### Alternative opportunities

Boshoff (2005) argues that while the barriers to women's participation in higher education academic careers cannot be disregarded, the absence of women in higher education

may equally be a result of the presence of better opportunities outside of higher education and positive national policies aimed at empowering women. Understanding both the factors discouraging academia and the factors pulling Black African women towards industry provides a comprehensive view. Making higher education spaces more welcoming may not necessarily be effective in attracting Black African women to academia if other forces in industry offer better pull factors.

The highlighted literature reflects the experiences of women in U.S. settings and does not take into account the socio-cultural considerations influencing Black African women's lives in a post-apartheid country undergoing transformation. Given the adoption of foreign-based research to explain the South African case, the ways women's experiences in STEM in South Africa differ from the rest of the world have been unexplored. Investigating the specific factors influencing the career choices of Black African women provides new information to address the underrepresentation of Black African women in engineering in South Africa.

#### Women in STEM in South Africa

Although the history of apartheid affects women of Black African, Indian, and Coloured descent more so than White women, the gendered challenges experienced by women in STEM fields in South Africa cannot be ignored. As noted previously, women's participation in engineering was previously disallowed. Given the social stereotypes that a woman's role in society was to raise the children and tend to the home, "the pressures of societal norms, parental expectations, educational environment, and popular images" were intensified for South African females who chose to pursue careers in science and technology (Martineau, 1997, p. 392). This section discusses some of the reasons for women's underrepresentation in STEM in South Africa

including women opting out of engineering and various barriers deterring other women from STEM.

## Women Opt Out of Engineering

The low number of professional engineers is attributed in part to the higher likelihood of women dropping out of engineering or pursuing non-engineering professions after graduation (Du Plessis & Barkhuizen, 2015). Du Plessis and Barkhuizen conducted a study to explore the barriers affecting career advancement of women in engineering and the reasons why women engineers chose managerial routes as opposed to professional engineering careers. Using a mixed-method approach, 21 professional women engineers and 8 women managers were surveyed and interviewed. The majority of the sample was Afrikaans speaking with Afrikaans engineers representing 52.4% and Afrikaans speaking managers accounting for 62.5% of the respective sample groups (Du Plessis & Barkhuizen, 2015). Thus the findings do not necessarily reflect Black African women's experiences but are none-the-less insightful.

The women who had pursued managerial positions indicated they did so because it allowed them to use a variety of skills and exposed them to new experiences (Du Plessis & Barkhuizen, 2015). While some women mentioned job benefits, the prospect of exposure to new experiences was significantly more influential in women manager's career decisions (Du Plessis & Barkhuizen, 2015). Career changes were encouraged by the career barriers women faced including gender discrimination, lack of mentoring and limited engineering positions for women compared to management roles. Other career barriers deterring women from STEM professions are now discussed.

# **Career Barriers**

Research from South Africa highlights some of the career barriers faced by women working in STEM related fields and engineering in particular. Some of these barriers include gender biases, sexism, and dealing with the discomfort of male counterparts.

Gender biases. In a qualitative study, also using a constructivist grounded theoretical framework as my study does, Martin and Barnard (2013) interviewed five women working in male-dominated fields in South Africa. The sample consisted of two White women, two Black African women, and one Asian woman. Two women worked as electrical engineers (in energy and in education), one as an information technology (IT) manager, one as a chief safety officer in mining and another as a locomotive operator in mining (Martin & Barnard, 2013). The women in the study revealed that as women working in male-dominated fields both in and outside of education, gender biases were prevalent in both formal and informal organizational practices.

The women working in mining indicated the absence of female change rooms, and the maternity policies that forced women to stay away from work but only covered five months of one's salary with no payment for the remainder of one's maternity leave (Martin & Barnard, 2013). Women in male dominated occupations experienced negative work-identity perceptions often being treated as incompetent. In addition, because of their decision to pursue male-dominated professions, the women reported a lack of support from their families when they attempted to talk about their challenges (Martin & Barnard, 2013).

### Sexism in the workplace

Female chemical and civil engineering students interviewed about their experiences of vacation work in industry in South Africa reported incidents of overt sexism including having to deal with pornographic images present in the workplace (Case & Jawitz, 2004). The women also

reported being asked to use their femininity in the workplace to get things done by male technicians who were presented as susceptible to female charms (Case & Jawitz, 2004).

# Male discomfort and proving oneself

The women in Case and Jawitz's (2004) study mentioned that the older men, between 35 to 40 years of age, showed the most discomfort with having young women in the workplace. The women resolved things would change as more women entered the workplace and "show their work, and actually gain their respect as engineers. And then eventually that kind of boils down to them actually accepting us" (Case & Jawitz, 2004, p. 421). For these women, the onus was on the female engineers to prove themselves to their male counterparts in order to be accepted as a competent engineer. The theme of male acceptance of women as engineers also emerged in a study conducted by Mlambo (2011) on White women engineering academic staff in South African higher education. In the study, the younger women reported feeling like they had to prove themselves to the older professors and once that happened, they were treated as competent equals (Mlambo, 2011). As highlighted previously, men are gatekeepers to the academy and in engineering generally (Mlambo, 2011). Women entering male-dominated fields are forced to adjust and adapt in order to fit in and succeed (Martineau, 1997).

Despite feeling like they had to prove themselves in the academy, the women reported that overall academe was a more positive working environment than what they had experienced in industry (Mlambo, 2011; Mlambo & Mabokela, 2016). The flexibility the academy offered, allowing women to tend to their personal responsibilities was mentioned as one of the main reasons women had chosen academic careers and remained in the academy, despite the challenges they faced (Mlambo, 2011; Petersen & Gravett, 2000). The findings reveal that both industry and academe are unwelcoming spaces. However, women's family considerations led

them to tolerate the hostility of academe in order to gain more flexibility. Once again, perhaps creating welcoming spaces is not sufficient to attract women into STEM or academia.

It is important to note Mlambo's (2011) study included only White women as the population of engineering academics at that particular institution did not have any Black African, Indian, or Coloured women academics. The underrepresentation of Black women in engineering departments in South Africa has implications for the research that is conducted and the usefulness of findings for the lives of Black women.

#### **Black Women and Minorities in STEM Globally**

Global literature on Black women and other minoritized groups sheds some light on the experiences of Black women in STEM. Discriminatory culture and structures and the absence of role models also appear in the literature.

#### **Discriminatory Institutional Culture and Structures**

In the U.S., despite African American women earning more than half of all science and engineering degrees awarded to all African Americans, African American women represent only 2% of the STEM workforce (Guerra, 2013). Women of all races represent 24% of the total STEM workforce (Guerra, 2013). Researchers attribute the underrepresentation of women and women of color in science and engineering to the institutional culture of engineering where White middle-class norms exist, making it easier for White males to thrive (Carlone & Johnson, 2007). A study in the United States found that women of color as a minoritized group felt discouraged by science professors who were viewed as overtly racist and sexist in classroom settings (Johnson, 2007). In particular women of color were negatively impacted by the cultural values of science and engineering as being neutral spaces such that claiming any gender or racial bias was frowned upon (Johnson, 2007).

A study by Alonso (2012) focused on gaining an understanding of the experiences of women of color in engineering in the United States. The women in the study revealed both positive and negative factors in their participation in engineering. Some of the negative factors included a perception that the institution blatantly ignored Black engineering students with additional experiences of in-class discrimination against women of color (Alonso, 2012). There was a clear structural and institutional attribution to the negative experiences in pursuing engineering higher education. Structurally, the manner in which classes were presented and the assumption that all students in the class had come from similar educational backgrounds, resulted in certain concepts not being sufficiently explained and the class progressing to the next topic despite the fact that some students from less privileged schooling systems had not yet grasped the concepts. However, in-spite of negative experiences, the women indicated that they chose to stay in the field because of future prospects of being identified as an engineer and the status associated with the profession (Alonso, 2012).

#### **Absence of Role Models and Mentors**

As already discussed, the absence of women of color in STEM academic positions limits the opportunities for mentoring and support, discouraging younger women of color from considering academic careers. Scholars working on diversity in science and engineering in the United States state that underrepresented minorities are more likely to consider pursuing graduate school when they have access to faculty of similar race and ethnicity (Jaeger et al.,, 2013). Lewis and Collins (2001) reported similar findings that women in STEM fields are more likely to select fields where other women of similar race and ethnicity are excelling. Another study exploring the experiences of successful African American women in STEM academia found that "the presence of African American faculty members greatly influences the lives,

perceptions and retention rates of minority students" (Galloway, 2012, p. 19). Given the low representation of women of color as STEM faculty, it is likely that most minority students leave higher education not having interacted with faculty who look like them (Jaeger et al., 2013). Scholars argue that the inability to create relationships with faculty from similar backgrounds deters graduate students from underrepresented minority groups from pursuing academic career paths (Jaeger et al., 2013). The absence of potential role models and mentors who share the racial and gender identities and social backgrounds of Black women in particular create the perception that STEM academia is more suitable for White males from certain backgrounds.

#### **Black Women in STEM in South Africa**

Research on Black women in South Africa who are in engineering is scarce and dated. Furthermore, information about the experiences of Black women in engineering is usually, if at all, infused within findings about all women in engineering and science in general or grouped according to racial experiences broadly (Case & Jawitz, 2004; Jawitz, Case, & Tshabalala, 2000) with limited disaggregation by race and gender as parts of women's multiple identities. While my study contributes to literature on Black African women, a review of all available literature on women in STEM in South Africa is useful. This section highlights studies on Black women but may include references to other racial and ethnic groups as appropriate.

South African studies on the Black female experience in STEM fields mostly focus on the pre-tertiary student population and their considerations of pursuing STEM majors in higher education and on students enrolled in higher education and the factors that influenced their decision to pursue or not to pursue science and engineering degrees. The next section highlights some of these factors.
### Factors Influencing Black South African Student's Career Decision-making

Authors studying career choices of South African students state, "career development is a socially constructed process involving complex interactions among different structures, forces, and systems all constituting spheres of influence" (Bojuwoye & Mbanjwa, 2006, p. 3). Career choice cannot be viewed as an individual act separate from the socio-cultural and political realities within which institutions operate (Roy, 2014). This section discusses key factors of socio-cultural considerations, family pressures, anticipated rewards and benefits, and feeling of being disheartened with school that influence the career choices of South Africans.

### Socio-cultural considerations

Studies investigating the gender and cultural influences on career choice among undergraduate South African students uncovered that culture plays an important role in the development of different racial groups in post-apartheid South Africa (Watson, Stead, & DeJager, 1995). Like most sub-Saharan African cultures, South African patriarchal culture views men as the breadwinner with women being relegated to the home and child bearing duties (Watson et al., 1995). The impact of socialization of girls regarding childcare plays a role in how women make career decisions such that even South African female medical students are weary of having a family and maintaining a full-time medical career (Lawrence, Poole, & Diener, 2003).

Other research indicates that women consider job flexibility as a factor in career selection and in engineering careers in particular (Mlambo, 2011). Flexibility of the job is associated with the desire to ensure that one will still be able to take care of child and family responsibilities where applicable (Netswera et al., 2005). While academic careers are viewed as being more accommodating of individuals with families it is seldom considered a first career choice among

White women in engineering and is viewed as a career to consider in the future when one decides to become a parent (Mlambo, 2011).

### Family influence

In most documented circumstances family plays an important role in the career choices of Black South Africans in different careers. Students in tertiary education indicated that parents, especially their mothers played a significant role in their career choices (Bojuwoye & Mbanjwa, 2006; Shumba & Naong, 2012). In a post-apartheid context where Black South Africans had limited access to education, "many South African black parents ... try to get their children to obtain [a] good education so that these children could get better jobs and live a better quality of life" (Bojuwoye & Mbanjwa, 2006, p. 10). In South Africa, as in many developing countries, there are often family pressures for students to begin to work immediately after graduating from undergraduate studies (Herman, 2010). Families who have already invested much of their limited funds to educate an individual may not be willing or able to continue to support a student through postgraduate education. In a cultural context where "the education of girls is seen as a less worthwhile investment" (Martineau, 1997, p. 391), the academy, which requires significant additional investments of time and funding becomes a less probable career option for Black women.

#### Anticipated material benefits

Career choice is also influenced by extrinsic factors such as salary expectations (Jagacinksi et al., 1985) and the prestige and status of the career (Bojuwoye & Mbanjwa, 2006). As highlighted previously many Black students come from low-income households, a product of apartheid discrimination. More precisely, in South Africa the socio-economic status (SES) of Black students is a product of an apartheid legacy of disenfranchisement and segregation. In a

study to understand the career choices of students from historically disadvantaged schools in South Africa, students associated potential careers with the prospect of financial rewards. Specifically, "participants mentioned money as a valuable resource for food, housing and to support their family" (Dodge & Welderufael, 2014, p. 29). The association of career benefits to acquire basic needs for one's family is in contrast to other South African research indicating that students seek careers with high prestige and status only (Bojuwoye & Mbanjwa, 2006).

In the same way that individuals seek financial rewards that will pay for basic needs, other individuals seek jobs "which pay well so that they could live good lives, be able to afford a car and a house in upper residential areas" (Bojuwoye & Mbanjwa, 2006, p. 10). One could argue that these material benefits reflect the hope that a particular career will provide social mobility for one's family allowing them to move out of the low socio-economic status imposed on them by historical events. Taking into account the ways in which South African history has impacted the present status of Black women in STEM and their considerations of academic careers is important in addressing the underrepresentation of these women in science and engineering.

## Disheartened with school

A study examining the learning experiences of engineering students at UCT revealed that students in chemical engineering felt alienated from the broader university because of the academic demands of the program (Case, 2007). In this case the feelings of exclusion were associated with the prioritization of academic work over non-academic campus activities. The students referenced their excitement at joining the chemical engineering workforce, including returning to the places they had carried out their internships. In all descriptions the workplace was viewed as a place other than the university space (Case, 2007). One Indian male student

indicated an eagerness to "get his piece of paper and get out of here" (Case, 2007, p. 129). While the author presented this in relation to the student not wanting to be a chemical engineer, an alternative interpretation is that the higher education space in general was no longer a place the student wanted to be. The duration of time towards earning a chemical engineering degree made the space less attractive to continue. Once again negative associations with higher education could deter potential consideration of higher education as a place of work.

The factors discussed here emerged from studies where choice of higher education majors served as proxies for career choice, or in the case of students in high school, the intent to major in STEM fields were treated as moments of career choice. These proxies are problematic as they assume that students in high school and in undergraduate studies make lasting career choices within their educational process. Instead students in high school sometimes make decisions about their degree while they are registering on the first day of tertiary studies, and in cases where students pick STEM majors, a large number switch to different degrees or pursue non-STEM careers upon graduation (Chen, 2015). Student data is therefore inappropriate and inadequate to determine career choice. What is required is research focusing on students who have successfully transferred into the world of work and have continued to work within STEM fields, as my study does. Such a focus allows for a better understanding of the ways STEM graduates make real career choices beyond education.

#### **Concluding Remarks**

As has been highlighted previously, given the negative experiences in higher education institutions, Black females who feel discriminated against may leave and pursue careers in other sectors where they perceive their identities will be more welcomed (Netswera et al., 2005). The absence of Black women and other minorities in STEM academic jobs may be one reason why

these women in South Africa are considering careers in industry and government and not higher education.

Although the literature provides useful findings on women and Black women's experiences in academia and in STEM, this review also shows that alumni who have followed career pathways beyond higher education are seldom the subjects of research. Their stories and the processes that have led to their particular career choices remain unexplored and untold. If Black African women engineers are choosing engineering careers in industry, what is contributing to this decision and what are the implications for increasing faculty diversity in engineering in the immediate future? This study addresses these questions. The next chapter explains how the research was conducted.

#### **Chapter 3: Methods**

This study aimed to understand why Black African women are absent as engineering academic staff in South Africa. Understanding the career choices of Black African women engineers who would are eligible for academic careers but chose careers in industry provides one avenue to understand their gross underrepresentation in academe. The following questions guided this study:

- 1. How did Black African, South African women engineering alumni make career choices?
- 2. What factors have influenced their career choices and how have they engaged with these factors in deciding about their careers?
- 3. Why have their career choices not included pursuing an academic career thus far?

This chapter discusses constructivist grounded theory as the methodological, theoretical, and analytical method used in this study. Grounded theory is based on inductive reasoning rather than deductive reasoning; therefore, conceptual frameworks are not used explicitly to guide the research. The use of conceptual frameworks to guide the research is not in standing with traditional grounded theory. However, constructivist grounded theory acknowledges that a researcher has preconceived worldviews which implicitly inform how and what one sees in the research (Charmaz, 2014). Thus as part of reflexivity it is important to be transparent about my worldviews and how they influence my approach to the research.

Conceptually, the study was influenced by a combination of constructivist grounded theory and literature on African feminism(s). These worldviews reflect my preconceived understanding of the world and were selected based on their relevance to the research questions, the purpose of the study, and my previous Master's thesis research, which established the

foundation for my view of the world as composed of multiple realities. A detailed explanation of the utility of these frameworks is provided in the sections to follow.

### **Research Paradigm and Epistemological Framework**

A paradigm is a framework for observation influencing the way we see and understand the world (Babbie, 2005). This research was guided by constructivist research paradigm. Constructivism is "a social scientific perspective addressing how realities are made" (Charmaz, 2014, p. 342). Constructivists reject the idea of a single, objective reality, believing instead that the world is made up of multiple realities constructed by individuals (Mills, Bonner, & Francis, 2006). Constructivism follows a relativist ontology and a transactional/dialogical and subjectivist epistemology (Guba & Lincoln, 1994).

Ontology refers to the nature of reality, while epistemology speaks to how we come to know (Levers, 2013). Ontologically, constructivist grounded theorists acknowledge the multiplicity of realities and truths (Mills et al., 2006). There is no single, universal reality, and reality is contextual and individually defined. Reality exists in people's minds and lived experiences as they articulate them and engage in dialogue with others (Levers, 2013).

For relativists, the purpose of science is to understand "the subjective experience of reality and multiple truths" (Levers, 2013, p. 2). Unlike the original grounded theory ideals, Charmaz (2000) asserted, "data do not provide a window on reality. Rather, the 'discovered' reality arises from the interactive process and its temporal, cultural, and structural contexts" (p. 524). The idea of an interactive process of knowledge creation represents the relativist subjectivist epistemology whereby "meaning is created through an interaction of the interpreter and the interpreted" (Levers, 2013, p. 4). The researcher's interpretations are shaped by *a priori* personal experiences that cannot be closed away for the duration of the research process (Levers,

2013). Thus the researcher is a co-producer of knowledge together with the participant (Mills et al., 2006), hence the need to be transparent about one's worldview.

### **Appropriateness of Research Design**

While what is considered qualitative research has changed over time (Schurink, 2003), a simple definition of qualitative research is that it "involves an interpretive, naturalistic approach to the world" (Denzin & Lincoln, 2005, p. 3) where the researcher engages with things and people in their natural settings "attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them" (Denzin & Lincoln, 2005, p. 3). Qualitative research is based on the socially constructed nature of reality. In essence the researcher and the participants are intimately involved in a co-creative process of understanding realities as they exist in particular contexts, and times (Denzin & Lincoln, 2005).

Qualitative research is also useful in exploring substantive areas where little is known about a phenomenon (Strauss & Corbin, 1990). As highlighted in Chapter 2, there is dearth in literature on Black African women in engineering higher education. Therefore an exploratory methodology is useful in facilitating a collaborative process of knowledge creation to understand Black African woman's experiences and choices. The idea of collaborative knowledge creation aligns with African feminist ideas about the holistic and collective process of making sense of women's lived experiences (Wane, 2011). As this study aimed to make known the experiences and sense making processes of Black African women engineers, a qualitative methodology was appropriate.

Qualitative research allows for meaning about phenomena to emerge from among the individuals, groups, societies or cultures within which they occur (Guba & Lincoln, 1994). This insider knowledge perspective is referred to as emic (insider) views rather than etic (outsider)

views where researchers impose existing theories "that may have little or no meaning within the emic (insider) view" (Guba & Lincoln, 1994, p. 106). As such, qualitative studies allow for knowledge creation grounded in the lived experiences of those who participate in the study. Constructivist grounded theory ensures theories emerge from the data and are not externally imposed.

#### **Research Design and Methodological and Analytical Framework**

A revision of Glaser and Strauss's (2006) traditional grounded theory, constructivist grounded theory (CGT) acknowledges the researcher's role in co-constructing reality during interviews (Charmaz, 2014; Kinloch & San Pedro, 2014) The acknowledgment of subjectivity challenges the positivist, objectivity-focused tenets of traditional grounded theory while maintaining the procedural elements that make grounded theory important (Hall & Callery, 2001). The ultimate goal of a grounded theory approach is to develop substantive theory/model from data. The working model I developed using CGT is useful in understanding the absence of Black African women engineers from academic careers. I refer to it as a working model because while it has utility, additional research will add to the robustness of the model.

Grounded theory was introduced in 1967 through the work of Glaser and Strauss in their seminal piece *The Discovery of Grounded Theory*. Grounded theory is, "an inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data" (Jones & Alony, 2011, p. 95). Grounded theory, developed in response to a growing focus on theory verification in sociology, de-emphasized "the prior step of discovering what concepts and hypothesis are relevant for one's research" (Glaser & Strauss, 2006, p. 2). Theory verification essentially involved research aimed at confirming or disconfirming existing theories when

applied in different places, on different phenomena, and with different populations. Grounded theory emerged from the belief that useful theory for particular contexts should be closely linked to the data. "Grounded theory can help to forestall the opportunistic use of theories that have dubious fit and working capacity" (Glaser and Strauss, 2006, p. 4) on particular research topics such as Black African women's career choice processes in the South African context.

The idea of theory grounded in data is important for research in new contexts that has previously relied on a theory verification approach. For example, studies on South African women and Black people in engineering have relied on theories formulated in the West. Examples of theories tested include Bandura's (2001) social cognitive theory; Lent, Brown, and Hackett's (1994) social cognitive career theory; Krumboltz, Mitchelle, and Jone's (1976) social learning theory of career selection; and Holland's (1996) occupational typology. All of these theories have been and continue to be used in research with South African populations. Although the verification of these theories provides useful information, because the theories reflect different ideals from the South African context, their fit and relevance to the South African context are questionable (Glaser & Strauss, 2006). Constructivist grounded theory in this study allowed for a context relevant model to be generated grounded in the lives of Black African, South African, women engineers (Glaser & Strauss, 2006; Smith, 2012).

#### **Tenets of Grounded Theory and Two Schools of Thought**

Over time original grounded theory evolved with the two authors Glaser and Strauss establishing their own unique strands. Two schools of grounded theory methodology emerged, aptly named the Glasserian school and the Straussian school (Jones & Alony, 2011). Although both schools fundamentally acknowledged the need for theory to emerge from the data and that through research reality can be discovered (Mills et al., 2006), they differed about how this

should be achieved especially as related to the researcher's role in the study. For Glaser, in accordance with the canons of original grounded theory, the researcher should have an empty mind when beginning the research, and should remain passive and distant throughout (Jones & Alony, 2011). Glaser's school, also referred to as the Classical Approach, is underpinned theoretically by Symbolic Interactionism, in which "the voice of the other is represented but objectified, and 'truth correspondence' criteria are used for legitimation" (Annells, 1997, p. 178).

In contrast, Strauss's approach follows a pragmatist underpinning and is non-dualist in nature such that, "the voice of the other is actively infused into and represented in the constructas-theory with the presence and influence of the inquirer made explicit" (Annells, 1997, p. 178). Pragmatism is linked to the idea that theories can be used to predict, control, and change outcomes (Hall & Callery, 2001). Strauss also argued that the researcher will never be able to approach the research *tabula rasa*, that is, with a mind devoid of any prior information or assumptions. Furthermore, the researcher is an active participant in the research process, influencing both the research and the participant's responses (Mills et al., 2006). Despite these differences, both have been criticized for espousing positivistic/objectivist philosophies due to the language they use, such as "discovery" and "emergence." This erroneously assumes that a single reality exists that can be uncovered as opposed to viewing realities as multiple, fluid, and created through dialogue (Jones & Alony, 2011). Although Strauss's thinking reflected early elements of constructivism, Charmaz (2014) took this idea further and fully embraced constructivist notions in a new grounded theoretical approach of CGT, which is the focus of this study and will be discussed in more detail later.

## **Benefits and Risks of Grounded Theory**

Overall, grounded theory is useful in conducting research on new phenomena. As it is grounded in the data, grounded theory guards against the use of theories that may not fit with a particular research context (Jones & Alony, 2011). In addition, grounded theory methods of interviewing, memoing, and constantly comparing (just to name a few) can be used for other research methods (Jones & Alony, 2011). However, the use of grounded theory is not without risks. One risk is that the research may not reveal any significant theory that is either novel or useful to understand behaviors. A second risk is that the "unorthodox nature of grounded theory will alienate the potential recipients from the research findings" (Jones & Alony, 2011, p. 96). In simple terms, grounded theory operates contrary to traditional research methods and may not be easily accepted by the research community. Hence other researchers trained in mainstream methods may disregard the findings.

For example, Charmaz (2014) noted how in her earlier presentations of constructivist grounded theory, positivist researchers criticized her inattention to issues of validity and reliability. She shared that grounded theorists do not necessarily follow these evaluative criteria, opting instead for criteria of usefulness, credibility, originality, and resonance. However, in this particular case her work was judged according to traditional positivist criteria (Charmaz, 2014).

## **Constructivist Grounded Theory**

In response to these criticisms, Kathy Charmaz (2006) developed constructivist grounded theory. Charmaz (2008) wrote, "Glaser and Strauss did not attend to how they affected the research process, produced the data, represented the research participants, and positioned their analyses" (p. 399). In addition, "their research reports emphasized generality not relativity, and

objectivity, not reflexivity" (Charmaz, 2008, p. 399). Instead, Charmaz's constructivist grounded theory follows a relativist ontology and a subjectivist epistemology (Mills et al., 2006).

These ontological and epistemological positions address the ways traditional grounded theory has assumed the existence of a singular reality to be discovered, and that the researcher should remain a distant observer throughout the research (Mills et al., 2006). In many ways Charmaz's constructivist grounded theory espouses humanizing ideals. Humanizing ideology aims to decolonize the research process by centering the lives and experiences of those who have been marginalized in society and in research (Paris, 2011; Prior, 2007). Decolonizing research is about treating research participants with respect and dignity as the holders of knowledge about their lives (Freire, 1996). As a humanizing framework, CGT provides a platform for Black African, South African women engineers' experiences to be elevated to the level of theory, to explain the processes of their lives. In this study use of CGT emerges from the idea that the experiences of White, heterosexual middle-class women cannot be viewed as universally applicable to all women especially those in the developing world who are situated in the margins of a globalized society dominated by the Global North (Steady, 2005).

#### **Conceptual Framework**

For this study constructivist grounded theory served as the overarching theoretical framework, but as discussed previously, my *a priori* view of the world is grounded in ideas of African feminisms, an evolution from my previous work using feminist standpoint theory, which is Western-based. While African feminisms and constructivist grounded theory are not exclusively indigenous to South Africa, they offer valuable ways of thinking about Black African women in engineering higher education in post-apartheid South Africa. However, it is because of the foreign nature of these theories to the South African context that a grounded theory approach

is necessary. A discussion of constructivist grounded theory has already been provided; the next section discusses African feminisms and concludes with a consolidation of these two frameworks as they were utilized in this study.

#### African Feminism(s)

African feminism(s) emerged in African women's literary writings in the 1970s that aimed to "dispel the mal-representations of African womanhood" in literature at the time (Mekgwe, 2008, p. 13). Additionally, African literary writers actively attempted to distance African women from Western feminism, which presented the global South as politically immature, requiring more guidance from a more developed Global North (Mekgwe, 2008).

The formalization of African feminism in contemporary literature should not be taken as an indication the absence of prior forms of feminism in the African context. Indeed there were indigenous feminisms, "there were traditional patterns within traditional African societies for addressing the oppressions and injustices to women" (Ogundipe-Leslie, 1994, p. 223). Thus, the use of the term 'feminism' to describe African women who challenge patriarchal dominance remains contentious with African women associating the term with Western ideology viewed as anti-male, anti-cultural, and anti-religion (Nkealah, 2006). However, other African scholars have noted that even with the elimination of the term feminism, "most African women scholars agree that African women's muting or invisibility is not desirable or justifiable, irrespective of ideological polarity and diversities in conceptualizing gender" (Kolawole, 2004, p. 254). For this reason I use the term African feminism(s), recognizing that some African scholars do not subscribe to this term.

In line with some African scholars idea about the necessity of including the term feminism, in 2006 African feminists congregated in Accra and developed a Charter of Feminist

Principles for African Feminists (Ahikire, 2014). As mentioned previously, Western feminism viewed African feminism as undeveloped (Mekgwe, 2008). The charter was "crafted as a critical movement –building tool" aimed at strengthening the legitimacy of the feminist movement by establishing guidelines "to reverse the conservative dynamics that work to undermine the critical edge of African feminism" (Ahikire, 2014, p. 7). An excerpt of the charter as cited by Ahikire (2014, p. 7) reads as follows:

We define and name ourselves publicly as feminists because we celebrate our feminist identities and politics. We recognise that the work of fighting for women's rights is deeply political, and the process of naming is political too. Choosing to name ourselves feminists places us in a clear ideological position. By naming ourselves as feminists we politicise the struggle for women's rights, we question the legitimacy of the structures that keep women subjugated, and we develop tools for transformatory analysis and action. We have multiple and varied identities as African feminists. We are African women – we live here in Africa and even when we live elsewhere, our focus is on the lives of African women on the continent. Our feminist identity is not qualified with "ifs", "buts" or "howevers". We are Feminists. Full stop.

The charter vindicates the use of the term feminism as a way to ensure theory created and put forward by African women, on the continent and in the African diaspora is afforded the same legitimacy as Western feminism. As the researcher the selection of a constructivist grounded theory approach was strategic to allow for theory creation that honors the values of African feminism(s) while furthering the African feminist agenda of self-naming as stated in the charter excerpt.

African cultures value collectivism and the collaborative creation of knowledge. As this study built a model of Black African women in South Africa, a theory that addresses the collective nature of women's experiences was necessary to include. "African feminism is about people, their children, their work, their day to day experiences, their stories of the past" developed collectively with other women to highlight African women's resistance and strategies for survival against oppression (Wane, 2011, p. 9). African feminism views African women as agents and advocates of their own lives (Wane, 2011). African feminists do not approach social challenges from a binary perspective of gender separating male and female concerns. Instead there is an understanding that in a communal system where individuals are entwined with the community, female issues are also male issues, and vice versa. However, African feminism(s) centers African women whose lives remain marginalized by systems of patriarchy that pervade African communities disrupted by colonization. Thus African feminism(s) views the world from the standpoint of African women and "challenges the institutional powers and imperial structures that have kept African women and their Indigenous knowledges buried under the weight of modernity" (Wane, 2011, p. 14). Therefore African feminists "are concerned about the continued marginalization of African women under the three-stripped banner of culture, tradition and religion" (Nkealah, 2006, p. 136), three social structures that perpetuate patriarchy. As a philosophical project, African feminism(s) "is an ideological force that poses fundamental challenges to patriarchal orthodoxies of all kinds" (Ahikire, 2014, p. 9). As a practical process African feminism is decolonizing, providing a platform for narratives of African women's lives rooted in African women's experiences to be elevated, while acknowledging men as allies in the struggle (Ahikire, 2014; Mikell, 1995; Wane, 2011).

African feminism takes into consideration African women's lived experiences rooted in indigenous ways of knowing that capture the holistic, collaborative and collectivist nature of life (Wane, 2011). In African feminism, individuals representing various cultures, values, genders, sexualities, and social classes engage in a collaborative interpretation and co-construction of knowledge to understand and explain African women's lives. Female and male allies jointly move towards emancipatory acts of decolonization, self-definition, and liberation from social and institutional structures that devalue African women and African women's ways of knowing.

In South Africa the term *ubuntu* refers to this interdependent nature of human relationships, including ideas of "humanness – a pervasive spirit of caring and community, harmony and hospitality, respect and responsiveness – that individuals and groups display for one another" (Mangaliso, 2001, p. 24). Mangaliso highlights how based on ubuntu assumptions, issues of decision-making are communal and words transferred orally are key aspects of communication and knowledge creation. These philosophical assumptions of ubuntu are reflected in African feminist ideas.

Ebunoluwa (2009) argues that an African centered theory on gender "should involve a dialogic or accomodationist approach, a healthy appreciation of African cultures, a recognition of the heterogeneity of African cultures, a realists and wholesome strategies devoid of unnecessary aggressiveness, and the centralizing of family marriage and motherhood as positive experiences for African women" (p. 232). Therefore African feminism is a tool that "can be used to analyze the lives of African women today" (Wane, 2011, p. 18). It places African women at the center, providing a platform where their experiences, their class, sexuality, culture, and values are considered as valuable knowledge.

In addition to centering African women's lives, African feminism acknowledges the researcher as a co-constructor of knowledge, obligated to become involved in the realities of the participants and to improve the lives of the people studied. Paris (2011) referred to this involvement beyond the research process and creating relationships of care as engaging in "humanizing research." The humanistic element of African feminism(s) where the researcher views participants as human beings worthy of respect and care is articulated in Filomina Chioma Steady's (1996) definition of African feminism, which states:

To summarize, one can say that because of the need for male-female complementarily [sic] in ensuring the totality of human existence within a balanced ecosystem, and because of the negative and destructive effects of historical processes and racism on Africa and its people, values stressing human totality, parallel autonomy, cooperation, self-reliance, adaptation, survival, and liberation have developed as important aspects of African feminism. These are important concepts in developing a framework for the study of women in Africa and in the diaspora. (p. 18)

The concepts Steady (1996) notes are important to take into account when creating a theory on Black African women in the South African context. The combination of CGT and African feminism(s) were valuable worldviews for approaching the data collection, analysis and interpretation in this study.

#### **Constructivist Grounded Theory and African Feminisms**

Constructivist grounded theory provided an opportunity to create a substantive theory grounded in the lives of Black African South African women engineers and the factors influencing their particular choices of engineering careers that have thus far not included the academy. As a co-constructor of knowledge, my theoretical influence of African feminisms was

not absent from the research process but was acknowledged and minimized to allow for participants' ways of knowing to surface. Figure 5 shows the link between the different aspects of the conceptual framework as I engaged with them to understand the experiences and career choice processes of Black African women engineering in South Africa.

From constructivist grounded theory the idea that theory should be grounded in the lives of participants rather than be imposed on the lived experiences of individuals remained at the core of this study. As has been shown, the experiences and career choices of Black African women engineers in South Africa who have successfully completed their programs and are arguably eligible for academic careers had not previously been explored. Instead Black African women engineers were studied as students or in research that did not pay particular attention to the intersectional nature of their lives. Furthermore, Western-based career theories have been used to explain career choice, which failed to take into account the contextual differences of women in post-apartheid South Africa. Constructivist grounded theory is a valuable tool to challenge the dominance and assumed universal applicability of Western-based gender and career theories often crafted from the experiences of White, heterosexual, middle-class individuals.

African feminisms focus on the need to center the lives of African women as marginalized entities in society. Although Black African women are the largest population group in South Africa, they remain a marginalized minority in engineering and leadership positions in higher education broadly. Understanding the lives of Black African women engineers informed by their own interpretations and articulations not only provides a platform for their voices to be heard but also facilitates an opportunity for their agency as constructors of their own lives to be

enacted and acknowledged in a scholarly conversation that often excludes African women's ways of knowing.



Figure 5: The Link Between the Different Frameworks Constituting the Conceptual Framework

Through grounding the study in the lives of Black African women engineers in South Africa, this study is an exercise in humanizing the research and the participants through elevating their stories to the level of theory (Solórzano & Yosso, 2002). Despite the criticism against grounded theory and the incorporation of more constructivist ideas by Charmaz, constructivist grounded theory still relies on the main data collection and analysis processes introduced by Glaser and Strauss namely theoretical sampling (to reach theoretical saturation), focused and axial coding, use of the constant comparative method and memoing, which will be discussed in more detail in the sections to follow. The next section discusses the research design carried out in this study.

## **Research Design**

The constructivist grounded theory method is illustrated in Figure 6, a flow chart highlighting the components and processes followed in this study. The figure is adapted from a model article on the use of constructivist grounded theory by Sbaraini Carter, Evans, & Blinkhorn (2011). Using an example of a constructivist grounded theory study on dental practices, Sbaraini et al. (2011) provide a flowchart similar to Figure 6 explaining the processes they followed in collecting and analyzing data in the creation of their theory. The aspects highlighted in Figure 6 illustrate the main components of the research design followed in this study as elaborated in the next sections.



Figure 6: Illustration of Grounded Theory Research Process. *Adapted from Sbaraini, Carter, Evans, & Blinkhorn (2011).* 

## **Research Sites and Sampling**

# **Selection of Research Sites**

To ensure a comprehensive understanding of the processes of career choice and the experiences of Black African women engineers, I initially planned to select participants based on their affiliation to two traditional universities located in one South African province. The selection of these two sites was based on a number of criteria. First, both institutions offer engineering degrees and are among the highest producers of engineering degrees in South Africa. Second, both institutions were historically White during apartheid, serving only White students (King, 2001). Third, both institutions represent the first institutions to offer engineering degrees

in South Africa and are the only two institutions offering mining engineering degrees today (Cruise, 2011). However, a low response rate early in the data collection process required adjustments to be made to the widen the research sites to include all accessible participants with postgraduate degrees in engineering who were located in and around the Province, regardless of institutional affiliation. Opening up the sampling criteria resulted in a sample distribution where 17 of the eighteen participants attended at least one postsecondary institution in the Province. One woman did not attend higher education in the Province but worked there. Two participants who had both attended higher education in the Province were working in other provinces at the time of the interview. I interviewed one on-site in the province she was located in, and I was able to schedule an interview with the other woman when she was briefly visiting the selected Province for work purposes. Therefore all participants shared a familiarity with the selected Province either through school, work, or both. Table 4 provides a breakdown of participant affiliation with the selected Province.

Attended at least one	Attended institutions	Permanently located		
institution in the	only in other	in the Province		
Province	provinces			
17	1	16		

# Table 4: Participant provincial research site affiliation

The final sample consisted of 18 participants with ages ranging from 24 to 50+ years of age. On average participants had worked in industry for 9 years with the least industry experience at 1.5 years and the most having worked in industry over 15 years. Participants represented 8 engineering disciplines namely Electrical (2), Industrial (1), Metallurgical (4), Chemical (2), Civil (5), Mechanical (2), Mining (1), and Computer Science (1). In terms of engineering degrees, most of the participants (13) had Honors degree qualifications, 2 had Master's degrees, 1 had a Doctoral degree, and 2 had National Diplomas still considered postgraduate qualifications. Seven women had additional postgraduate degrees, 7 had MBA's, and 2 were finalizing Master's in Engineering degrees. Table 5 presents a summary of participant data.

Number of Participants		
Alumni		18
Administrative Staff		5
Age	Age Range: 24 – 50+ years	
	Approximate Mean Age: 32 years	
Industry work experience	Mean working experience: 9 years	
Institutional Affiliation	Traditional Universities	18*
	Universities of Technology	4
	Comprehensive Universities	2
Postgraduate qualifications	Honors	13
Engineering Only	Master's	2
	PhD	1
	National diploma	2
Additional qualifications	MBA	7
	Finalizing Master's in Engineering	2
Engineering discipline	Electrical	2
	Industrial	1
	Metallurgical	4
	Chemical	2
	Civil	5
	Mechanical	2
	Mining	1
	Computer Science	1

 Table 5: Summary of participant demographics

\*All 18 participants had attended a traditional university for one of their degrees/qualifications.

While the women had a shared traditional university experience, the overall composition of 7 different institutions allowed for a broad representation of experiences and career choice processes.

#### **Sampling and Recruitment**

In grounded theory research, the selection of research participants is guided by the aim of creating a theory grounded in the data (Breckenridge & Jones, 2009). Furthermore, grounded theory discourages definitively predefining the number of participants to be sampled for a study encouraging instead the reliance on theoretical sampling and theoretical saturation, which are both discussed later. Before theoretical sampling, initial sampling (guided by purposive sampling) was utilized to identify an initial participant group from which to begin the research (Sbaraini et al., 2011). I approached the research with a plan to identify an initial sample of 12-15 participants. The sample size was informed by other constructivist grounded theory studies such as Ford's (2010) study with 10 children admitted to hospital for surgery, and Porter's (2013) study with 13 Black women on the identity development of Black undergraduate students in the United States. Other grounded theory studies conducted in South Africa had used less than 10 participants (Burden & Roodt, 2007; Martin & Barnard, 2013).

#### **Purposive sampling**

As has been noted purposive sampling was utilized to identify an initial sample from the two original research sites. Purposive sampling facilitates the selection of individuals who offer rich information on a particular topic of interest (Shaw, 1999). In particular I used criterion sampling, which "involves searching for cases or individuals who meet a certain criterion" (Palys, 2008, p. 697). Participant criteria included the following:

1. Identify as Black African, South African and as a woman,

- Completed their postgraduate qualification (Honors, Diploma, Master's or Ph.D.) in engineering in the past twenty years,
- Currently working in industry (defined as all non-academic spaces) and have been for close to two years,
- 4. Have not worked in higher education as an academic professional, and
- 5. Attended higher education or worked in industry in the selected Provincial area.

The selection criteria were based on the understanding that those with a postgraduate qualification were eligible for junior lecturer positions in South African universities (Herman, 2011; Mlambo, 2011; Portnoi, 2009b). During data collection in speaking with institutional human resources staff responsible for hiring academic staff, I was informed that changes had been initiated at some institutions regarding the minimum requirements for junior staff. In some institutions striving to become world-class, candidates are now required to have (or be working towards completing) a Master's degree to be considered for a junior lecturer position. For the purposes of my study, I continued to use an Honor's degree as a minimum requirement because of the leeway provided that working towards a Master's degree is still acceptable for entry into academe.

As most engineering academic staff members have prior industry experience, research shows that engineers in industry make career changes to higher education after a reasonable duration of time working in industry (Mlambo & Mabokela, 2016). The most common length of time South African's remain at a single job is between two to five years (Worku, 2014). Therefore after two years those working in industry may have considered career changes and this study wanted to understand if the academy was ever considered.

I used the two original institutional sites as a basis to identity the first participants. Using alumni listserves (mailing lists) at one institution and the alumni Facebook page from the second institution, both accessed through the respective alumni offices, recruitment emails were sent to all Black African women engineering alumni, who graduated from the institution in the past twenty years (see Appendix). I also surveyed engineering company websites and used the career social networking site LinkedIn filters to identify Black African women engineering network organization South African Women in Science and Engineering (SAWISE) to recruit participants through a similar listserv strategy, accessed through the organization's secretary. Through purposive sampling I received 4 responses from eligible interested participants almost immediately. However, more participants were required for the study to achieve theoretical saturation.

### Snowball sampling

To account for the low response rates from purposive sampling, I also used snowball sampling to increase participant numbers. Snowball sampling involves asking participants and other contacts to refer people who fit the sample criteria to the researcher (Remler & Van Ryzin, 2011). In addition to referrals from the first participants I had interviewed, I leveraged the engineering academic staff contacts I had established during my Master's research including other local contacts working with engineers to expand my participant pool. I also used family and friends to advertise about my study, including posting on my Facebook page. The remaining participants for this study were all identified using snowball sampling to both for theoretical sampling and to reach theoretical saturation.

Glaser and Strauss (2008) describe theoretical sampling as "the process of data collection for generating theory whereby the analyst jointly collects, codes, and analyzes his data and decides what data to collect next ... in order to develop his theory as it emerges" (p. 45). Halfway through data collection I noticed that I had greater representation among younger women with less than 5 years of experience than older women whom I assumed would have more life and work experiences. In order to provide a comprehensive understanding of Black African women's career choices using snowball sampling I actively pursued women with more than 10 years of work experience, those with spouses and children, and those in senior positions in their workplace.

Before closing data collection I also noticed that the sample consisted of mostly women with undergraduate and Master's qualifications, who admittedly were easier to access as those with doctoral degrees often hold executive level positions and did not respond to my solicitations. However, in an effort to ensure that all postgraduate levels were represented I reengaged with my networks and was able to gain access to one woman with a Ph.D. Her perspectives mirrored the experiences shared by other women, which allowed me to determine that I had reached theoretical saturation. Theoretical saturation is when no additional data is found to elaborate on emerging constructs and categories identified in initial data (Glaser & Strauss, 2008). Thus the final sample consisted of 18 Black African women engineering alumni (Table 6 provides alumni participant demographics).

Name	Current	Eng. Field	Highest Eng.	Highest	Age	No. of
	Role		Degree	Degree		Years
						Working
1. Bontle	Engineering	Electrical	BEng. Hons.	Pursuing	32	10 yrs
	Manager		Electrical and	MBA		
			Electronic			
2. Palesa	Project	Industrial	Hons.		29	5 yrs
	Engineer		Technology			
			Management			
3. Audrey	Candidate	Metallurgical	MEng.	Thinking	27	4.5 yrs
	Researcher		Metallurgical	about Ph.D.		
4. Mpho	Senior	Chemical	BEng. Hons	Considering	32	10 yrs
	Process		Chemical	an MBA		
	Engineer					
5. Maria	Project	Civil	BEng. Hons		36	14 yrs
	Manager		Transport			
			Engineering			
6. Noku	Freelance	Civil	National	Finalizing	35	9+ yrs
	Maintenance		Diploma	MBA		
	Engineer		Eng.			
7. Vuyo	Software	Computer	BEng. Hons		34	15 yrs
	Developer	Sciences	management			
			technology			
*8. Tumelo	Engineer	Mechanical	BEng. Hons	Finalizing	27	4 yrs
				MEng.		
				Maintenance		
				Engineering		
+9. Lulama	Senior	Mining	BEng. Hons		33	11 yrs
	Mining					
	engineer					
10. Aphiwe	Engineer	Civil	BEng Hons.	Pursuing	25	2 yrs
				MEng		
11. Melita	Civil	Civil	BEng Hons	Applied for	26	3 yrs
	engineer		transport	MEng		
			engineering			

Table 6: Participant demographics

# Table 6 (cont'd)

Name	Current	Eng. Field	Highest Eng.	Highest	Age	No. of
	Role		Degree	Degree		Years
						Working
*12. Siwe	Unemployed	Metallurgical	BEng Hons	MBA	35	15 yrs
	(student in		metallurgical			
	transition)		& BTech			
13. Ayanda	Network	Electrical	MEng.	MBA and	37	13 yrs
	engineering		Electrical	MEng		
	design					
	manager					
14. Teboho	Manager	Civil	BEng Hons		33	10 yrs
	traffic		Transport			
	engineering		planning			
	and transport					
	planning					
15. Nandipha	Master's	Metallurgical	BEng Hons	Pursuing	24	1.5 yrs
	student			MSc		
16. Naledi	Reliability	Mechanical	National	MBA	37	16 yrs
	engineer		Diploma			
17. Rose	Candidate	Metallurgical	BEng Hons	MSc Eng.	24	2.5 yrs
	researcher					
18. Lerato	CEO	Chemical	Ph.D. Eng.	Ph.D and	50**	15+ yrs
	parastatal			MBA		

**Notes:** \*Indicates those who did not receive a bursary for their undergraduate education, \*\*Indicates that data was from an interview that was not audio-recorded and relied on the researcher's post-interview notes.

+ Indicates the one woman who utilized the NSFSA financial aid prior to receiving a bursary for undergraduate studies.

For triangulation purposes 2 Black African women currently in academia were interviewed. One

woman (pseudonym: Bridgette) held a PhD and was currently a senior administrator with close

to 10 years working in academe. The other woman (pseudonym: Tlenganani) was a lecturer with

less than 1 year<sup>10</sup> of academic work experience finalizing her master's at the time of this study.<sup>11</sup>

<sup>&</sup>lt;sup>10</sup> Adjusted timeframe to protect her identity.

<sup>&</sup>lt;sup>11</sup> Vague descriptions of the two Black African women are deliberate to protect the women's identities. Given the few Black African women in academe these women could easily be identified if more information is provided.

Additionally, 5 administrative staff including 3 human resources staff members, 1 Dean of an engineering faculty (pseudonym: Paul) and 1 Associate Dean of an engineering faculty who is also a Black woman academic and was interviewed separately for both perspectives. The administrative staff represented 3 different institutions also located in the Gauteng area. Human resources staff included 1 White male, 1 Indian woman and 1 Black African woman. The Dean was a White man and the Associate Dean was a Black African woman. These interviews merely served as supportive data to clarify issues shared by the alumni participants and are utilized sparingly to substantiate some claims throughout this dissertation where appropriate. (Refer to Appendix A for the interview agenda).

### Engaging with institutional gatekeepers and participants

As described previously, access to alumni emails was acquired through the respective institutional Alumni Relations Offices at the two initial research sites. Alumni Office Directors were contacted via email requesting access to alumni electronic-mailing lists. Information on the targeted population was provided to determine availability of the required participant group. Upon receiving approval from Michigan State Institutional Review Board (IRB), a copy of the solicitation email was sent to the Alumni Office Directors (along with proof of IRB approval) for distribution through the listserv (Refer to Appendices II and IV). One institution sent emails out through their listserv on my behalf with my contact information provided for interested participants to follow-up. The second institution was not authorized to send emails through the alumni listserv but assisted by posting my call for participation on their engineering alumni Facebook page.

I received responses from interested individuals within 24 hours of the invitations being sent out and proceeded to schedule interview dates and times with the individual Black African

women. Similar scheduling protocol was used through snowball sampling. Interested individuals had access to my email, local phone number, and WhatsApp number. Upon receiving their first communication expressing interest, I sent each woman an email with screening questions to determine if they met the criteria. I then requested their contact number and their availability within the proceeding 5 days. Participants determined interview venues and I travelled to meet them at their selected locations, which included their places of work, their homes, and restaurants. For those unable to meet in-person, telephonic or Skype interviews were scheduled as preferred. Access to institutional administrators was facilitated by an institutional gatekeeper who used their relationships within the institution to set up interviews on my behalf. Interviews with the Black African academics were a result of snowball sampling where people aware of my study suggested I contact these two women to hear their stories even though they were not the exact focus of my study.

#### **Data Collection Methods**

In order to provide a comprehensive understanding of phenomena qualitative research utilizes a variety of empirical materials. Each tool provides a different perspective of the world, which allows for a better interpretation and "understanding of the subject matter" (Denzin & Lincoln, 2005, p. 4). Also referred to as triangulation, the use of multiple methods "reflects an attempt to secure an in-depth understanding of the phenomenon in question" given that a single objective reality can never be captured (Denzin & Lincoln, 2005, p. 5). This study utilized a combination of interviews and memoing to begin to understand Black African women engineers" career choices in South Africa. This section discusses each of these methods.

### **Semi-structured Interviews**

One-on-one, semi-structured interviews were carried out with each participant on a single occasion either in-person or telephonically as appropriate. Semi-structured interviews are conversations where a set of predetermined questions are in place geared towards learning about a particular topic of interest. However, the predetermined questions do not constrain the conversation, as semi-structured interviews allow for each participant to guide the conversation (Fylan, 2005). In conducting research, "less structured formats are well suited to social constructionist paradigms" (Fylan, 2005, p. 66). In constructivist grounded theory, interviews serve as interaction sites where two people mutually negotiate and construct ideas about the world (Ghezeljeh & Emami, 2009). Semi-structured interviews minimize researcher-participant power relations by allowing for the participants to direct the conversation (Mills, Bonner, & Francis, 2006b).

In semi-structured interviews, "the questions can be very open, and the conversation can take many directions before all the areas you want to address are covered" (Fylan, 2005, p. 66). As such the interview agenda created "doesn't determine the order of the conversation and is subject to revision based on the responses of the interviewees" (Zhang & Wildemuth, 2009, p. 2). However, the agenda allows for consistency in different interview conversations. Examples of questions in the interview agenda included: How did you arrive at your current career? What was important to you when thinking about your career choice? How would you describe your higher education experience? (Refer to Appendix A for the interview agenda). The agenda was pilot tested and found to be both logical and appropriate for the purposes of the study. However, because understanding the career choice processes of Black African women engineers required

understanding their career pathways, I adjusted the first interview question to elicit such information. As a result the first interview question reflected a life history interview agenda.

## Life history interviewing

The first question on the agenda was an open-ended question, "tell me about yourself" with prompts asking the women to talk about their childhood and how they came to where they were in their careers today. The question allowed the women to share information they felt was pertinent to their life narrative and career pathway. Life history engages a participant in conversations that allow for individual explanation, description, and self-reflection in making sense of one's particular life experiences as lived in a particular place, time and social circumstances (Hatch & Wisniewski, 1995). "Life history places narrative accounts and interpretations in a broader context - personal, historical, social, institutional, and/or political" (Hatch & Wisniewski, 1995, p. 116). In simple terms life history views individual's stories of their lives as socially constructed occurring within particular contexts with the events remembered and shared by the participant having been shaped by socio-political and cultural events (Shacklock & Thorp, 2005). Thus the role of the researcher is to situate the stories shared in the wider contextual circumstances. In South Africa these circumstances include the vestiges of apartheid and the transformational agenda of a post-apartheid South Africa influencing Black African women engineer's career choices.

In keeping with a social constructivist paradigm, "life history inquiry is a dialogic event where participants act together in an ongoing, non-linear process that leads towards the construction of an account" (Shacklock & Thorp, 2005, p. 18). The intimate involvement of the researcher in co-creating life histories requires that the researcher engage in reflexivity. This involves being transparent about how my positionality as the researcher influences the research

and the interpretation of the data in telling the stories of Black African women engineers. Life history questioning was also a useful ice-breaking tool to being an interview conversation about one's career trajectory in engineering.

### Memoing

In addition to semi-structured interviews, I wrote memos during data collection and analysis. The memos were written after the interview to capture any initial thoughts related to the interview since I did not take notes during the interview. Memoing is a data collection method that serves as source of data and a tool for ensuring researcher reflexivity (Charmaz, 2014; Glaser & Strauss, 2008). Memos "can serve the purpose of producing more robust description of the research context and analyses of research data" (Green, 2014, p. 157). Memo writing encourages the researcher to analyze the data and codes early on in the research, note researcher biases and standpoints, and to note new ideas that may be useful in subsequent interviews (Charmaz, 2014). In this study memoing provided supportive data to help me conceptualize, analyze, and interpret the interview data as I created the streamlined model of Black African women engineer's career choice processes.

#### Analysis

Grounded theory analysis is an ongoing process occurring in conjunction with data collection. Data analysis involves coding, use of the constant comparative method and theoretical sensitivity to arrive at theoretical saturation culminating with the development of a theory. Coding occurs in three steps: (1) open/initial coding, (2) axial coding, and (3) selective coding. Open coding involves a line-by-line analysis of the data to identify emergent codes that are treated as provisional but help in identifying gaps in the data at an early stage of data collection (Charmaz, 2014). Initial codes ensure that no categories are overlooked, and provide guidance

for the researcher on areas to focus on in the next interviews (Charmaz, 2014). In this study interviews were transcribed immediately to allow for initial open coding to inform subsequent interviews. Axial coding involved linking categories identified in open coding into clear subcategories/themes (Charmaz, 2014). Axial coding "specifies the properties and dimensions of a category, and reassembles the data you have fractured during initial coding to give coherence to emerging analysis" (Charmaz, 2014, p. 147).

Finally selective coding involved identifying core categories also referred to as theoretical codes, which identify relationships between categories (Mills et al., 2006a). Theoretical coding involves the theoretical sorting of categories at an abstract level as one begins to think about the formulation of a theoretical model (Charmaz, 2014). Throughout data analysis the process of *constant comparison* took place. This involved comparing data with other data within interviews, and between different interviews for similarities and differences (Charmaz, 2014). Constant comparison ensures the final substantive theory is grounded in participant's articulated experiences (Mills et al., 2006a).

During data collection interview transcripts were read along with post-interview memos, which helped inform additional questions and topic areas to ask the participants in subsequent interviews. However, detailed analysis took place after all data collection was completed. Using Microsoft word I re-read each interview multiple times before engaging in line-by-line opencoding identifying key phrases and terms that served as emergent codes. Open-coding generated 843 unique codes which closely resembled the participants' words. Examples of the open codes included "no dreams to be an engineer," "opportunities available with engineering," "absence of Black women in engineering," "academia racial composition preparation for industry," "industry bursaries in high school," "used to being the only Black woman in work," and "real engineering
as outside of academia." During focused coding I grouped the 843 initial open codes into 32 categories. Examples of the categories included "race in engineering," "university experiences," "work opportunities," "academic competencies," "school experiences," "personal attributes," "financial support," "legacy," and "state of the economy." Through axial coding I consolidated these 32 categories into 7 final categories with sub-categories. The seven categories included "race in engineering," "workplace considerations in job decision-making," "university experiences," "choosing engineering," "pre-choice exposure," career choice moments," and "future goals." My process of axial coding involved diagramming, creating mind maps, and memoing, which helped me articulate and keep track of how I was thinking about a category and the accompanying sub-categories. An example of category memo is as follows:

### Coding Memo – 3 October 2016

Category: University Experiences

This covers all experiences within their undergrad and postgrad studies. Issues of surviving a minority status in a white male dominated space, differences in treatment between black and white students (especially based on language segregation in schools). Participants also discussed not being taught by a black lecturer and feeling underprepared for university which resulted in them struggling in the beginning. The university experience contributed in part to not considering academe as a career especially when they felt the university was not a welcoming space. More importantly was the fact that the lecturers seemed unhappy which was seen as a bad representation of the job. The idea of academia not being sold as a potential career by lecturers during the student's time in university is provided as a reason for not considering academia. In postgrad some professors did encourage students to return to teach after they worked in industry. This reaffirms the idea I am finding in the data that academia is something to be done after one has worked in industry. The sub-categories that fit here are: "surviving university as a minority" and "perception of academe & academe as not a primary career."

I continued to think about the 7 categories and questioned whether they clearly reflected

the career choice processes of Black African women as they shared in their stories. Charmaz

(2014) states that while axial coding provides a useful analytic frame to organize the data,

"relying on axial coding may limit what and how researchers learn about their studied worlds

and, thus, restricts the codes they construct" (p. 149). My concern with the axial codes was that

they did not provide clear responses to the research questions regarding the actions and behavior components of career choice. Glaser and Strauss (2008) urge the researcher to focus on the "actual process and behaviors" in the data, rather than the descriptive concepts the researcher uses to label the data (p. 107).

In grounded theory, theoretical sensitivity serves as part of the analysis process. It involves the researcher using their experiences and knowledge of methodology to think about data in different ways (Hallberg, 2006) and to provide a " theoretically sensitive analysis of participants' stories onto a higher plane while still retaining a clear connection to the data from which it was derived" (Mills et al., 2006b, p. 12). This analytical allowance meant I could rethink the data analysis process in the way that made sense for the data and the purpose of the study.

Therefore I decided to re-examine the focused codes and rearranged them to better reflect the events, considerations, and consequences articulated by Black African women as they spoke about their career choice processes. The idea to organize the data in this way was borrowed from Strauss and Corbin's organizing scheme also used in Porter's study of Black women's identity development study. Strauss and Corbin's organizing scheme includes the conditions or circumstances structuring the phenomenon, the participant's responsive actions/interactions, and the consequences (Charmaz, 2014; Porter, 2013; Strauss & Corbin, 1998; see Table 7).

I framed the different categories according to (1) events around career choice, (2) Black African women's overall considerations influencing career choice, and (3) the consequences, which included actions taken related to career choice (see Table 7). The final categories captured in Table 7 were then used to formulate four main thematic areas of (1) receiving and internalizing, (2) utilizing one's positionality, (3) branching out, and (4) thinking ahead which

better explained "the actual processes and behaviors" (Glaser & Strauss, 2008, p. 107) of Black African women engineer's career choices. These themes and categories are discussed in significant detail in Chapter 4.

Events	Considerations	Consequences
Pre-choice exposure	Teacher Influence	Selecting subjects
Selecting subjects	Industry recruitment practices	Developing ideas about
		engineering
Switching jobs	Developing ideas about	Linking choice to personality
	engineering	
Pursuing non-engineering	Money and family	Surviving as a minority
career desires	responsibilities	
	Recognizing changing career	Capitalizing on work
	desires	opportunities
	Aspirations for the future	Finding and leveraging
		mentors
	Establishing a legacy	Developing ideas about
		academia
	Academia as a way to 'give	Investing in self-development
	back'	
		Pursuing non-engineering
		career desires
		Switching jobs

Table 7: Axial-coding categories organizing scheme

## Trustworthiness

Charmaz (2014) highlights criteria for evaluating a constructivist grounded theory study namely: (1) credibility, (2) originality, (3) resonance, and (4) usefulness. In addition to being aware of these four criteria I also used member checking to ensure the model aligns with the Black women engineer's lived experiences and the career choice processes they shared with me.

# Credibility

Charmaz (2014) views credibility in constructivist grounded theory as being based on the researcher being intimately familiar with the research setting and topic, the adequacy of data

collected to serve as evidence for claims made, and the methodological rigor of the study. Credibility was ensured in this study by the use of member checks, triangulation through the use of interviews and memos as sources of data (Patton, 1999). The findings presented emerged from 18 interviews with alumni and 5 additional interviews with administrative staff conducted over a 3-month period in South Africa.

Credibility in qualitative research is also associated with the self-presentation of the researcher (Patton, 1999). As highlighted and will be shown in the following chapters, memo writing provided an opportunity for me to be reflexive throughout the research process. Reflexivity is the "thoughtful, conscious self-awareness" where I as the researcher engage in meta-analysis of my interpretations of the field experience (Finlay, 2002, p. 534). Reflexivity provides an opportunity to "examine the impact of the researcher and participants on each other and on the research" and ensures that these are acknowledged and accounted for in data collection, analysis, and interpretation (Finlay, 2002, p. 535).

### Resonance

Linked to credibility is the question of whether the grounded theory "makes sense to your participants" (Charmaz, 2014, p. 338). Member checking provides the platform to ensure that research findings and the theory created resonate with the participants. Member checking is when interview transcriptions and later the research findings are shared with the participants for verification and validation (Goldblatt, Karnieli-Miller, & Neumann, 2011). Member checking contributes to credibility since the participants are able to confirm or deny the researcher's interpretations of their articulated lives (Goldblatt et al., 2011). In addition to serving verification purposes, member checks are also part of the co-construction of knowledge by the researcher and the participants in line with constructivist ideas. Member checks represent the deliberate

involvement of participants in theory formulation (Goldblatt et al., 2011). Participants were invited to provide feedback on their transcripts and on the final model. Feedback was incorporated and has been used to substantiate the claims made in Chapters 5 and 6 to follow.

### Originality

The substantive theory created should provide new insights into a phenomenon. Charmaz (2014) poses the question, "How does your grounded theory challenge, extend, or refine current ideas, concepts, and practices?" (p. 337). In the absence of theories grounded specifically in the lives of Black African women engineers in the South African context, this study provides "new rendering of the data" (Charmaz, 2014, p. 337). In Chapter 6, the final model created and the findings are discussed in relation to the existing theories and literature. The study provides new evidence on Black African women's career choices, with implications for theory, practice, and future research.

### Usefulness

Perhaps the most important factor in CGT is whether the substantive theory or model has utility value and contributes to knowledge (Charmaz, 2014). As mentioned previously, the study provides a contextually relevant theory of Black African women's career choices in engineering in South Africa. Charmaz (2014) adds to the idea of usefulness whether "the analysis sparks further research in other substantive areas" (p. 338). In addition to future research implications articulated in Chapter 6, the hope is that this study will inspire more indigenous research based in the lives of African women in South African and on the continent engaged with STEM fields.

#### **Researcher Positionality**

My interest in conducting research with Black African women engineers in the South African context arose from my Master's thesis. In 2010 and 2011, I explored the reasons women

academic engineers persisted despite the challenges they faced in a historically male dominated field. As a Black woman who was born in the United States but raised entirely in Zimbabwe and later in South Africa and who identifies as African, I had been exposed to what I considered patriarchal norms that seemingly relegated women to subordinate positions. I say seemingly because through my scholarship I have since realized that I was imposing Western ideas of patriarchy to interpret the African cultural norms I was part of. Western feminism aims for gender equality while advocating for the dissolution of patriarchy with women at the forefront of the movement. In contrast, African feminism acknowledges the importance of including men in the movement and women's social and cultural roles are viewed as equally important to maintain.

In my Master's research, I wanted to highlight the usually unmentioned women who were thriving in spaces that cultural gender socialization had decided were male only spaces. While I learned a lot from the women I spoke to, I noticed the absence of Black women among the selected research population at the research site. Where were the Black women who look like me? How can I write about empowered women in the academy in a country where Black women are the largest population and yet have to rely on the narratives of White women alone? Thus began my desire to locate and uplift the stories of Black African women engineers in South Africa who graduated with engineering degrees, but chose to pursue careers in industry rather than the academy.

I found myself closely resonating with the study and the narratives of my participants who indicated some of their reasons for not considering academic careers. As I do not have an immediate inclination towards academe, I was concerned that my decision not to pursue academe would influence my interaction with the participants. Instead during interviews I became the

advocate for academic careers, providing information, urging participants to consult other people about potential opportunities to engage with academe. Through this work I realized that while I have a great appreciation and reverence for academic staff, academe is not an immediate desire but like the participants it may be a career path I follow in the future.

In this study the use of CGT ensured I did not erroneously impose Western-based theories to explain the lived experiences of these women as other researchers have done. My initial conceptual framework included feminist standpoint theory, an explicitly Western-based framework. As a theory I had used in my previous research I was drawn to its recognition of women as a marginalized group in society whose lives should be centered in research challenging patriarchy. I received feedback from my dissertation committee regarding the conflicting nature of African feminisms and feminist standpoint theory. Upon reflection I understood the tension. Considering my desire to honor African feminist agenda for African feminism to be viewed as a legitimate framework that does not need the backing of a Western lens, I eliminated feminist standpoint theory from the framework. However, in the spirit of transparency I am aware that my feminist vocabulary and my interpretation of the data has elements of feminist standpoint theory, chief of which is the idea of constrained agency as is explained in later chapters. I initially thought about this idea of limited agency as I was analyzing the data. In trying to find an appropriate term that would not diminish the women's agency I found feminist readings that articulated this idea of constrained agency in the same way that the data indicated. Therefore the data guided the final model created but my familiarity with Western feminist scholarship allowed me to make connections that may not otherwise have been made by someone else whose expertise lies in other scholarship.

Nonetheless, allowing Black African women's narratives to create a model applicable to them and the South African context serves as a post-colonial project and reminds me that women in all contexts are holders of knowledge from whom I and other scholars can always learn. In addition to the African feminist agenda as highlighted in the charter I previously discussed, I approached this work guided by North American indigenous scholar Linda Tuhiwai Smith (1999) who writes about indigenous-led research and theorization as follows:

As Kathie Irwin urges, "We don't need anyone else developing the tools which will help us comes to terms with who we are. We can and will do this work. Real power lies with those who design the tools – it always has. This power is ours." Contained within this imperative is a sense of being able to determine priorities, to bring to the center those issues of our own choosing, and to discuss them amongst us. (p. 38)

### **Ethical Considerations**

#### **Ethics Approval**

Prior to conducting this research, ethics approval was obtained from the Michigan State University Institutional Review Board. Permission was also obtained from the ethical boards from one institutional research site in South Africa, which allowed me to conduct research with alumni and institutional staff from that institution and other institutions.

#### **Informed Consent**

Individual women who agreed to participate in the study were informed of the purpose of the study, the voluntary nature of their participation and that they could withdraw from the study at any time. Participants were requested to sign an informed consent form, which served as documented proof of participant approval for their involvement in the study. A small cash token

was provided at the end of the first interview as an acknowledgment of the participant's time. The women were informed that the token did not impede them from withdrawing at any time.

### Confidentiality

Participant and institutional identifying information remains confidential and pseudonyms have been allocated to protect all identities. All information will be kept safe under a locked computer file with identifying information separated from all other data as required by the institutional review board.

### **Concluding Remarks**

This chapter highlighted the research design that was used in this qualitative study. A constructivist grounded theory approach served as the conceptual, methodological and analytical framework guiding this study. While feminist African feminism(s) influences my worldview, it was used loosely as an accompanying framework, with emphasis being placed on the lived experiences of the Black African, South African women engineers who participated in this study.

#### **Chapter 4: Findings**

The purpose of this study was to understand the career choice processes of Black African South African women engineers and why the academy has not been a career option thus far. The research questions guiding this study were as follows:

- 1. How did Black African, South African women engineering alumni make career choices?
- 2. What factors have influenced their career choices and how have they engaged with these factors in deciding about their careers?

3. Why have their career choices not included pursuing an academic career thus far? The findings presented in this chapter and the model created is grounded in data collected with the 18 participants represented in Table 7 in Chapter 3.

In talking about their career choices the women in this study talked about their choices as temporally progressive beginning in high school, with subsequent decisions either reinforcing or deviating from engineering as a career choice. The progression through time is further divided into four moments I refer to as phases. A phase represents a cumulative, time-related cluster of personal and community driven considerations. The findings are presented in phases of career moments capturing the different influential processes and factors influencing Black African women's choices at each phase of their career paths.

Black African women engineers provided narratives of their career choices in an ordered manner closely aligned with life events from schooling to university attendance and first jobs. The presentation of the model captures this organized, consecutive and somewhat linear nature of career choice. The ordered nature of individual career narratives is typical when life history is used as participant narratives "tend to be selective, contingent upon remembered events that are amenable to being told, and provide a clear and ordered record of a personal truth" (Shacklock &

Thorp, 2005). Furthermore, as career pathways occur over a period of chronological time the events and considerations captured in the model are cumulative and temporally progressive, building upon each other as an individual progresses along through different career moments. The four phases as illustrated in Figure 7 include:

- I. Early Phase: Receiving and Internalizing
- II. Middle Phase: Utilizing One's Positionality ("make it work")
- III. Late Phase: Branching Out
- IV. Future Phase: Thinking Ahead

Figure 7 illustrates the working model explaining the streamlined career choice process of Black African women engineers in South Africa. Describing the career choice process as streamlined refers to the minimal resistance experienced on the engineering career pathway which is often facilitated by communal relationships, teacher influence, and industry funding provisions geared towards enlarging the South African science, engineering, and technology workforce.

In this chapter, the different parts of the model are presented with supporting evidence in the form of direct quotes from the participant interviews provided to show how Black African, South African women engineers talked about and made sense of their career choices. Where appropriate, narratives of the two Black African women engineers currently in academe are provided as evidence of the applicability of the model to those whose pathways led them into academe. The findings should be understood in the context of some of the key factors influencing particular career choices outside of academe and the considerations and decisions the women made that have thus far excluded the academy as a career choice. The findings are

presented in order of the different phases of career choice starting with the early phase of receiving and internalizing career information.

### I. Early Phase: Receiving and Internalizing

The early phase of receiving and internalizing primarily involved the women being receivers of information about their competencies and career options from the people around them, and internalizing this information in making career choices. As young women in school they were navigating a post-apartheid system of education that requires an early selection of subjects prior to writing the final high school (Matric) examinations. As highlighted in Chapter 2, the education system in South Africa requires students to select subjects in either science, humanities or commerce majors in Grade 8. The selection of subjects early on in one's schooling where the average age of students is 13 years old creates a system where students rely heavily on their teachers and caregivers in deciding which subjects to pursue. Within the context of this system, the women shared that they made the decision to pursue engineering without an understanding of what engineering was, having simply received and internalized information presented to them by teachers. Lulama captures the essence of an early career choice:

...At the time, I mean, you were 18 years old, you don't really have an appreciation of the career choice that you've made. It's really about choosing something and, okay, I've chosen something and I'm going to study without really appreciating what it means.... (Lulama).

In the context of limited understanding of what one's choice meant, the receiving and internalizing phase included the following: (a) pre-choice exposure, (b) teacher influence, (c) developing ideas about engineering, (d) selecting school subjects, and (e) industry recruitment practices.



Figure 7: Model of Streamlined Career Choice Process of Black African, South African Women Engineers (Source: created by author)

#### **Pre-choice Exposure**

The amount of exposure to engineering prior to making a career choice varied among the women. Most women had no formal engagement with the field nor any real understanding of what engineering was while some had been exposed to career expos or rarely had conversations with family members who were engineers. Prior to being exposed to engineering, the career options available to these women were largely based on the careers they had been exposed to through family members. For example, Noku whose sister was a nurse had wanted to become a doctor, switched to engineering only after her exposure to engineering at a career expo in school. Ayanda who also wanted to become a doctor describes how she switched career choices after an unplanned engineering exposure opportunity:

I think my childhood was not geared for engineering...I have an uncle who's an engineer but was living in exile in Swaziland so I really did not grow up around people who were engineers or even working in technical space. So for most of my life, I wanted to become a doctor. It was only when I was in grade 11 standard 9 then, that my guidance teacher came to our class and she said there's an opportunity for someone to attend engineering week at the University of Pretoria. Is someone interested? The rest of the class was quiet and I was like, ugh, why not? And then when I took the forms from her afterwards, I filled them in and then I was invited for engineering week. I enjoyed it that much that I thought this is something I would like to do going forward. So I changed my career choice. (Ayanda)

However, by the time Ayanda changed her career direction she had already selected subjects that were aligned to pursuing medicine. She later shared how not choosing engineering-related subjects like technical drawing resulted in her having to participate in a university bridging

program post-matric to help her catch up with her peers who were better prepared earlier for engineering. The value of career guidance was articulated by Vuyo who did not receive any guided exposure to engineering or any other career and felt that this had resulted in her picking a career in engineering that did not suit who she was.

Yeah. I think, I think as I grew up, I didn't think too too much about my career path other than I thought I wanted to be a doctor. So I had a limited time to choose by matric, what next to do. And I chose it based on, of course, which one will pay me the highest but as I look back, it was not the best option. Yeah, I think, I was not exposed enough to maybe career guidance that could help me assess the type of person I am and which kind of jobs would suit me more. (Vuyo)

Only one woman grew up in a household with an engineer. While she acknowledged that her father may have indirectly influenced her decision, she noted that her early exposure to engineering through her father had also made engineering less appealing as a career:

well like I said my dad is an engineer, also an electronic engineer so, I've kind of always been exposed to what he does,...during schooling I mean, ok, we, we had like a computer when I was young, we used to do things together on it, sometimes I would assist him with some of the things that he was working on or we used to discuss a lot of the work that he did but at the time it never appealed to me in the sense that I thought oh this is definitely what I want to do with my life. (Bontle)

For Bontle, her mother's career as a lawyer was also not appealing. Having seen her mother work long hours and growing up feeling like her mother was never around, in addition to the large amounts of reading associated with law, becoming a lawyer was never an option. Bontle's decision to pursue engineering was largely based on her academic competencies and the need to

pick something as she completed her Matric, a choice she said, made independently of her parents. Despite having the same feelings of displeasure with both the careers her parents were involved in, it is interesting that she eventually picked engineering.

In contrast, Aphiwe, whose father was an artisan, acknowledged that her early exposure to technical work contributed to her decision to pursue engineering. Her exposure to engineering through school field trips to mining companies taught her the differences between being an artisan and being an engineer. Given this information she decided to pursue engineering as a way to "do more" than her father had done as an artisan. She shared about playing with her father's tools and working with him at home:

...As much as I felt it was because I didn't have a choice...if I wanted to play and have fun I had to join the guys, the boys in the house and do it, but I'm like this is, this is ok this is good but I'm like I don't think I want, cause I mean I look at my dad everyday I'm like I don't think I'd want to do what you do exactly because a little bit I think its, its too much and I always feel if you were more educated you could have done more you know and I'm like, ok so lets go and do more. I'm gonna go and do more and I'm gonna become an engineer, and I'm gonna be awesome! (Aphiwe)

Aphiwe associated access to more education with the availability of more career options. In educational spaces the women were exposed to information about different career options they had previously not considered. Bridgette, currently in an administrative role while also supervising master's and doctoral students at a university of technology recalls being exposed to career expos but also researching about different careers which led her to decide to purse engineering.

Well, yeah, although I was in the village but my final year, I went to career exhibitions and University of Venda was there. I used to do my Saturday school at [University
Name] so I would go to the library, I will read a lot. I used to like that. So I knew about most of the prominent engineering fields, I just didn't know about industrial engineering.
Bridgette initially wanted to pursue aeronautical engineering and was unable to secure entry at

her first choice institution. The university she eventually attended did not have her preferred specialization but guided her towards industrial engineering as an option, which as she shared she did not know about before.

For Maria an encounter with an American teacher at school provided direct access to information about engineering as a career choice for her even though she also did not know much about it.

So in standard nine (Grade 11), we had an American teacher. But she was not teaching me directly. She was at the school and we were involved with her so much in sport. So during one of our practices, she asked what we wanted to do and then I'm like, I want to be a lawyer and at that time, you could be a lawyer, a teacher, you know, like you know, the normal things...And then she said, so none of you want to be engineers? Like no, what is that? We don't want to deal with engines. And then she says...no, I'll bring papers about engineering. But by that time, most of my people in the class, they wanted to be doctors and accountants and I knew that I don't want any of that. So when she brought the pamphlets, I'm like, okay, maybe I can try this. You know, maybe I can try engineering. It sounds cool. But I didn't know much about it. (Maria)

Maria explains how early career decisions were sometimes based on the information the women had access to. Specifically, early desires to be a lawyer, doctor, or an accountant were based on

the exposure of those careers through their families or communities. Through career guidance, expos and information pamphlets at school, the women became aware of alternative career choices to consider. Maria received information about a career she previously had no knowledge about, which ultimately influenced her decision to pursue engineering. The pre-choice exposure moment allowed for the women to receive information about engineering as a career option.

### **Teacher Influence**

All the women mentioned how their interactions with school officials (teachers and principals) influenced their career decisions either directly through providing information about engineering as a career option as discussed, or indirectly through pointing out the women's academic competencies and urging them to consider science-related careers. Lulama credits her teachers with having an understanding of her academic aptitude before she was fully aware of her own strengths and what that would mean for her in the future.

I think the people around me knew that, yeah. I only got to understand or at least know what I liked later on...in high school. Perhaps not what I liked but what I was good at... Then as a result, I also enjoyed lots of support from family, especially from my teachers at school who guided me into, you know, do interesting stuff, like the science Olympiad. (Lulama)

Teachers were integral in pointing out a student's academic competencies and encouraging the consideration of engineering as a career. The internalization of teacher information about one's skills contributed to the women's career choices. In response to a question about influential people in her career choice Melita responded,

Well definitely my teachers. My teachers at school you know when you're in high school teachers, especially teachers that you like and that you look forward to, like they're the

ones who shape your career choice they tell you 'oh my gosh you're so good in maths you're so good in science you should consider engineering.' You immediately take what they say. So for me it has to be my teachers. (Melita)

In two other cases a school principal directly changed the course of a student's career choice. Maria grew up wanting to be a lawyer because her father was a magistrate. When it came time to select subjects in standard eight (Grade 10) she chose the subjects that aligned with her career goals but was promptly redirected to math and science subjects by her principal who informed her that she had not made the right choice.

My dad was a magistrate so I wanted to be a lawyer. And then in grade, I will call it standard because we used standards at that time. In standard eight, you have to choose the subject to streamline to so in standard seven (Grade 9), I passed everything...but I chose the histories because I wanted to be a lawyer...So I went to the history and economics class. So my principal, so my results for standard seven was I passed in science and math well and then she says no, she doesn't think I chose right. And then [I said] ...no, I'm very, very sure I want to be a lawyer. I don't want to be anything. I don't want to do anything that has to do with math. She said we had a deal. She said if I try math and science for first two terms and I don't do well, then I'll go back to the history class. And then I tried so hard to fail...And I didn't fail. Even with my trying to fail, I still passed. I think I got second position in class so she says, no, then you have to stick with maths (Maria).

A principal also influenced Lerato's subject choices. Lerato had selected history because she had a positive relationship with her history teacher. Upon finding out about Lerato choice her principal walked into her class, picked up her bags, and told her to follow him as he walked her

over and sat her in a science class. According to Lerato, it was in that moment that she was tracked towards science. With exception for one woman who indicated an early interest in engineering all other women had aspirations to pursue careers that were not engineering.

Teachers and school officials appear to have an influence on student's career choices that supersede family, socio-cultural and individual preferences. The deference to teachers about what career pathway a student should follow is noteworthy especially in the cases where students were physically steered away from other subject choices towards the sciences. In cases where students are coming from low-income and limited education communities the teacher is viewed as the intellectual authority and trusted advisor who knows what is best (Lewis & Naidoo, 2004). As a result information received from the teacher is trusted and not challenged even if alternative information contradicts teacher dictates.

#### **Developed Ideas About Engineering**

After being exposed to engineering mostly through school, the women began to seek information about engineering as a field and developed ideas about engineering as a career from media, family members, and friends. Some ideas included that it was a lucrative career, there were few women in the field, and engineering involved problem solving,

...In grade 11 when I was applying, I didn't, I wasn't necessarily applying because I knew the specific, the specifics of the type of engineering that I was applying to but I sort of, the gist of it was, okay, this thing is about problem solving and I love problem solving, okay... I remember, I spoke to my cousin cause she was actually one of the people who played such a vital role in that because she happened to be working for the (CSIR) at the time but she was sort of like in HR...she sort of like told me a bit and then her husband is a mechanical engineer so I spoke to him. He told me and so I was like,

okay, cool. I hear what you're saying. But still, you know, it's still abstract because you can't really picture what it is. So I was like, okay, I love problem solving. You know, ok I like numbers and all of that stuff. Okay, so cool. (Nandipha)

While some women like Nandipha tried to find out more about engineering as a career, other women simply accepted the ideas that were presented to them and used that information to make their career decision. For example, Melita describes how engineering was the popular career at the time and everyone wanted to be an engineer despite not understanding what it really meant:

So we'd always go for career days even at universities they used to invite students who were doing maths and science to come and hear about engineering and, and back in the day at that time engineering was like on everybody's lips. Yeah it was the in thing, everybody just wanted to be an engineer and most of us didn't know what it meant to be and engineer, we just wanted to be engineers. Yeah you could just, heard that this is a very nice career if you're good at maths and science this is definitely for you it pays well, and you're like oh ok we all wanna be engineers. (Melita)

For others the prospect of a high paying job was enough to convince them to choose engineering, I didn't really know what it was but I knew it paid a lot of money compared to other things. (Vuyo)

The ideas developed about engineering seldom involved an in-depth understanding about what engineering entailed or the types of engineering one could pursue. The image of a well-paying career suitable for individuals who were good in math and science and liked problem solving were key ideas created and held by all the women.

### **Selecting School Subjects**

Some career decisions were a result of the structure of the education system in South Africa. The system requires students in Grade 8 to select subjects in one of three major areas of physical science, economics and accounting, and arts and humanities. To be eligible to pursue engineering in higher education a student would need to pursue the science stream with mathematics and science as two specific Matric subject requirements. The selection of subjects in high school inevitably tracks students towards particular careers. Melita describes how subject choice was carried out at her high school:

So when I moved to high school I always knew that maths and science were like my strongest but then strange enough when I got to grade 12 our subjects, the way our subjects were structured it was in such a way that they were structured in packages so they would use, they would put a package of Maths, Science, English, Afrikaans, Biology, and Accounting and you know would put it in different packages so in the package that I took I was forced to do Accounting yeah so it was a bit strange for me because I was always a Maths and Science person now all of a sudden I need to do Accounting. (Melita)

All participants mentioned they were good in mathematics and science and that they enjoyed these subjects, which allowed them to consider engineering as a career choice, in addition to other science fields,

I don't think I picked the career until I got to high school. Maybe grade 10 but then, you know, even when you're young and you're kind of good with the maths and the sciences, people will be like, mmmm, you should be a doctor. That's what the teachers say and the

parents say but I think we had a career day when I was in grade 11. By then, I had decided I was leaning towards engineering. (Mpho)

Although most women had made the decision to pursue engineering prior to matriculating, two women made the decision at university registration where the registration officials recommended engineering as an option based on their maths and science grades. Palesa describes how engineering found her as opposed to her choosing engineering based on her matric subject grades:

...In high school, my marks were pretty, they were not great but they were good. And I hadn't decided what I was gonna study but I had, I thought, to apply to university, I thought I'd go for interior designing. Another thing that I thought of doing was BComm informatics. I'm not sure, I don't remember what informed that. So yeah, I got there and then, you know, I was, I think I started with BComm informatics and then the guy there was like why don't you do engineering? Your marks are good and then that's how I got into engineering...Engineering found me. I didn't, I don't think I even knew about engineering. (Palesa)

Despite not having an understanding of what engineering was, she accepted the recommendation and enrolled in engineering on that day. Palesa's reference to "engineering finding her" points to moments of limited agency involved in making her career choice. Her academic aptitude made her eligible for engineering, which, she had not considered until the registration official pointed it out to her. While she chose to take the official's recommendation, she did not feel that she really chose the career herself. For Palesa, engineering chose her.

#### **Industry Recruitment Practices**

Industry recruitment practices involved going to schools to recruit top preforming students in mathematics and science and offering various opportunities including funding extra lessons to prepare one for Matric exams, high school and university bursaries, and one company even offered a pre-tertiary training program that allowed students to be exposed to the industry before making a decision about pursuing an engineering degree at university. Bursaries are monetary awards provided by government or industry to assist students in paying for education costs (National Student Financial Aid Scheme, 2016). Unlike scholarships, which are usually merit-based or loans, which have to be repaid, bursaries are available to all students meeting the eligibility criteria set by the organization. In South Africa most organizations offer bursaries on condition that the recipient will work for the provider on completion of one's studies.

Bursaries are especially important for students from low-income households who would not have otherwise been able to afford the costs of post-secondary education. While the bursaries offered were welcomed as opportunities for one to study further, the provision of the bursaries to fund specific fields left some women feeling as though the career had been imposed on them. For example, Mpho shared how her academic competencies made her eligible for various bursaries but that she was "pushed" into engineering, despite making her interest to pursue accounting clear to the industry recruiters.

And then the final thing came, then when the companies came, they interviewed us and yeah, and then I got the bursary with (Company Name). But I say that I wanted to be an accountant... I wanted to be an accountant but I looked for bursaries at that time, and it was also through this [recruiting] company so I said...I want to be an accountant but my marks, I did very well in math and science. Yeah, so and also I didn't have enough

information. I didn't know that, you know, I can go to school without a bursary. I didn't know that I can apply for financial aid it doesn't necessarily have to be a bursary because with [a] bursary, you're more secured you know it's a done deal and you know, yeah, so I didn't know I had those [options]...So they [the sponsors] were giving for accounting. I think geology and engineering. Yes, but they, and I think that the waves in the country at that moment, they were looking to get us into engineering. So I was in that wave and I was pushed into that if you understand what I mean ... so that's how I ended up with engineering, mainly because of that; the money was available for me to do it. (Mpho) With no other funding options and little information about alternative funding structures, Mpho accepted the only bursary offered to her in engineering.

Celiwe made a similar finance driven decision where deciding to pursue engineering was a means to an end. For her, the end goal was to make money both while studying and later in her career.

You know something's not your passion but it's an ends to your means because I could've gone into commerce and accounting with my Matric because I had science and accounting, I had those two options. But someone said, no, it doesn't pay very good. So takes long for the pay. Engineering on the other hand, while you're still studying, you get paid. (Celiwe)

In contrast, Noku who wanted to study engineering applied for bursaries and was awarded two. Her selection of which bursary to pursue was based on one company having a pre-tertiary exposure training program. She liked the idea of being able to experience the career field before committing to it, along with the perks of being paid to do so. She describes the program as follows:

I was taken around the operations of the platinum from the underground, to the processing plants, to the, you know, two months here, three months here. Meeting engineers, meeting foremen. All that....so you spend the whole year in the mine with a little bit of a salary. You feel like you're working there, you know, and you don't have to bother at home with money, pocket money. I mean, you're starting to buy your own things. So you know, it got me very independent as well, a little bit more independent outside of home, even though I was quite responsible, babysitting my sister's kids cause I'm older and so that was, yeah, now the beginning of my career in a way before I even hit class. (Noku)

This process of exposing students to industry was a useful practice for companies to recruit young women into engineering careers. It showed the women what they could expect after they earned their degrees and kept interested students linked to the company through the bursaries the company provided to fund the women's education.

...so past Matric [before university], I got a scholarship to go and upgrade my marks. Maths and science marks. I think at the time, the main sponsor was (Company Name) and... Forgot the other guy. So they went around South Africa to the local schools in the locations, I went to school in the location [Black community, mostly low SES]. I didn't go to multiracial school. So they went around and selected the best students from those schools and they offered them bursaries and scholarships to go and upgrade their marks so that they can then be able to go and study in varsity...Then during that year then when we applied for bursaries, went through interviews and as part of the interviews, then they get to take you to site, to go and visit the site and my first mine visit was at a gold mine in the (City Name). Yeah, (Name of Mine), I won't forget it. I still have a photo, actually

have a photo of it. And yeah, they were probably 2000 centimeters underground and I just fell in love with it. I loved it because when you came out of that, the number of people that were applying for mining engineering bursaries drastically reduced. People switched...Yes. People switched and said no, I'm gonna do geology or I'm gonna do metallurgy or electrical....that's when I made the decision to do mining. (Lulama)

Not everyone received an industry bursary. For example, Palesa whose mother paid for her entire undergraduate degree described being actively recruited by a company after graduation.

And in my final year, (Name of Company) was...looking for people and I think at that time, finding a person who wasn't under a bursary was not easy. So when they found [me] they were like, wow, yeah, a woman! No bursary, nothing? Come, come, come! (Palesa)

Since most students were already linked with some companies, women who were free agents in the job market were actively sought after. Industry was the main destination for women engineers, both with and without bursaries.

While industry experiences positively influenced the women who later returned to industry, for some women including women like Tlenganani who ended up in academia, industry exposure was not always encouraging.

I'd done some vac [vacation] work every December during the holidays. I didn't like it. It was just too routine. I think that's what they do, they just, if you're a student, they just give you something basic to do. The money is good. Buy something nice for yourself at Christmas holidays but no it was too routine for me. But I think the thing that sort of like changed my mind was, you know, it should be different when I work full time...[so] I

was thinking about it because I felt, okay, maybe if I actually work as an actual employee full time, it'd be different.

Despite her less than positive perception of industry, and although she was not a bursary student, Tlenganani was still planning her career pathway with industry in mind. The information she received from family and peers was that all engineers went to industry, and upon graduating the recruitment company that had organized her scholarship was committed to helping her find a job in industry.

Overall in the early stages of choosing a career, the women made decisions based mostly on external influences with little and sometimes no understanding of the choices they were making and what they meant for their lives going forward. For Black women academic aptitude allows for teachers to direct students towards particular educational opportunities such as engineering. A teacher's social position and identity provides a level of authority regarding subject choice and career considerations that seem to go unchallenged by students or their family members. For Black women with academic aptitudes in mathematics and science, career choices appear to be chosen for them. Decisions about one's career are not only made by teacher, but are also determined by the socio-economic and cultural circumstances of the women's lives that limit Black African women's ability to pursue alternative pathways without consequences. After being directed towards a particular career path the women began to find ways to make the best out of their choices. The next section highlights some of the decisions made in the middle phase of Black women's career choice process in engineering.

#### **II. Middle Phase: "Make it work" - Utilizing One's Positionality**

The middle phase involved accepting one's new positionality and using it to work for one's needs. Given that their career choices had been largely influenced by other people during

their schooling, the women's new positionalities afforded them the opportunities to "make it work" and to take ownership of the experiences they exposed themselves to in their new careers. The middle phase was comprised of the following: (1) linking choice to personality traits, (2) surviving as a minority, (3) fulfilling industry obligations, (4) capitalizing on job opportunities, (5) money and family responsibilities, (6) leveraging mentors, (7) developing ideas about academia, and (8) investing in self development.

The broader idea of "making it work" in engineering came from one of the participants, Mpho, who in describing her mental state upon having had engineering chosen for her first by her mother who selected the pre-tertiary schools she attended, second by her teachers who told her to pick science subjects, and lastly by the company recruiters who provided only an engineering bursary as an option despite her indicting she wanted to pursue accounting. Given her new circumstances, Mpho decided to make the most out of what she had been dealt. She shared,

And also, I think internally, I think with me, I had, you know, fear and not enough exposure. I think that's what we lack, a lot of Black women, I think we lack of a lot of exposure of what is out there, what you can do, you know, and there's fear that, okay, this is what I have and this is what I need to do. Okay, now I've got a bursary. He's expecting me. I'm gonna work, I'm gonna make this work and then you kind of get caught in that...And I see like when you start working, I meet a lot of people and girls from different countries and I see how they can just up and leave, you know. I have to make this work. (Mpho)

One of the steps towards making engineering 'work' as a career was finding links to one's personality in a manner that justified the career choice to themselves, and possibly to others.

Justification to others can be seen in Mpho's idea of living up to the expectations of the bursary provider whose funding serves as an investment in the individual student. However, justifying to others can also be linked to the desire to prove that women and Black women in particular are capable of being engineers given social narratives abound that engineering is not suitable for women.

### Linking Choice to Personality

Almost all of the women mentioned that they liked being challenged and engineering provided the opportunity to always be challenged. Additional personality traits were a dislike for routine and liking practical work. In a memo I wrote after my interview with Melita I noted the repetition of these personality traits as described by many of the participants:

### Post-Interview Memo #13 - July 22, 2016

After speaking to Melita I am struck by the repeated ideas of 'wanting to be challenged', 'liking new things', 'getting bored easily' and 'liking the practical things' that also appeared with other participants. There seems to be a process of early realization of their abilities, preferences and personality links to career choice, after being told by family or teachers that this [maths, science and engineering] is their ability (and sometimes later on after having worked in engineering).

The women also described the fact that they were the first person in their families to pursue engineering as indicative of their independent nature and as people who like challenges. For some women being the first person in their family to pursue engineering appealed to their desire to be different and not wanting to do what everyone else is doing. While for some this realization came as they developed ideas about what engineering was, for most women it appears to have been realized after engineering had already been introduced to them and they had begun studying. The act of linking engineering to their personality traits took place as an afterthought that our interview conversation allowed them to explore in ways they had not previously done. You know, I'm the first engineer in the family as well and it was engineering and I guess because if I look back at my journey, I was always meant to do, to be different. To do something different in my family. (Lulama)

The need to be a pioneer woman was also one of the rationales provided for pursuing a career in industry and not the academy. Siwe said,

And for me, personally, again, as a Black young woman, you come from a history politically and economically that says that now is your time. Right? And you have to be an example. I wanna be an example so that when I go back to the township they can say, ohh whara whara [so-and-so] she works at. Not an academic professor because, as Black people, as women, we had in the past penetrated that and a lot of professors, successful professors in academia. But even though we're not talking about in engineering but in general, we feel that if there's more than we can do in terms of our legacy in the areas whereby we need to tell our kids, uncharted environment. I'm an example go do it. You see women want to go to aviation. Because before academia that's where, I feel like it's saturated in terms of, in terms of being a women and a Black women. I'm gonna [just] be a number there. (Siwe)

Engineering industry was seen as the place to set records as the "first woman," compared to academia which was considered women saturated. Being a pioneer in industry was more appealing to these women, especially when considered in reference to the apartheid history of Black and female exclusion from engineering. While one would assume that the perceived overrepresentation of Black women in academia would help in sending the message that academe is a welcoming space for Black women, the saturation by Black women in higher

education actually reduced the appeal of pursuing academic careers among Black women engineers who strongly identify with a pioneer woman identity.

### Surviving as a Minority

The women spoke about their experiences throughout different moments in engineering in terms of surviving in a space that was White and male dominated. Surviving meant learning to accept whiteness as the norm and getting used to sometimes being the only Black person in a space. Rose describes her undergraduate university experience and having only White professors:

Like we had accepted it. It's a matter of us just saying we just need to get our degrees and go, that's it. Yeah, we had accepted it. Yeah its just how it is you can't change it, you are here so you just have to live with it. (Rose)

Noku describes her early reactions to being the minority in engineering undergraduate education as a culture shock that she eventually got used to.

Yeah, at first, a bit of a culture shock because in class, there'd be like five of us out of a class of 30 Whites, Indian, you know, so you'd be like a few but after a while, you forget about that. You are all *nje* [just] a part of the group. You're all trying to get a pass. So at first might be a culture shock but yeah, you get used to it. You get used to that quite quickly. (Noku)

Given the predominance of White professors, Black women viewed the higher education space as a transitory space where they needed to pass and get their degrees to be able to go elsewhere. An academic career, which would inevitably involve spending more time in a predominantly White space, was not even considered.

Despite being one of few Black African people, Black African women found ways to survive in engineering higher education. Mpho noted that because she was an academically good student she was able to use that as leverage to enter White spaces in ways other Black African people may not have been able to. She did note however that entry was possible with the younger generation while the older generation only saw you as Black and did not care how good a student one was:

I think as a Black woman, this was my experience. And there were two parts to it. Because one, I worked very hard so I did all my work, my assignments. So I felt that there were a lot of people from the Black community that I interacted with and that you know asked me 'how did I do this?' So there was that one part. And also, I think because of that, as well, it gave me an opportunity to also interact with the White students. So I could break in, [Interviewer: Oh, because you were a good student?] Yes. Yes. Because of that, then I could break in, I could interact with them and talk with the [White] students. But then in terms of now, the lecturers, that is where the difficulty was. I couldn't break through in there whether academics or not. I couldn't break into it... I felt, I made an assumption that it's because I'm Black Yeah, so I made an assumption that it's because I'm Black. That's why I'm not able to talk to him or her the way they would...I think it's the different generations basically. That you know, we were, our generation, we did not go through the struggle if I may put it that way, but then with the older generation, you know, they were, they were still into it so that so it didn't matter how good you were. (Mpho)

The history of apartheid and the racial hierarchies and prejudices the apartheid system created which presented Black people as incapable scholars remained present among older academic

staff in engineering higher education. As a result regardless of Mpho's academic competencies that allowed her to be accepted by White peers, her academic prowess did not preclude her from the racially biased ideas held by older academic White staff. Teboho, who had worked for 10 years in engineering industry, mentioned issues of language and racial bias as something she also had to endure but for her this was more salient in the workplace and not in university.

We're treated equally when we study. In the workplace, that's where you start to feel that. I'm a female. I'm a Black person, especially if you are in Pretoria. Those guys, they'll invite you to a meeting. All of a sudden, they're speaking in Afrikaans, like, okay, do I stand up? Do I say anything? Then you say 'guys, I can't hear you', then they switch back to English. Down the line, then they start, then you feel like I shouldn't be here. It's difficult in the workplace in being a woman, an engineer, and Black. In the workplace, it's difficult but in schools, it's not. (Teboho)

In addition to being a Black woman in engineering, being a Black mother meant surviving with limited support and required additional survival skills. Siwe felt like she had to work twice as hard as a black woman with a child while in industry compared to her White female counterparts. She describes how she felt pressured to return to work immediately after giving birth because she was a Black woman in a senior position. However, the mixed messages she received from the male dominated environment about her new identity as a mother made her feel like she had to split her mind at all times so she could attend to both work and family responsibilities equally:

...you're working in a male dominated environment. For them, you are still a mother. You should be at home. You should be nursing. At the same time, you're a Black young woman who's in a senior position at that stage, not senior senior but you're more in a

middle management position and there's issues with affirmative action and everything else. You know, 'no she must perform just like us' so you get more double the pressure than if you were not a Black, if you were a White maybe woman, they give you more support, people will rally around you they will lobby and make sure you're covered but then now, you're a Black person. (Siwe)

The idea of Black African women having to work twice as hard and to prove themselves in the workplace was echoed by the two Black African women in academe. As women working in an environment where students considered Black women as the antithesis of the acceptable White academic image Black African women felt pressured to over prepare.

I've noticed, when I come in with this skin in class, and I'm this age, and I'm a female, you see the look already....[So] I put myself under so much pressure that I tell myself, okay, you have to know everything. You must know that and more and almost as if more than what... Because if I say don't know, I'll ask, okay. Really? [Interviewer: They don't trust anything else?]. Yeah...cause I've seen it. If Dr. [White male professor] for example if [he] says 'I'm not sure about that I'll get back to it.' It's okay. If I say I'm not sure, I'll ask [Interviewer: Everyone will sort of snicker]. Yeah. Hmm, yeah. So you know what, we've come a long way in this country but we haven't come long, we haven't come long enough.

Bridgette the other woman in academe shared similar sentiments. In response to my question regarding how she knew what the image of a Black woman professor was if she had never been taught by any Black person before, neither male nor female she responded,

It was just self-taught, you know...I suppose you just...make sure that you [are] prepared for the class and not want to make yourself an idiot. I suppose we even, we overdo, we

overdo it because we don't want to embarrass ourselves and things like that. The absence of other Black females in engineering posed a challenge for all women in both industry and academe. In order to survive one had to learn to look past the minoritizing experiences. Lulama noted how her peers had been unable to accept this reality and had left engineering to join other careers in finance:

...we didn't have Black females or even Black lecturers to look up to at the time... you know, the whole industry was White, it still is today. But back then it was more so, you know, so it's, it was difficult to even find, there were a few Black people and all male at the time. Like I said, the first female graduate was when I was a first year. So still, I mean, even today, apartheid is still big in the industry. So it really never, I think if you don't look beyond that, past that, you might then decide otherwise and I think it has..., that has actually forced other people to look otherwise cause we've lost quite a lot of engineers to the financial institutions. (Lulama)

Lulama makes a direct connection between Black women's experiences of industry as blatantly discriminatory and hostile, with the prevalence of apartheid ideals in industry where White male dominance prevails and Black people are viewed as incompetent. It appears then that for Black women who cannot look past the hostility the finance sector offers an alternative career option and not the academy. Rather than remain connected to engineering through the academy, Black women would choose to pursue non-engineering career paths. It is probable that because engineering was an imposed choice commitment to engineering is limited such that one would
prefer another sector of work. Alternatively the academy is not an appealing career change and is thus not ever considered when the opportunity to change careers arises.

### **Fulfilling Industry Obligations**

Women who had received industry funding felt obligated to persevere through their studies. For most women the bursary offered the only opportunity to pursue higher education. As a result they felt that not doing well academically would lead to losing the bursary and their only opportunity to attend university:

And for me as well I was the first one to graduate at home so you know I had too much riding on me so you know I always had to pick myself up everyday and be like just go on, you know. Because with us when you're coming from a black family you know you're not all privileged you know so there's certain things that you wish you could have and you couldn't ...I was on a bursary, I could not afford to mess up. You know because firstly I didn't have the money to pay them back if I did mess up and I didn't have the money to pay for myself if I, you know. Yeah so, giving up for me was not even an option at all. (Melita)

In addition these women were contractually obligated to work-back their bursaries, meaning immediately after graduating they were required to work for the sponsoring company for the same number of years for which they had received funding. Mpho described this bursary obligation process as something that streamlines one's life since from the first day of sponsorship one is usually guaranteed a job and the obligation removes the option of pursuing other work opportunities, at least in the immediate timeframe after graduating:

you know, the bursary, I think it sort of, a bursary sort of, it streamlines your life because it has a lot of, it's a big package that comes with it because when you finish, you have a

job. You know, so there's no stress looking for a job and all that. And then number two, you have an obligation to the company that you must... 'Cause the agreement was we

pay for you for four years and then you work for us for four years. (Mpho) Fulfilling the industry obligation also meant accepting whatever position one was given which was usually based on industry needs removing the ability for bursary recipients to choose their job. The bursary obligation further exposed these women to industry work, contributing to their comfort and understanding of the industry space. The additional exposure to industry meant academia as another career became less tenable and academia became solidified as only a space for acquiring theoretical skills so one can go and get a job in industry. Even for those who did not receive bursaries industry remained the place to go and work. Siwe shared her idea of academia as never being an option even though she did not have a bursary that tied her to industry:

We knew that at the end of the day metallurgist when you graduate can either go to industry, can either go to research or you can either go and become a lecturer, junior lecturer. Junior lecturer? Come on now! Literally, it [academia] was something you laugh over... I think that the perception is I am not an education specialist so if I wanted to be a lecturer, I would've gone to study education I'm an engineer, for goodness sake. So I must design. I must invent. (Siwe)

In some cases bursary obligations were waived due to industry hiring constraints. For example Tumelo had received a bursary but was released from the working obligation upon graduating. yeah and then after when you're done with school you're supposed to work for them for a few years to pay back the bursary money but in my case they didn't have space for me so they released me from the contract. (Tumelo)

The release from her contract also meant she was not guaranteed a job after graduating and having to search for new job opportunities. Only one woman shared that she had gotten herself out her bursary obligation by getting a job in government and telling her sponsor company that she was leaving and she would not be paying back any of the money since she was going to work directly for the government. When I asked her why other bursary holders did not leave like she did, she said it was because the bursary recipients did not know that they have other options but also that the luxuries that came with the guaranteed job made people comfortable and "dimmed their light" (Lerato) in terms of thinking about other job opportunities. This idea of comfort in a bursary guaranteed job echoes Mpho's idea of a bursary streamlining one's life, as mentioned previously.

In contrast, Black African women with obligation-free scholarships were easily able to follow other career paths.

I was on a scholarship so there was no having to go and pay them back. It wasn't like a bursary...They pay for you over four years and then, yeah, [you] just decide what you want to do after that. So after honors, my parents expected me to go back to industry...and I was like, no I actually want to study... I still wanna go for my master's, and do my PhD eventually so let me just get it out. Cause the plan was let me just get it out of the way soon as I can and then I'll go into industry (Tlenganani)

Tlenganani's plans to eventually go to industry "didn't work out that way" as she ended up staying for her master's and being recruited into academe. A pathway into academe was possible in part because there was no bursary obligation streamlining her career towards industry.

## **Capitalizing on Job Opportunities**

As part of "making the choice work" for them, the women capitalized on job opportunities they came across in industry. For Palesa and Siwe who were not bursary students, Tumelo who was released from her bursary obligation, and Aphiwe who received an obligationfree bursary, job choices were based on what was available. In picking her job, Siwe shares her thought process after graduation:

I think the critical thing at that stage was do I have choices? Do I have alternative? It was never about who do I wanna work with, and I'll give you the reason. At that time, yes, the mining sector was booming, right, but at the same time, there was becoming a sort of a saturation of metallurgists. So everybody, you know, most people wanted to do metallurgy and I was not a bursary student. So my selection choice, I didn't have a plate with a selection. Cause as a bursary student, even though you know [Interviewer: Yeah, you're going there] but then after going there, I'm gonna have this selection. I'm gonna be choosing this and this. For me, at that stage, the most important thing was I must get a job. Whatever comes first, you will get a job and will go into it because of again, jobs were not easy coming. (Siwe)

For bursary recipients, after serving their obligations they were able to take new opportunities that arose separate from their sponsor company. For example, Lulama left her job in the mines after serving her obligation to pursue a new opportunity at a company that had been a client of her sponsor company:

...I was asked to join the (Company Name). I was working on one of the projects for the company, yes, and then they asked me to come and join them. [Interviewer: What made you move to them?] It was that growth prospect. Yeah, the only other reason I've ever

left a company, in fact, the main reason, apart from there's always going to be politics in everything, but the main reason when I decide to leave a place is if I don't see, if there's growth prospects where I'm going. (Lulama)

In contrast Naledi was honest about pursuing a job opportunity that arose because of the money that was attached to the position. For Naledi, money had been the reason she picked engineering as a career in the first place. Now with family responsibilities money became even more important for her. She explains her decision to switch jobs as follows:

I did my project management while I was with them, which was also fun. But I left them a year after that. [Interviewer: Okay. So what made you leave?] An opportunity with (Company Name) to do a GCC. I don't know if you know what a GCC is? It's a government certificate of competency. So it was taking me back to engineering cause I wanted money. Honestly, the reason why I went to engineering was for money, so if I'm not getting that money, what's the point? ...I had kids now and people, they're [the company] not giving me what I want. At this stage, I should be here and not here so that's why, so I left. I went to (Company Name)...So the minute you get that post, it's perks, titles... I was like, cool. I'll suffer through this! (Naledi)

Naledi's reference to 'suffering through this' reflects the idea of making the path she had chosen work for her lifestyle needs. She would suffer through this new job opportunity for the financial rewards guaranteed even if the job was not something she enjoyed. Naledi's light had been 'dimmed' by the luxuries and perks of the job which she was willing to accept in exchange for her professional happiness.

### **Money and Family Responsibilities**

Money was presented as a motivating factor mostly linked to one's family responsibilities. Mpho a more seasoned engineer having worked 10 years in industry shared why Black women pursue careers in industry and not the academy.

And I think also the pressure comes from, as a Black woman, you want to go back home and do things for your home and that's why as soon as you get in a position to study, you want to go and do something that can bring you the finances to go and support your family. Because we feel a lot of responsibility. Especially in our generation, we felt that, okay, we were one of the first, you know, the first groups to get bursaries and get proper education, get to do what you want. With our parents, it wasn't like that but with us as we're given that opportunity to get, you know, to do something that will work, do important work, let me put it that way, and get a proper salary. As soon as you get that opportunity, you want to do it so that you can actually provide for your sisters, your mothers, your grandmothers because there is a lot of responsibility that you naturally just carry. That I have a grandmother, I have an aunt, I have this, I have an uncle. I have sisters, I have brothers that are not working and I want them to live this type of life. So as soon as you get an opportunity to leave university, I think you do. (Mpho)

Tlenganani a lecturer at a traditional university had similar considerations about the perceived value of future income for her family. Prior to switching to engineering at the postgraduate level, she studied chemistry at the undergraduate level, a choice she says she made because of family expectations unique for Black people.

With us Black people, you're expected to, you know, financially, you know, I mean, when I came to university, I didn't' necessarily wanna do a science. I just happened to be

good at math and science. You know, so it was like one of those, if I wanted to, I would've done art or design, architecture, something like that. You know, but knowing us and our Black parents, you know, do something that you know you'll get a job with, you know. So I opted for chemistry.

Maria also a seasoned engineer with 14 years of experience working in industry shared the same sentiments as Mpho about family relying on her for money.

Number one, main reason is we don't have money. We need the money that is in the private sector and in the, in other industries. Like we are mostly the first people to graduate at our home. We are the first engineers at home. Like we've never had an engineer in my home and even other people who are working, they don't seem to be making as much. So my mom would always be looking at me and that is, that is one big thing, I think. (Maria)

Nandipha, a younger woman, echoed the same idea that as the first people at home to go to university individuals weigh the cost and benefits of continuing to study in the pursuit of academic careers versus taking an opportunity in industry that pays the money one needs to meet their family needs.

And also because when you specifically, pertaining to South Africa, I mean, as much as we have more graduates, the background of those graduates, it's still very under privileged so a lot of graduates now are having to carry the burden of their family because it's like I'm not studying for just me. I'm studying for me and my family. So to tell someone who's young and Black and who's got a whole family waiting for them to arrive, telling them to go to university, out of job satisfaction. Cause I mean, I think mostly people who lecture, I think job satisfaction is like, I think it's the most satisfying

job ever. I mean, if you're really there and you're doing what you like, I think you're so fulfilled in terms of your career. But now, when you actually weigh what you get paid at varsity and what you get paid in industry, you just weigh it and you're just like, I can't. You know, so you don't even allow yourself to develop the passion to even know what it would be like for me to go back and lecture. So it's, it's mostly money, I think.

(Nandipha)

Women like Bridgette currently working in academia also explained how Black people are drawn to industry because of family responsibilities related to money. Even for those in academe the expectation to provide for one's immediate and extended family remained a reality.

I think the main problem is money, honestly. I mean, for me to come here, I had to probably lose about 10 to 15,000 of my salary to come from industry, from engineering manager to a lecturer. So the main thing, I know main, main issue with particularly our Black people, it would be finances. Because first of all, they've got, you know, families to, extended families and what not, like just now my sister's son was just phoning me wants something. Your hand will always have to be open every time. So finances are quite a main or contributing motivator. I mean, I see it, I've got students in industry that really wants to come or want to do their master's and D [doctorates] but they cannot leave their job to come and do their master's and D [doctorates] because they've got responsibilities. They've got kids and they've got families. They must still provide at the end of the day

The connection between family responsibilities and finances was not only real for Bridgette but also for her students. Even when some students expressed personal interest in pursuing academic careers, family obligations took precedence.

From speaking to one of the Deans (Paul) it is evident that institutional leaders are becoming aware of the ways in which money and family responsibilities are linked, a perspective that has been missing in the conversations regarding Black people's underrepresentation in academe in South Africa. Paul also made the links between most Black student's first-generation status, a reality of a transforming post-apartheid South African society.

The reality is that academia doesn't offer the rewards that industry does...many of the youngsters coming into the [higher education] system have obligations to a much broader family than I suppose some folk would and I think quite seriously there's an element of that. I don't think anybody would say it as bluntly as that but I really think that, and I've been very conscious of that when interacting with folk that I really thought should be doing academic careers but their reality is 'Prof you cant pay me enough to make it worth my while' and that's not saying that they think money is important its just the reality where one finds oneself, and you look at that and you think yeah I'm not going to argue with that I understand. So I think there's an element of that so first-generation very often, you moving into profession which pays well and you've got a lot of people that you have an obligation to support in one way or another you know and I think there is an element of that.

The recurring theme around the money conversation was the women's identity as first-generation students. First-generation status was also linked to the history of Black people and access to tertiary education that the women believed had hindered their parents from obtaining similar education opportunities. Therefore, as the first in their families to attend university and to graduate the women had family obligations that required one to have "proper salaries" (Mpho) that were seen as only existing in industry and not the academy. Family obligations outweighed

individual considerations for careers that may have been more fulfilling to the individual. Financial necessity and family obligations meant that Black women could not allow themselves to entertain alternative careers especially academia.

However, it is important to acknowledge that indeed some women were motivated by the prospect of money alone and did not mention it in reference to family or community obligations. For example, Palesa found out about a job opportunity at another company and moved for what she says were primarily monetary reasons.

My job there was brilliant. I loved it. Also analysis type of work. My boss was a lady. She was, she was fine, calm and easy and she trusted me, she trusted me to do my work but I was pretty happy. One of the best jobs, actually. And then the only reason I left was for money. Yes. I left because of money. (Palesa)

These findings are of particular importance given the narrative that women continue to be absent in academe because they are chasing more lucrative opportunities in industry. As David, a human resources staff members in the faculty of engineering shared, while there has been an increase in undergraduate enrollment by Black women,

...our biggest challenge is still then is to come through to basically PhD level but as I say, you know normally undergraduate honors and then they move into the market. And as I said, our biggest challenge is the pool that we and industry is from the same and their [industry] salaries are much more competitive than ours. So that's the biggest challenge for us. (David)

For women like Palesa coming from middle-income households, the pursuit of individual riches may be true. However, for the majority of women in this study coming from underprivileged backgrounds, the narrative of prioritizing money fails to take into account how the pursuit of

money is linked to family and community needs more so than the individual. Fatima, an Indian woman also working in human resources, understood how family considerations influence Black women's career choices away from academia towards industry:

It's still basically your salaries. That's the biggest thing. You know, and if you look at the backgrounds, right? Most engineers are mainly White. And if you look at the few African and, you know, your EE [employment equity], it's very few of them and they all go into industry. The salaries are higher. And what I know as a Black person, you support your family. You understand. So you go for the highest salary because you've got extended family that you're supporting. And I think that's, that's the biggest, the biggest thing for them. A better salary where they know they can provide. (Fatima)

### **Leveraging Mentors**

In finding ways to navigate the newly selected careers in industry, women leveraged mentors where they could find them. Noku found mentors in male figures, both Black and White. When asked about some of the influential people in her career path Noku responded,

Oh, definitely those big brothers I'm talking about, the mentors. While now we were, I was in tertiary, coming for vac [vacation work], I would see one Black engineer, young. You know, he just qualified. He's starting now as a manager. That will ignite the passion even more and be excited and you know, now you have someone you call a brother, like Bhudhi [Brother] Martin you know, always us Black kids always saying can't call them by first name. That's Bhudhi Sipho graduated so now he's like you're claiming him as your brother. So those are the people that kept me going. "Wow, we hear about you. We can see you're hard working. Keep going. You can do this." (Noku)

Noku also found a mentor in a white male who recruited her to go and work in the corporate head office of the company and exposed her to management.

...there was, it was like a mentor, a White mentor. His name was (Name of mentor), he was at head office in (Name of Town). And he's been eyeing me, talking to us and saying, I'd like to mentor you. Sometimes coming to visit our head office. Coming to understand where (Company Name) was coming from. And then a year and a half into the second position, he scooped me and said I've got a position opening up in head office. We've never had young engineers coming to head office but I want to take you. I went for the interview. I got the job! (Noku)

The presence of both Black and White male mentors in industry created a supportive environment for Maggie contributing positively to her career advancement. In contrast, Bontle's work experience involved seeing her White male colleagues receive mentorship she was not offered.

you get young guys brought into the department who were, what the department was used to dealing with lets say young Afrikaans males coming in. They would actually immediately get put on work related to what the company does they would get formal training and mentorship and you would have to kind of see all of this happening and be

ok with it. It was a constant fight and it kind of put me off the engineering field. (Bontle) The absence of mentors in the workplace for women like Bontle can also be seen at the university level. However, while the women stayed in industry despite this off putting absence of mentors, in academe the absence of Black women created a perception that academia was not a place for Black women. During the interview Mpho reflected about how she had not even

thought about the absence of Black women as mentors and role models in her academic pursuits until I had raised the question:

I actually never thought of it, to be honest. To be honest with you. I thought that's how it's supposed to be. I actually never thought of it but now that you're asking me the question, I feel wow, I think I missed out. I think if there was someone like me, a Black woman, teaching me to become an engineer, I think that would've been that motherly touch to it as well. Someone you can go and speak to and ask questions. Someone who would inspire you. It would be more comfortable for you. I think I would have had a different perspective about engineering. As, even if it wasn't my best. But because this woman is standing here and she's Black, she's, there would be just that connection. So I think, I think it would've been, it would be actually absolutely beneficial to me to have Black women as lecturers. (Mpho)

The normative nature of Whiteness and maleness in engineering academe sent the message that some spaces are not for Black women. A clear example lies in Mpho feeling that the absence of Black women in engineering academe was how it was "supposed to be."

It is important to highlight that in the absence of Black female mentors, Black African women in academia leveraged the male mentors they could find. For example, Tlenganani who was completing her master's at the time of this study had been recruited to become a lecturer by one of the White male professors she was working for. As he was retiring the White professor encouraged her to consider taking over his position and secretly submitted applications on her behalf for a government funded academic recruitment program targeting Black people and women.

I remember when [Black male professor] left and he had turned me over to [White male professor]... he was retiring. It was the end of his term here at the [University of Name]...So he was looking for someone. So he didn't tell me he had found out about this [Government program] and he applied for me and then only when the application was approved, the funding was approved, he then told me about it. Cause initially, he had told me about a year, a year before that, that he's thinking that I should, I should actually apply for the post...'cause he was leaving and he wants me to take over his post. So I was a bit uneasy about it because I initially wanted to go into industry and I never really thought about being an academic per se. So but he really wanted me to do it. So he convinced me, okay, I'll think about it.

Tlenganani had been mentored first by a Black male professor who convinced her to continue to postgraduate studies. As he was leaving academia he made sure she had another male mentor. Her new White male professor mentor then looked for resources to support his efforts to recruit her into academe. Tlenganani recalls how her White male mentor "fought for me. He fought for me. He fought for me to be appointed" when senior people in the department were not enthusiastic about giving her a chance.

### **Developing Ideas About Academia**

Throughout their training to become engineers the women developed ideas about academia that further informed their career choices. Despite these women pursuing postgraduate studies they never considered academia as a career. For them doing engineering happened out of the university. The academic space was a passing point to real work "somewhere else" out there:

...and I think usually when we think of engineering, we tend to more think of not academia. Yeah, I think when you're thinking academics, you think I must go through it

and go work somewhere else. Yeah, I think it's more also that we have not applied our mind to the possibility of us doing it. Just think, okay, this is something I have to go through and go work somewhere else. (Vuyo)

As real jobs were "somewhere else" academics were viewed as engaging in the noble cause of preparing students to go and do great things outside of the higher education space.

But with (University Name) lecturers, engineering lecturers, I feel they were just in a silo and the world did not exist. And yeah, that's what I saw of them. And yeah, it's not, it's a bit dull. A bit dull. It's like taking on a noble cause. That's what you would say they were in. It's noble because they were giving us foundation, they were preparing us for better things but I felt they were a bit isolated. (Noku)

The women mentioned a lack of knowledge about how one can get an engineering degree and become a lecturer and still be considered an engineer. The message they received was there was a shortage of people in industry and so the universities offered postgraduate degree classes organized in block weeks of two weeks every month, which allowed people to continue working in industry while pursuing postgraduate qualifications. The academy was never presented as a working opportunity and so they did not consider academia as a job:

We don't think lecturing is a job. We don't think so, it's a job, so we are going to the market industry. That's our job for us. (Teboho)

For the one woman who did consider academia as an option at one point and pursued her Honors and was enrolled to continue with a Master's, even though academia was an option, she still considered the academic route as unrealistic when family responsibilities arose in her life. Despite her passion for academia, the real world of work was outside of higher education: I then did my Honors and everything but like my Honors year and then I found out that my parents were not well and, and then I'm like ok, you have to be realistic you cant be a student forever you can't, you need to help out at home, you need to have a plan kind of. And, where I come from having a plan means you must have enough money to take care of yourself if, if it comes to taking care of your other siblings and family you must be in a stage where you can be able to do that and then I'm like yes, studying further no, it's gonna have to wait. I'm gonna have to put it on the side and, and get a job, be a grown up basically (laughs), grow up and get a job and so that was after the Honors year I had to leave my studies. (Aphiwe)

Aphiwe's response brought up the idea that pursuing an academic career required one to have solid financial resources. The absence of such resources meant that one had to "be realistic" and go seek employment in industry to be able to make this money. Tumelo seemed to think that only wealthy people could afford to pursue academic careers:

If you look at most of them [academics] they have their either married to wealthy people or they have a good, this is a generalization, so their either married to a wealthy person or they have rich parents or pretty, yeah. Or they have rich parents and what not. And most of them take them [academic jobs] after they've done their industry work or so, so they take them when they are ready to settle down and won't be moving anymore its sort of like your, comfort career. (Tumelo)

According to Tumelo, academe was not only for those who had enough money but it also was a second career option for those who no longer wanted to work in industry. In addition to thinking an engineering career is only in industry, all the women also indicated that they had not received any information about the academy as a career choice.

I think its just lack of knowledge, information. Because I don't even know what qualifies one to be a professor, a lecturer. I don't know, I've never even asked myself why are those guys lecturing us? Do we need 10 years experience in the field? Or do you need certain qualifications? It's just not knowing and think, okay, this career [engineering] is industry. We don't even think that you can study, be a qualified engineer and go straight to lecturing. I don't know if it's possible. So how do we, I don't know. How do we solve it? Maybe there must be also guidance while you are at school, that these are the opportunities. When you start, it doesn't mean you qualify, how do you practice as an engineer. You can be an engineer and be a lecturer. That's it. But we don't know that. We don't uh uh [no]. We just know there's shortage of those people [engineers] in industry, that we know but how do they get there? We do not know. (Teboho)

Teboho raises an interesting question about how the narrative in the country is geared towards having more engineers in industry, but little is asked about how engineers are made, that is, the education component and the academic staff who contribute to ensuring there are enough engineers in the country.

The lack of information coupled with the women's perception of academia as an unwelcoming environment for Black women deterred these women from thinking about the academy as a place of work. Audrey shared,

And I suppose the environment as well. It's just not that attractive. It's still like an old boys club, if I can put it like that. So it's, yeah, and it's like that wherever you go. Whether it's (University 1, 2 or 3), it's still like that. It's still a club of, closed circle of people who speak a particular language and you can go be the brave one and go in but then you risk being the token in the group. (Audrey)

The women in this study also used White women as a benchmark for how they perceived they would experience academia. Tumelo and Aphiwe both share how they thought about what their experience as a Black woman in the academy would be like based on their experiences of watching White women in engineering academe struggle:

But it's also very hard to go into that field. It's because you need, you've got to prove yourself so much just to, it's bad in industry and it's even worse in academia for what I feel, how I feel cause even the White women lecturers find it tough to compete in that male environment so, and they are White! (Tumelo)

Aphiwe shared,

...You know. So, you know, I don't know what, if you would think if you're White female you'd think you're more likely to get there and even for Black male I think its very very tough so if you think you have two White female, and right now I think we have zero Black male in our [previous university] department, I think female, Black, you're at the bottom. (Aphiwe)

Tlenganai's experience of gaining entry into academia confirms the negative perceptions regarding academia for Black African women. Despite having a White male professor vouch for her capabilities, Tlenganani felt that the pushback she received during her recruitment process would not have occurred had she been White. Given the assumptions of academic competency automatically awarded to White people in higher education as a Black African woman she had to prove herself. She recalls:

I remember I presented...then afterwards we went back for like a feedback session. And [White male professor]'s like, most of the staff didn't know who you are but they were actually impressed, they won't understand it because it's different fields, but they were

actually impressed, but the current HOD [head of department] at that time...to actually convince him and he was like, okay... So it still had to be a fight...I think if I was not Black, they would've been like, okay. I feel like it would've been okay. It's alright from the get go. But I had to still prove myself. (Tlenganani)

Even with a White male mentor vouching for her capabilities, as a Black African women mentorship alone was insufficient to gain access. Black African women still had to prove themselves to other White academics whose skepticism was present from the beginning.

Interestingly, the women acknowledged the challenges they faced as women in industry were similar to what they perceived academe would expose them to, and yet they still wanted to respond to the challenge in industry and make inroads into spaces they felt women had not yet conquered. I argue that there is more associated with being afraid to have their intellectual capacity open for scrutiny in academia in ways that perhaps industry does not do, a concern I can identify with. This idea was presented by some of the women who mentioned they were intimidated by students and not feeling like they could teach until they knew their "stuff":

The one decision that I made when I was a student, I said I'm not gonna be a lecturer. You need to know your stuff. Kids can be mean sometimes. They'll ask you certain things just to expose you. That's how students are. I said, okay, you need to know your stuff when you become a lecturer so I am not gonna be lecturing any time soon. (Teboho) It is important to highlight that in developing ideas about academia most of the women revealed that they had not had a conversation with a lecturer or academic staff members about what academia as a career entailed. Furthermore most noted that their professors and lecturers had never spoken to them in class or elsewhere about the job they did in academe. A few of the women mentioned that at the postgraduate level academic staff had mentioned in passing how

the students should consider coming back to higher education to "give back" one day in the future. In the absence of direct information from current academic staff, the women relied on their perceptions and interpretations of their observations of the work academics do. The feeling of being distant from their professors and lecturers further contributed to their inability to seek out and receive accurate information about academia as a career.

### **Investing in Self-development**

The women participating in this study all had a postgraduate qualification, which in the South African context refers to any advanced qualification obtained after an initial undergraduate degree is obtained. In this study a postgraduate qualification included an Honors level degree or diploma, Master's, and Doctoral degrees in engineering or another non-engineering field. All women had at least an honors engineering qualification. It is important to note that some institutions had recently changed their minimum requirements for academic staff positions to a Master's degree, which would change the eligibility of some participants in this study at more prominent institutions. However, the assumption guiding this study remained that an honors degree is sufficient to allow Black women to pursue academic careers in South African universities.

While I initially assumed that a postgraduate qualification would serve as the actual selection of a career given that postgraduate studies serve as a career defining moment for academics (Austin, 2002; Herman, 2010; Perna, 2004), the women made clear that their career choices were made prior to attending university. Instead postgraduate studies presented opportunities to further solidify their choice in engineering or to diversify their skills by pursuing other fields of study. The latter will be discussed as part of the next phase. Here I discuss

postgraduate studies as they relate to those who pursued engineering postgraduate degrees as a way to solidify and take ownership of their career choice.

Through her workplace exposure Tumelo realized that there were some courses she had not received during undergraduate studies and so pursued a postgraduate Honors degree at an institution different from the one she had attended for undergraduate studies to enhance her knowledge,

...during my first year working at (Company Name) there's a lot of research work and yeah I was working with a lot of the lecturers there and yeah they had some nice courses that I wanted to do so I went to, I did that, that's where I did them cause there were courses that we didn't do at (University Name) tertiary. Additional courses that I wanted...not for my job necessarily it was for myself... I paid for it myself. (Tumelo)

Tumelo's emphasis on having paid for postgraduate qualification herself indicates a different sense of ownership of her postgraduate qualification than her undergraduate degree, which her mother had paid for. Teboho spoke about postgraduate studies as being for herself but also to set education standards for her children to follow:

Studying further was just for my own self-enrichment actually. I just did it for myself. I said while I'm young so why not? Let me study and be a good role model one day to my kids. And they will say 'oh mommy graduated five times', whatever. So setting a record for my kids. (Teboho)

Melita pursued an honors degree in engineering because she felt like her job was not utilizing her undergraduate degree and that she was losing connection to engineering. Postgraduate studies offered her an opportunity to remain connected to her engineering degree while she worked:

For me when I first started working it was just a different environment as compared to school, like for a moment there I felt like ok what happened to all these things that I learned? So for me to do my Honors I just didn't wanna let go of my degree and everything that I learned as an engineer and when you first start working especially for these government institutions, you know you feel like what happened to my civil engineering knowledge? ...Because all of a sudden you went from you know doing designs working with hardcore buildings you know, doing hard core engineering and then you come to work and they just give you something so trivial and you're like, what's happening? You know, yeah so for me I felt like I was gonna lose myself as an engineer if I didn't continue studying because I felt like work was just not giving me that platform to be an engineer. (Melita)

Postgraduate studies were not viewed as preparation for a career in the academy but were part of an individual's desire to develop and add to their knowledge in engineering without compromising their jobs in industry. Having and maintaining a job in industry was viewed as more beneficial to the individual and their communities than continuous education endeavors. A job in industry was prioritized while postgraduate studies were relegated to the realm of additional and unnecessary personal goals that should not interfere with one's job. Even for Tlenganani who studied full-time and eventually ended up in academe, pursuing postgraduate studies was a strategic decision for future career advancement in industry.

You're sort of told an undergrad is not enough. You sort of know, that okay, should I want to go into industry? If I wanna get in industry, I should be a step ahead of the rest. You know, to sort of get a better pay, you know, so you know, I need to do an honors

before I go into industry. Or should I go into industry after my undergrad, then I should be pursuing honors while I'm working.

The fact that higher education provided special class structures like block week classes to accommodate industry needs reinforced a narrative that the higher education space was merely a preparatory space for industry needs. It is therefore not surprising that Black women did not view higher education as a place of work. However, Melita's feeling that the industry environment was jeopardizing her ability to remain engaged with engineering contrasts how most women did not view the academy as a space where real engineering took place. After somewhat solidifying their careers in industry the women then began to explore alternative career paths more aligned with their interests, branching out into other engineering spaces and even going outside of engineering to do so.

### **III. Late: Branching Out**

During the late phase the women began to branch out from the previously streamlined career path in engineering to explore some new and existing personal interests both in and outside of engineering. Branching out involved (a) switching jobs, (b) pursuing postgraduate degrees in other fields, and an overall (c) recognition that their career desires had changed over the years. Although the women ultimately did not leave engineering, they considered other career paths and prepared themselves for potential non-engineering opportunities in the future. One woman left engineering briefly to teach but returned to engineering after not being able to secure employment in the finance sector. Another woman left to pursue an MBA and at the time of the interview was considering either returning to engineering consultancy or pursuing a teaching path. Switching jobs was something that all women either considered or had done at least once.

## **Switching Jobs**

Women in the earlier part of their engineering careers spoke about looking for other engineering career opportunities including finding other jobs where they could be exposed to new things and develop skills in a different area. In most cases switching jobs was linked to cleaving from the bursary sponsor or the first job they had been exposed to after graduating. Rose, who currently works for the company that sponsored her education, talked about wanting a different environment:

I want a different environment. I want somewhere not research environment. I want to gain experience in a different environment where I can learn different skills, skills like how to manage people, how to work with a group of people...in plants where you get to work with different people and gain experience in the production center. (Rose)

Aphiwe who had abruptly halted her postgraduate studies to go and work in industry due to illness in the family had become disillusioned by her job and wanted a change. At the time of the interview she had just been accepted into a full-time engineering Master's program and was scheduled to leave her job in the coming months. However, she explains that had she not been accepted into the program, she would still have left because she wanted something different that would be more fulfilling than her current job:

I said last year I think it was last year September I was like next year I won't be here and they laughed and was like where are you going?, I said I don't care anywhere – I'm gone. It'd be nice to get a scholarship but I will take a job if it comes as long as its different I don't care about the pay because a little bit I felt now as much as you know you have a faith that things are gonna change the one thing that is keeping you is because oh my God

that paycheck is really really nice you know, and I couldn't have a life that's like that, the only, only good thing about your job right now is the pay! It just makes me feel I don't know, dead inside. So I'm like no, no, I don't care like I made a decision that I'm leaving whatever happens I'm gone. (Aphiwe)

On one hand it is possible that Aphiwe's early disillusionment with her job, having worked in industry for only 2 years could be based on the fact that she was forced to defer her ambitions to study further due to family considerations. On the other hand, her desire for new opportunities may be a reflection of the ways in which Black women begin to consider other job and career options after having worked in engineering industry and feel unfulfilled.

## **Pursuing Non-engineering Avenues**

Three women made decisions to pursue other non-engineering MBA's after being exposed to management experiences in the workplace. Noku, Siwe, and Ayanda had been exposed to management and became interested in understanding the business side of engineering ventures.

I was at corporate (Company Name) as a young engineer, getting involved in projects and seeing the other side of the business. And it sparked my, me wanting to have my MBA and, you know, now looking to be more on the business side in the mining industry... once I got to corporate, it just ignited the business side to say let me understand more of the business language. What does this, how does the economy impact the mining industry and so on. So MBA was perfect and I went for it first and I think it's also a good foundation for me if I decide to go solo. (Noku)

Noku had pursued her MBA on a part-time basis before deciding to quit her job and study fulltime. However, she continued to work as a consultant electrical engineer leveraging her White

male mentor to find consultancy jobs. There was a trend among most of the women towards pursuing MBA's. When I asked Ayanda why this was the case, she explained that engineering was focused primarily on technical aspects. However upon getting to industry for work, the women were thrust into management roles with little understanding of how to manage people. Furthermore, there was a way of thinking broadly that engineering did not teach, but MBA's taught, and this additional knowledge enticed a lot of engineers to pursue MBA's. An MBA was also selected with one's future career goals in mind. For example Ayanda saw herself being a CEO one day. She felt an MBA would prepare her for this future role:

Okay. It was a choice as well. I think I looked at where do I want to be in a few years' time. Like I said to you, I want to see, I saw myself as someone who wants to lead a company and also I felt like the decisions are obviously made at the managerial level...so when I looked at where I wanted to be, Yeah, CEO, so that's when I decided to go into an MBA. (Ayanda)

Mpho who had always had an interest in accounting but was pushed into engineering temporarily quit her engineering job and opened up a school in a nearby township. She explains her decision to quit her job by saying,

It's because I felt like... I should be doing something else and I think every day, it was just growing stronger and stronger and I just said no I need to stop this because if I don't,

I will never see that materialize. (Mpho)

She eventually returned to engineering when she could not secure a job in any other sector but her break from engineering showed her that she could pursue other areas of interest. She was considering pursuing an MBA in the near future. The link between engineering and the economics (business and finance) worlds is interesting given that subject selection in schools

treats science and economic subjects as distinct pathways and yet in the workplace job skills related to economics emerge as important for engineering work.

The women who had worked in engineering for over 10 years talked about their decision to pursue non-engineering avenues as linked to their desire to priorities themselves and their personal interests. Siwe talked about her decision to pursue an MBA as finally being able to do something for herself, whereas her career choices before had been based on considering other people:

I decided, you know what? This is my time. I'm going to quit, I'm going to do my MBA. It's going to be about me, me, me, me, me and I'm gonna do consulting. It's gonna be about traveling, it's gonna be about me, me, me, me because again, as an African Black woman, there's always this instilled pressure in values, whatever it is, that, you know, marriage comes first. You know, your failures, your successes are measured around your ability to keep a happy family or to keep a husband or whatever it is. So you've got those type of societal pressures that, you know, makes you to actually put your career second even though that was not your intention. So what really, really will divert your concentration on your career, definitely children does. Being married definitely does. And you know, and I said to myself, you know, for the last seven years, I've put everything, and presented everything, my energy into my kids and my husband and my career. Less about me. (Siwe)

The women who had just begun their careers in industry did not talk about such decisions indicating that this may be a feeling that emerges as one progresses through engineering. Early career engineers were more concerned with thinking about more immediate job changes within engineering.

### **Recognize Changes in Career Desires**

The more seasoned engineers spoke about how they recognized that their career desires and needs had changed over time as they had grown and matured. Siwe reflects on how her choice early on had been to prove a point:

...So I did engineering to prove a point...I can do it. Why do people think that as a Black person I can't go into such [an] environment? But as you grow, as you grow up as a person, you get in touch to, who am I? What are the things that I hold dearly to me? What are my values? You know, what are my natural talents? You realize especially at my age that actually, gave the same output, probably even half the output that I used to sweat so much in industry in an area that falls so natural. That is aligned to my natural talents. That makes me so seamless. So now you're thinking if I should be offered a job where I would be well paid, would it be mining? Would it be engineering? So you start now growing as a person and again, for the fact that you are in level whereby you call it probably self-actualization. You've taken care of your basic needs and whatever so this is not all about now. It's all about a legacy. Who am I? What am I gonna leave behind? You know, am I doing something that's for me instead of doing something to prove a point or whatever else. So I'm in that stage in my life. (Siwe)

Bontle who had 10 years of experience mentioned the same idea of growing and maturing interests over time:

Where I am now is completely different to where I was then. So I think my interests have grown and matured as my career has grown and matured. Where before I was really I wanted to absorb as much knowledge as I possibly could so anything around my field that I hadn't been previously exposed to I was open to and I wanted to know.

Bontle's description of wanting to absorb knowledge early on in her career echoes what the findings show regarding early career engineers like Rose wanting their next jobs to expose them to new skills. The early career desires to learn more seemed to change over time as one gained sufficient experience in the field. Noku also shared that after paying her dues in industry she was no longer interested in proving a point and could "afford to be picky" about jobs she took. In our conversation at her home on a sunny Saturday morning as we sat on her porch drinking cups of hot tea and assorted biscuits she shared,

I think they've been changing [career preferences] as I grew and now, it's more about flexibility for my life. I'm not looking for high stressful jobs just to prove a point. I feel my health is important. So I always look for that...So that's key. It's my life balance. I still want that social life. I've denied myself of a social life for so long and now when my friend has got a wedding, a bridal shower, I can be the one organizing, choosing the right colors that I never used to wear at campus, so now its colorful. Life is good. I want my house to be this way. If I wanna get work done, I'm available. And I'm enjoying it. I can have tea in the garden and not be at work on a Saturday. Cause that's the type of life you couldn't live as an engineer. There's breakdowns and you are in the mines 24 hours. So I'm not looking for that. I always cross it out to say is this not going to be stressful? Is this gonna maintain my life balance, my lifestyle and now, I'd like to be settled in Jo'burg. I don't want to go to the *bhundus* [middle of nowhere] anymore so is the job gonna be corporate and then me traveling in and out? Still be able to see my family around the corner? My sister's kids are growing up in Randburg, they need to come and play here. And so it's life balance mainly. I want that for myself. I want to be healthy. I

want to be rested. I want time to travel and enjoy my hard earned cash. So those are the key things now, life balance is what I look for. (Noku)

Mpho's early motivations for choosing university and job locations had been based around family, now she wanted to pursue her own interests with her spouse.

At this moment, that point, that's what life was like. Okay, I need to go back to my parents and this and this but now, I've grown through those feelings, I want to travel. I want to travel, I want to meet new people. And also, my husband and I we preach the gospel so we want to be free and go further. (Mpho)

While the women in industry were beginning to make decisions that were not driven by their family considerations, the two Black African women in academe had followed an academic pathway because of their family lifestyle needs. Bridgette had worked in industry and returned to academe when she "fell pregnant."

I fell pregnant. Actually, that's what made me come to academia. It's not that I really wanted to come to academia. I think I was in the prime of my career then the thought of having a baby, it was daunting but I decided let me have a baby, God gave me a chance so let me have this baby. So I had a baby, then I realized that if I want to have this baby, then I have to make things, things have to change [Interviewer: your lifestyle has to change] Exactly. Not running for career improvements. Have to look after the baby. The baby must go to crèche, the baby must be picked up from school. So I [said] ok, maybe I should look to academia. They've got flexible time. I had a friend here who was a lecturer here so he was the one who said, why don't you come to academia?...[there's] flexibility. Be able to take care of the kids. (Bridgette)

The considerations of lifestyle changes and the flexibility around time in academia were key career change motivators for Tlenganani resulting in her abandoning her industry pursuits and being streamlined towards academe.

Again, like I said, I'm a Christian. My church schedule is very hectic. I go to church literally every day except for Friday. So I, for me, it's a personal thing. I understand and I accept the fact that I have to give time to God more than anything else. So I had to make the decision that I can't per se go to industry where I'll be working long hours, coming back home late at night. So this is very flexible. And I'm gonna have kids soon. I don't, I don't wanna spend time away from my kids, working and working. Spending time away from God. So for me, it was a personal choice. I think this fit in very well.

Tlenganani's religion was a priority influencing her career choice. She shared that religion had not previously been a key aspect of her life prior to meeting her husband who invited her to church. Before that she had been applying and interviewing for industry jobs,

Well, when we [my husband and I] met, I was already in this. I was already doing my master's. So I mean, by then, I didn't actually know, cause by then, I wanted to still go into industry. You know, it's only after I met him [my husband] that church became like more. He actually invited me to church. So only then I realized, you know what? This is my life now. And so because I remember when we first thought, when we first met, I had been going to interviews... Met him and then, cause after I met him, I started going to church more often. Yeah. Then we got married and then we want to have kids soon so I need to have a flexible hours. And I think academics is very flexible.

For women in industry phase 3 of career choice represented a choice moment less influenced by family responsibilities. For women in academe, it seems phase 3 represented a shift towards family lifestyle and responsibilities not linked to income.

The reflection that allowed these women to recognize their changing career and job preferences was only possible given the number of years the women had navigated their personal and professional lives over time. In particular older women with more life and work experiences were able to reflect on their career paths in ways that younger women whose careers were still beginning did not show. More experienced women had also begun to think about their future career trajectories while younger women spoke about their future in a largely hypothetical manner. The next section captures some of the ideas about one's future that the women spoke about.

### **IV: Future: Thinking Ahead**

The last phase explains how Black African women thought their careers will be in the future. While there was a great amount of uncertainty about the future, the women spoke about their (a) future aspirations, (b) establishing a legacy, and (c) the consideration of academia as a way of giving back later in life.

#### **Future Aspirations**

Most women were hoping to receive their official registration with the Engineering Council of South Africa (ECSA). ECSA is the only recognized body in South Africa responsible for regulating the engineering profession including bestowing engineering titles for those who have met the professional registration criteria. Nandipha who is early in her career talked about future plans to become a registered engineer and that this was a requirement for all engineers:

...I want to register as a professional engineer because we need to, because I think the review process, it's five years into your career and that's when you can actually go to them and say, okay, I want to see if I can qualify. So there's certain things that you actually need to fulfill. So they look at certain criteria. So for me, it's also because if you're not registered as a professional engineer, you can't work outside the borders of South Africa, like as freely as you want. You can't, like just certain things that restrict your career. So that's why it's so important for me to work because those things need to be fulfilled. (Nandipha)

Additional career goals the women shared were associated with advancement in their current jobs, with many seeing themselves in top management positions. Teboho shared her goals at her current job:

And another thing that I still want to try to achieve here, now I'm Manager of a section, I would love to be the Chief Engineer at the corporate level. We've got regions, I'm at region, so we've got (Company Name) it's big. We've got the east, the south and the north, and then we've got the corporate office. I would love to be the Chief Engineer of the corporate office. Then if I can be that Chief Engineer of the corporate office, I will love to be a Divisional Head, if I bow out [retire] as a Divisional Head I'm happy. (Teboho)

Teboho based her aspirations on the available career trajectory in her current place of work. Siwe explained how industry provided many paths to the top to aspire to, compared to the seemingly long process of progressing up the ladder in academe:

[In academia]...What are the opportunities for growth? Ok, you become a lecturer, junior lecturer, then you become a lecturer. Then you become head of department if you're

lucky. Then what? In industry, I mean, you know, the options are endless. I can go operations. I can go management route. I can go strictly engineering, purely processing, environment, whatever it is. I mean damn I can be a CEO one day! And you think you never see an engineering lecturer becoming a dean. Is it a dean? Or head of a university Yeah. (Siwe)

The multiple career progression pathways in industry provided these women with something more clear and concrete to aspire to in the workplace. Academia was viewed as following a rigid pipeline framework where one had to endure the arduous steps towards achieving any status in the workplace. As a result even in cases where there was a little bit of uncertainty in industry, staying in engineering industry, management, or research and development remained a part of the women's goals:

Yeah. Then after this, I don't know. Maybe I'll do a bit of traveling. Maybe I'll follow my friend in Dubai and get to experience life in Dubai as an engineer, and maybe come back and open my own thing or go back to corporate. So it's either corporate or me going solo as a business and a little bit of overseas. I'm done with the operational side cause I did it a lot and I've been a student for a long time. So I don't see myself as an operational manager anymore. So more corporate but engineering still. (Noku)

## Establishing a Legacy

In addition to advancements in their career the women mentioned the desire to create a lasting legacy where they become the go-to-expert for something specific in engineering. Two women shared their desires to be top experts:

And I think, the thing about research, it sort of motivates you to wanna be good at something...so I wanna find one area that I can be really, really, really good at and be

like 'the' person. I don't know if it's what I'm pursuing with my study or some other area but I do want to get to the top of the game with that and just feel accomplished and then yeah, just be a top researcher. (Audrey)

## Palesa shared,

I think I have the desire to grow my career and be one of the people that's known in the industry. Yeah, I wanna have presence in the industry at some point so I wanna find myself in a company where I can actually make a difference.... Like I said, I want to be an industry guru at some point. I wanna be that Black woman who, I don't know, who's good at changing a company and making it profitable or that's what I see. (Palesa)

This desire to be an "industry guru" was mostly shared by early career women.

# Academia As a Way to "Give back"

As part of establishing a legacy, all the women talked about the idea of returning to academia in the future. The women spoke about academia mainly in terms of lecturing or teaching, with no mention of other aspects of research and service associated with academic careers. For these women academia offered an opportunity to give back, but they strongly felt they needed the practical experience from industry to be able to give back effectively. In a conversation about her considerations of an academic career in her future Melita responded,

you know what I think about that, I think once I have enough experience and I have a lot, lot more knowledge than now, then I think I would be in a position to wanna give back and transfer that knowledge that I would have acquired through all these years as being a engineer. So I think sometime in the future definitely I would even if it's part time or whatever but I would wanna do that yeah. (Melita)

Bontle shared,

I would consider it one day, not in the immediate future I think for now I'm more focused on the practical side of it but yeah I definitely wouldn't exclude...it would be nice one day to once I've experienced all of this to then be able to share it with people I would love to then lecture on that stuff. (Bontle)

This idea of industry as being more practical was juxtaposed by the idea that academia was strictly theoretical and not "real" engineering:

That [academe] perhaps I might do, I might go do it in the future. Even if it's just on a part-time basis or guest lecturing or something like that. And I think I'm also thinking about it now because I'm at a point in my career and in my life where I'm, I'm happy and I'm confident with what I know and therefore, you know, would not then mind to go and stand in front of [students], and teach because then I would not feel that I'm exposing myself to an unknown world. It's, you know, there might be things taught in textbooks but nothing beats the real! (Lulama)

Academia was perceived to be a space where only those who knew what they are talking about should be. Despite graduating with multiple engineering degrees, Black women engineers still felt they needed to learn even more in terms of practical knowledge in industry before they considered themselves capable of teaching others.

As Black African women in industry were considering academia as a place to return to later in their careers, the two women in academe speculated about future careers in industry in different ways. Bridgette saw herself completely leaving academe to become CEO (Chief Executive Officer) of her own company in an industry setting.
I always said that it's just a matter of time. I don't think I am cut out to be in academia until I retire. Yeah, I think, you know, soon or later, I'll probably go full time into business or be a CEO somewhere. (Bridgette)

In comparison Tlenganani envisioned a part-time consultancy engagement in industry, while remaining in academia.

I'm gonna be here for a long time I mean academics is, you know, I think you get comfortable with it. I'm gonna be here, I feel I'm gonna be here for a long time... You know what I see myself doing, instead of going into industry, consulting. I'd rather consult than actually be full time in industry.

It should be noted that Bridgette had spent close to 10 years in academia while Tlenganani had only been employed as a lecturer less than a year. It is possible that Tlenganani's long-term optimism with academe could change over time in the way that Bridgette's ideas had shifted. However, at the time of this study, it was clear that the younger academic (both in age and tenure in the academy) had more positive long-term aspirations in academe than the veteran.

Although the initial career choice moment occurred in high school, the women continued to make career choices throughout different phases of their lives as they grew and matured both personally and professionally. Different factors played key roles in different phases of one's career as these women navigated post-apartheid family, education and industry contexts. The factors can be divided into three broad areas namely (1) events, (2) considerations, and (3) consequences. Events describe localized occurrences, which influence actions and outcomes. Considerations are motivating circumstances or people that are taken into account when making a career-related decision. Consequences are the outcomes and actions that arise as a result of the events and considerations with the aim of achieving an established goal. As presented in Chapter

3, Table 8 summarizes how each of the sub-themes fit into each of these three broad areas that explain the career choices of Black South African women engineers.

From the table one can glean the complex nature of career choice as some aspects fall into multiple categories. The next chapter builds on these findings and discusses the model in more detail to help the reader understand how the model was conceptualized, and how the different parts of the model explain the career choice process of Black African, South African women engineers.

Events	Considerations	Consequences
Pre-choice exposure	Teacher Influence	Selecting subjects
Selecting subjects	Industry recruitment practices	Developing ideas about
		engineering
Switching jobs	Developing ideas about	Linking choice to personality
	engineering	
Pursuing non-	Money and family	Surviving as a minority
engineering career	responsibilities	
desires		
	Aspirations for the future	Finding and leveraging
		mentors
	Establishing a legacy	Developing ideas about
		academia
	Academia as a way to 'give	Investing in self-development
	back'	
		Pursuing non-engineering
		career desires
		Switching jobs
	Recognizing changing career	Capitalizing on work
	desires	opportunities

**Table 8: Themes and sub-themes** 

#### **Chapter 5: Streamlined Career Choice Model**

This chapter discusses the working model of the streamlined career choice process of Black African women engineers in South Africa. The Collins English Dictionary defines the word "streamlined" as used in general engineering to refer to "offering or designed to offer minimum resistance to the flow of a gas or liquid" (item 1). I use the term to describe the way in which Black women's career choices are made in response to socio-political dispositions and family circumstances that constrain the women's ability to freely choose their careers, resulting in choices that follow a career pathway of least resistance into the engineering industry workplace. As highlighted in Chapter 4 the streamlined model reflects the ways in which different events, considerations and consequences influence the lives of Black women engineers and how the women interact with these factors in making choices towards industry careers. The chapter begins with a summary of the model followed by a discussion of each phase of the model from phase one: receiving and internalizing, phase two: utilizing one's positionality to "make it work," phase three: branching out, and phase four: thinking ahead. A summary concludes this chapter.

### **Summary of Streamlined Career Choice Model**

Figure 8 shows that Black African women in engineering in South Africa make career choices within a post-apartheid context, which is still influenced by the apartheid era of 1948 to 1994. During apartheid Black people and women had limited access to education and engineering as a career option. In contrast, in a post-apartheid context where the government is committed to redressing the inequalities of the apartheid era, Black people, women, and people with disabilities are designated as special groups to be considered for affirmative action hiring. Therefore the model is guided by the assumption that the experiences of Black people in South Africa in all aspects of socio-political and economic life cannot be divorced from the apartheid and post-apartheid contexts as articulated in various ways by the participants.



## Figure 8: Model of Streamlined Career Choice Process of Black African, South African Women Engineers - Model Summary

The family context accounts for the socio-political dispositions including the underprivileged status of Black families in South Africa during apartheid that contributed to Black people making up the majority of low-income households residing in under-developed communities today. The family context influences the pre-tertiary school an individual attends and the overall upbringing of the individual, which serve as references for later decisions made. For example most of the women accepted the bursaries offered to them because they knew that without that funding, their families would not be able to afford to send them to university. The constraints imposed on the individual by the historical and economic and family contexts create the environment for a streamlined career choice process where career decisions are determined by the contextual structures and circumstances of one's life.

The red semi-permeable line around the model separates the macro-level socio-economic context from the micro-level procedural factors and acts of decision-making with which the individual is engaged. The semi-permeable nature of the line reinforces the idea that individual career choice involves interplay between the individual as an agent of their lives, and the communal and structural factors that limit what choices an individual is able to make, thus creating an environment of constrained agency (Forrier, Sels, & Stynen, 2009). The second outer black semi-permeable line acknowledges that all STEM endeavors in South Africa, as in other nations, take place in relation to the forces of globalization, influencing both government and industry motivations for increasing the number of engineers in the country. Although the effects of globalization on Black women's choices are beyond the scope of this study it is important to note the existence of such forces as they shape STEM career pathways.

The different phases in the model function as individual steps on a stairway. As an individual progresses over time, the experiences and choices made in the previous phase have a cumulative influence on the next phase. Career choice moments in phase one and three represent the key events where a direct decision is made to pursue a particular career path. In all other phases the different events serve as supporting factors to already made decisions. For Black women who pursue engineering the first career choice moment takes place in the first phase and is strongly linked to pre-tertiary schooling and community experiences. The first career choice moment is a prerequisite for all other career-related choices made henceforth. The second career choice moment, which occurs in phase three applies to those who voluntarily decide to pursue non-engineering related career paths at some point in their careers. The occurrence of the second

career choice moment is not dependent on the outcome of that moment, meaning an individual can pursue a non-engineering career and simultaneously choose to remain in engineering during or after alternative career avenues have been explored, as was the case with all of the women in this study.

As illustrated by the forward pointing arrow at the bottom of the model, the overall career choice process is always temporally progressive in that it reflects a forward motion from one phase to the next. While individual women can remain in one of the phases for an indefinite period of time, progression towards the last phase of Thinking Ahead is inevitable, in the context of employment lifecycles where retirement marks the culmination of an active career in engineering. The relation to time also reflects how the women recalled their career decisions in relation to developmental life events from attending school, postsecondary education and transitioning to the workplace. However, while the recollections are linked to particular moments in time, the considerations and actions taken are not necessarily time-bound as some life stage moments overlap within the model, and early phase events influence later phases. The continuous nature of the career choice process confirms Super's idea of career development as "an ongoing process that accompanies the person's entire life" (Chen, 1998, p. 439). My model captures Black women's choices up to a particular point in time leaving room for further investigations into future choices the women will continue to make going forward as they reach retirement and beyond.

The forward pointing arrow in the model also reflects the range of individual agency in career choice decisions with agency increasing progressively through each phase from lower to higher levels of agency. However, the higher level of individual agency in the later phases remains regulated by contextual influences that originally streamlined the women's early career

choices into engineering, and essentially confined their career choices to a particular pathway. In effect the individual agency Black African women engineers possess is similar to the constrained agency as articulated in feminist scholarship (Hallstein, 1999). Feminist standpoint theory acknowledges that marginalized individuals interpret their own experiences, making sense of their lives as inhabitants of particular social and historical contexts (Hallstein, 1999). This ability to make meaning out of one's life within the constraints of socio-historical and contextual patriarchal structures is called *constrained agency*. An excerpt from Hallstein (1999) states:

The view of agency that emerges from feminist standpoint theorists' work is one that I refer to as constrained agency. Constrained agency simultaneously grants women agency and recognizes that that agency occurs within constraints. Constrained agency, then, also refuses the binary logic that either denies agency by viewing subjects as fully oppressed or denies oppression by viewing the subject as fully free. Instead, constrained agency recognizes that subordinate subjects have suffered systematic oppression that is damaging without condemning subjects to positions of victimhood. For example, constrained agency suggests that just because subjects are constituted by discourses does not mean that they are fully determined by those discourses. (p. 37)

Therefore, women as marginalized individuals are still able to define their own lives even within the structures that attempt dictate their existence. Constrained agency is the ability to make decisions about one's life, despite the constraints imposed by environmental circumstances (Hallstein, 1999). In terms of career development specifically, constrained agency refers to the limitations placed on individual workers by state, community and labor markets (Coe & Jordhus-Lier, 2010). For Black women engineers, the limitations were imposed by family socio-political and economic circumstances, opportunities presented by industry, and the central influence of

teachers in choosing school subjects, which tracked the women towards science and engineering careers. These limitations experienced in the first phase influenced subsequent phases, creating a streamlined career pathway in engineering industry and not academia.

The summary speaks to the overall model. The next sections provide more nuanced descriptions of each phase and how the different parts of each phase cumulatively explain the streamlined career choice processes of Black African, South African women engineers. The descriptions show how I conceptualized the model through a reflection of my memos, participant interview quotes, and participant post-model review feedback that validates my model as an explanation of their career choice processes.

### I – Early Phase: Receiving and Internalizing

The participants indicated that they came to find out about engineering as a career option through school officials with teachers being the primary source of information in most cases. Teachers were also presented as the key people who identified individual student academic competencies in science and mathematics, sometimes imposing the selection of school subjects that essentially tracked students towards science and engineering careers. Teachers were integral in providing pre-choice exposure opportunities for students to learn about engineering, allowing students to develop ideas about industry engineering as a viable career path. Schools were key sites socializing Black African women to believe that they were capable of pursuing and excelling in a traditionally male-dominated career, with experiential opportunities provided to demystify engineering work. In a memo I wrote during the early conceptualization of the model, I noted the connection between information received and internalized, and the career choice made thereafter:

### *Model creation memo #1 – October 5, 2016*

I just started writing again today after a long period of writers block. I am realizing grounded theory is a messy process. My anxiety and need for order was blocking how I was looking at the data and what it was telling me. For example, I have had to rephrase the first theme almost three times from: (1) Early career phrase as streamlined life (2) Early career as receiving to finally (3) Receiving and Internalizing. While pulling quotes I realized these women received particular information about engineering and themselves, they internalized this information as fact and often blindly followed the options presented to them by teachers, family and friends.

Figure 9 shows how all the events, considerations, and consequences interact within the first phase as they all contribute to the first career choice moment. In the figure, red represents events and considerations associated with receiving information from external entities. Blue represents where the women internalized the information they received about their competencies and engineering as a career and used that information to take actions geared towards pursuing engineering. After receiving positive information about their competencies related to engineering, Black women internalized that information as a true reflection of their identities as students who excelled in science and mathematics and therefore as capable and suitable for engineering.

Literature on women's career development shows individual expectation contributes to successful performance of certain job behaviors, often referred to as self-efficacy expectations (Hackett & Betz, 1981). Self-efficacy, "people's beliefs about their capabilities to exercise control over events that affect their lives" (Bandura, 1990, p. 128), is often attributed to four sources namely, successful task performance, learning through observing others, emotional responses, and verbal persuasion. Although Bandura (1990) views task performance as the most powerful influence of self-efficacy, this study shows that for Black African women in South Africa, verbal persuasion actually holds more weight (Hackett & Betz, 1981). Verbal persuasion refers to "the verbal suggestions of others" which encourage career pursuits and increase self-

efficacy expectations (Hacektt & Betz, 1981, p. 332). Black African women received information about their academic competencies and suitability for engineering careers from teachers. The internalization of this information resulted in an increased sense of self-efficacy contributing positively to the selection of engineering as a career. Teachers were also responsible for the pre-choice exposure to engineering that contributed to Black women's ideas about engineering as a career. Additional, information was gleaned from other people including family members and friends.



# Figure 9: Interaction Between Events, Considerations, and Consequences in the Early Phase of Career Choice

Nandipha notes that in Grade 11 when she was applying for university she did not know

"the specifics of the type of engineering" she was applying to and so she spoke "to different

people and then people will tell you their opinions" (Nandipha), she eventually decided on metallurgical engineering. Some of the people she spoke to included her cousin and her cousin's husband who was a mechanical engineer working in industry. The involvement of teachers, family, and friends captures how the career choice is not an individual process but involves input from one's community who influence what Black African women consider when pursuing a career.

While an engineering career in industry was largely encouraged, an individual's community also "demotivates" (Rose) women on the idea of pursuing academic careers. As they were streamlined into industry careers Black African women engineers did not allow themselves to even "develop the passion to even know what it would be like for me to go back and lecture" (Nandipha). The demotivation against academic careers makes non-academic careers the only socially acceptable option for Black African women engineers to consider.

The close relationship between school-related choices and career choices is highlighted in Lent et al's (1997) description of their social cognitive career development theory, which posits that the mechanisms utilized in making academic choices are similar to those used in career development. Specifically the authors of the theory state, "interests and skills developed during the school years ideally become translated into career selections – although social and economic factors frequently intervene to affect the level and content of choices pursued" (Lent et al., 1997, p. 81). My model acknowledges the link between school and career choices, but it goes a step further by showing that for Black African women in engineering in South Africa, subject selection simultaneously represents a career choice moment as individuals, henceforth, are tracked towards particular careers. This finding improves on Lent et al.'s (1997) model showing that, school subject choices are also career choices and the two should not be viewed as separate activities where school choices are seen only as influencing subsequent career choices. In simple terms, for Black African women engineers, school subject choices and career choices are

synonymous.

In addition to teacher's guiding students towards careers in engineering, industry recruitment practices streamlined women towards industry careers in particular. Industry recruitment practices of facilitating career fairs and offering postsecondary education bursaries further influenced Black African women's career selection by portraying engineering as a financially lucrative career.

## Memo: December 15, 2016

If the teacher is appearing as integral to choices made in school regarding academic competencies and the pursuit of engineering – I have to find a way to illustrate how the teacher interacts with all other factors present in the early phase and how this results in selection of a career path to pursue – which the women described unequivocally as the moment they chose their career being in school, prior to entering tertiary education. The influence of the industry appears to show up also – but this is tied closely to the bursaries offered to allow the women to go to university – and the prospects of being able to make money later which will go a long way to help support family responsibilities.

It is important to note that industry is actively involved in both the exposure and opportunities it presents to students but also in the ability to select the individuals it wants to support. Thus career choice in engineering is a reciprocal process (Lent et al., 1997) evidenced by the fact that individuals are not always successful in every bursary application. Audrey who had applied for a bursary recalls that she was unsuccessful in securing the bursary with one company, although she later secured one with another company and then secured another one for her postgraduate studies with her current employer:

[I] actually went to an interview with one of the member companies of the society but it wasn't successful...I was disappointed when they called me afterwards and said no, we're not going to take you up. (Audrey)

While industry rejection does not necessarily preclude one's ability to pursue engineering, the inability to secure adequate financial support would be a barrier against an easier pathway to an engineering degree and career. Black African women are able to exercise their agency in surrendering to industry recruitment practices but their agency is constrained both by their socio-economic statuses that rely on industry funding, and industry's ability to accept or reject the women applying for financial support.

In the first phase the cumulative effect of teacher's influence, subject selection, prechoice exposure to engineering, and industry practices contributed to the women's perceptions of engineering industry as appealing. In the absence of information about academic careers Black African women who excel in mathematics and science are tracked towards engineering careers in industry. Black African women who choose engineering careers reconcile with their choice and "make it work" as they progress through higher education training and the workplace thereafter.

### **II - Middle Phase: "Make it work" - Utilizing One's Positionality**

In Figure 10 for the middle phase red represents the main considerations that contributed to Black African women persisting in engineering and making the career choice work. Blue represents the actions taken by individual women in relation to the main motivations, and green represents the consequences of the motivations and actions.

Like Rose, for the women who received industry sponsorship, fulfilling the bursary obligations was an obvious expectation. In creating the model it was important to capture the centrality of the need to fulfill industry obligations both during one's higher education experience and immediately after graduating with an undergraduate degree.

### Post-Interview Memo #10 – June 29, 2016

The interview with Rose went fine. It was difficult to get her to open up at first. I sensed distrust with what the information would be used for especially given the recruitment email was sent by her boss...Like Audrey she had no interest in industry

(private sector) but loved research (hence her career path in what she describes as a nonacademic research space). But I wonder how much her current job was based on her obligations to the bursary – what happens when you know that your career has already been determined because a particular company paid for your higher education. How much freedom does one really have to decide their career path in such circumstances?

The apparent influence of external entities in Black African women's commitment to an engineering career counters other theories that "do not believe that choice actions are automatically implanted by the press of one's environment" (Lent et al., 1997, p. 94). Instead such theories state that individual's self-set goals "afford a measure of personal agency in the determination of one's career future" (Lent et al., 1997, p. 94). My model contradicts this notion and shows that personal agency is constrained by environmental factors including one's sociopolitical dispositions including coming from low socio-economic backgrounds that make financing higher education a concern, family responsibilities that make a lucrative career appealing, and the availability of industry sponsorship as a conduit to address these needs. Fulfilling industry obligations limited the women's personal agency but allowed the women to address their needs.

In fulfilling industry obligations Black African women justified their career choice by linking it to their personalities as people who enjoyed challenges and solving problems. This finding contradicts Holland's career choice theory, which assumes that individuals are aware of their personality preferences prior to choosing their career paths. In Holland's theory, knowledge of one's personality and other personal characteristics should guide the choice of a career designed to match those traits. Instead the Black African women engineers in this study found links between engineering and their personal characteristics as an afterthought after the decision had already been made to pursue engineering.

Additionally Black African women endured the challenges of being a minority in both engineering higher education and industry, finding ways to survive the racism and sexism they encountered along the way. After completing their higher education training, those with no bursaries capitalized on work opportunities early. Those who had received bursaries after serving their obligations also then capitalized on opportunities as they presented themselves. For example, Lulama, who was headhunted by a former client, and Siwe, who was offered other opportunities within the mining company she was working.

In reflecting on the model and how it represents her life, Audrey who has a Master's in metallurgy and is currently working for her postgraduate studies sponsor with four and a half years of working experience identified herself as being in this phase:

I find the [streamlined career choice] model is giving an accurate description of my career path. In my own self-assessment, I would say I'm currently in the second phase of the model, where my main focus is on career development, building my reputation and exploring the industry further by pursuing various opportunities as they come along. (Audrey)

Some women leveraged mentors within the workplace to find new opportunities and to learn about ways to navigate the engineering workspace. Finally the women in this study all had post-graduate qualifications, which were not necessarily related to their immediate career needs but were part of the women's desire to invest in their own self-development. Although some of the women envisioned post-graduate education as potentially useful for their careers in the future, none of the women indicated that the additional qualifications were a requirement for their current industry jobs. Mangcu (2014b) attributes this disassociation between postgraduate pursuits and academic careers to the part-time culture of postgraduate studies in South African

higher education, where "those who complete their degrees see it as yet another certificate to be added to their CVs for the job market in the private sector and in government" (p. 2).



# Figure 10: Interaction Between Events, Considerations, and Consequences in the Middle Phase of Career Choice

Contrary to existing literature stating that postgraduate studies are a training ground for academic careers (Austin, 2002; Herman, 2010; Perna, 2004), Black African women engineers in South Africa do not envision pursuing academic careers after receiving their Honors, Master's, or Doctoral degrees. In fact due to the women's higher education experiences and their perceptions of engineering industry as a lucrative career option, Black African women had negative ideas about academia including the low salaries, high teaching and grading workloads, and the perceived that academe distanced them from real engineering work in industry. One of the participants clearly articulated the shared idea that academe was not real engineering,

Well I can only speak for myself for me I don't know like I, when I, if I go back to teach I would feel like I'm not an engineer. For me like, yes lecturing takes away me having to go out there and solve a problem you know because now all of a sudden I'm dealing with text book problems that are just hypothetical but if you're out there I'm dealing with *real* life problems you know, when there's a pipe burst out there we have to design a new pump system I'm dealing with something that is real but when I'm a lecturer I'm just dealing with students and text book problems. (Melita)

A study to understand why women physicians in different parts of the world chose academic careers in medicine also found that medical physicians in academia were not viewed as real doctors compared to practicing physicians (Borges, Grover, & Navarro, 2013). Black women engineers in my study, including those whose pathways led to academic jobs did not consider the academy as a place of work but as a transitory space where one received an education and went to real work in industry. The idea of higher education as transitory was confirmed by Diana, a Black woman in human resources in the faculty of law, who noted the lack of marketing of her institution as a potential employer, contributed to Black African women alumni not considering academia as a place of work:

As a university, we have not marketed ourselves as an employer. So the flag that we are sending out is education. The flag that we are also an employer is not coming out. It's not there, out there. We don't even advertise ourselves...So people only know that [Name of University], you go there, you get a good education. But to say, okay, [Name of University] as an employer, we don't, we've not worked on doing that. (Diana)

The model shows how the women's resolve to make engineering work was also influenced by their negative perceptions of academic careers, which solidified their choice of industry as the only available and acceptable place of work.

### **III - Late Phase: Branching Out**

Figure 11 represents the Late Phase where the women who had worked for at least 10 years began to think about their changing career needs. The red box indicates the motivating consideration, and the green circles represent the consequences of those considerations. The black box represents how individuals branch out to pursue different interests while remaining connected to the engineering field in some capacity, with women like Mpho returning to engineering after leaving the field for a brief period.



## Figure 11: Interaction Between Events, Considerations, and Consequences in the Late Phase of Career Choice

In the two previous phases the women had been motivated by the desire to prove a point about Black African women's capabilities in a White, male dominated field, and the considerations of their family responsibilities requiring a financially lucrative career. In the later phase the women wanted to pursue other interests geared towards achieving a more fulfilled life as an individual versus as someone with community obligations.

The later phase represents a process of branching out from the streamlined career pathway that women were initially tracked into, towards other career interests that reflect both existing and emerging interests in other fields. In her feedback on the model, Audrey, a young woman who was in the earlier part of her career and who self-identified with the second phase, found that this third phase of Branching Out explained some of her private thoughts that she had not shared in our interview regarding pursuing other avenues in the future:

What I find striking is how the model is reflecting some of my unspoken thoughts about possible future career developments. I have toyed around with the idea of branching out into other non-engineering areas and possibly doing something entrepreneurial. I have not worked out the details in my head but it is something I want [to] look into 10 years or so from now, and it was quite an interesting surprise to see that same line of thought in fellow Black female engineers under the Branching Out phase. I don't think that decision would come out of me losing interest in engineering, but more out of a desire to challenge myself and get out of my "comfort zone." (Audrey)

During the branching out phase Black African women engineers either switched jobs within the engineering field or pursued non-engineering academic endeavors.

At the time of the interviews two women who had left engineering work to become fulltime students in MBA programs were about to graduate and were considering leaving engineering to enter into the business consultancy world, which could involve working with engineering companies. One of the women provided feedback on the model as follows:

My initial thought on the illustration is that it paints a clear picture on my career journey to date and into the future. What stands out is the branching out phase, as it describes where I'm at currently. I can't point out anything missing. It's spot on! (Noku)

Although the women sought out new opportunities in other career spaces, they remained linked to engineering, a secure career from which one could safely test the waters in other areas

while remaining employed. The desire to pursue alternative non-engineering avenues can be explained as a consequence of the streamlined career choice process where Black African women who excel in mathematics and science are tracked towards engineering degrees, despite sometimes having different career interests.

### **IV- Future Phase: Thinking Ahead**

In the Future Phase Black women were thinking ahead into the future about their careers in engineering. In response to an interview question about their future career aspirations, everyone had some career-related goal they were striving towards. For the newer engineers goals included acquiring their official certifications as registered engineers. However, more seasoned engineers spoke about their aspirations to rise up the ranks within their respective organizations or to become CEOs of a company one day, either in engineering or in business. Overall for all women, the ultimate goal was to establish a legacy as an engineer who contributed to solving problems and changed the world with their work. Figure 12 is an illustration of this fourth phase. Red represents career considerations with green representing the desired consequence.



# Figure 12: Interaction Between Events, Considerations, and Consequences in the Future Phase of Career Choice

During coding I noted the importance of thinking ahead as a theme as it emerged in multiple

interviews. After reviewing Teboho's interview I noted,

### *Coding Memo* #13 – *August* 31, 2016

In thinking about pursuing postgraduate education (a Masters) in engineering she was thinking ahead in terms of her career trajectory in wanting to be a manger one day. The idea of thinking forward seems to be a key feature in women's career choice process.

In addition to hoping that their future careers will help establish their legacy, the women viewed the academy as a possible post-industry retirement career. Given the association of an academic career with teaching and the sense that teaching itself is a noble career, Black African women engineers saw an academic career as a way to "give back" by transferring the knowledge they gained in industry to aspiring engineers. The model captures how despite having gone through post-graduate studies, all the women felt inadequately prepared to take on an academic position to teach others. However, continued exposure to industry work was viewed as eventually providing the necessary knowledge and experience to teach others.

## **Concluding Remarks**

This chapter described the multiple parts of the model and how it explains Black African women's career streamlined choices into engineering industry. The model shows that while career choice appears to be carried out by the individual, the process of coming to one's career is in fact a communal process. The process influenced by various events, considerations and consequences interacting within each phase, limiting the choices of Black African women with distinct socio-political characteristics in a post-apartheid context. In this chapter while each phase could be deconstructed as a stand alone, the complexity of career choice is illustrated by the different aspects of the model who's multiple parts combine to represent the sum of career choice as a streamlined and temporally progressive process.

### **Chapter 6: Discussion, Implications and Conclusion**

This chapter discusses the working model of the streamlined career choice processes of Black African women engineers in South Africa as outlined in the previous chapter in relation to the research questions guiding this study and related literature. In interpreting the findings the socio-political context at the time of this study is useful to provide to help the reader make sense of some of the findings. The chapter also discusses implications for theory and recruitment and retention practices for pre-tertiary schools and higher education institutions. Implications for future research are also discussed with an examination of the limitations and strengths of this study concluding the chapter.

### **Current Socio-political Context**

As mentioned in chapter 1 at the time of this study South Africa was experiencing a number of social protests related to issues of higher education access and transformation, and decolonization of the curriculum (Badat, 2015). Tertiary students across the country from Cape Town to Limpopo were engaged in protests that resulted in higher education institution closures due to incidents of violence and vandalism (Powell, 2016). In a country where public higher education institutions are subsidized by government funding, protests took on political, economic and ideological dimensions (Badat, 2015). Politically, students were unhappy with the lack of higher education transformation 20 years after apartheid as students "who are Black and come from disadvantaged backgrounds tend to experience the environments and cultures of the historically White universities as discomforting and exclusionary" (Badat, 2015, p. 85). The ruling party the African National Congress (ANC) was seen as complacent in allowing inequity to persist through failing to enforce policies of transformation (Badat, 2015).

Economically higher education is inadequately funded receiving only 0.72% of the nation's GDP, significantly less than other African countries like Senegal and Ghana with an allocation of 1.4% (Badat, 2015). Badat states post-1994 ANC policies "shaped by neoliberal prescripts, have not generated the kind or level of economic growth or development...required...to invest in higher education" (p. 77). In the absence of sufficient government funds, institutions have to be creative to acquire additional funding, resulting in increasing tuition fees and outsourcing of staff to reduce direct costs (Badat, 2015). Furthermore, as revenue creation became a key priority, higher education institutions began to operate like businesses further entrenching neoliberal ideology emphasizing economic growth versus issues of equity, inclusion and transformation articulated in the various higher education policies discussed in chapter 1.

Neoliberal ideas have created higher education spaces where "access and success in higher education continue to be conditioned by social class and 'race'" (Badat, 2015, p. 77). In a post-apartheid context where wealth remains in the hands of White people and few non-Whites have been able to move up into the middle-class higher education continues to be a White elitist space. Weiler (1978, as cited in Badat, 2015) notes:

"there is little evidence to suggest that education, even with a tremendous effort at reducing its own internal disparities, is likely to have an appreciable impact on the achievement of greater distributive justice in the society at large, as long as that society is under the influence of a relatively intact alliance of economic wealth, social status and political power which is interested in preserving the status quo" (p. 78).

The absence of Black African women in engineering academe so long after the end of apartheid demonstrates the issues South African students were raising. In a country where transformation

is a priority and where non-White people are the majority with some making inroads into previously restricted spaces like industry; how has higher education remained predominantly White? Weiler would argue that people and forces are acting to maintain the status quo. As products of apartheid, Black African women have followed different career pathways that have led them away from academia. While the women's agency in their career process should not be diminished, understanding the wider political, economic, and ideological context provides a broader perspective when reviewing the findings.

### **Discussion Of Emerging Theory In Relation To Research Questions**

The purpose of this constructivist grounded theory study was to identify the career choice processes of Black African women engineers in South Africa, to understand why the academy has not been a career option thus far. The following research questions guided the study: (1) How did Black African, South African women engineering alumni make career choices? (2) What factors have influenced their career choices and how have they engaged with these factors in deciding about their careers? (3) Why have their career choices not included pursuing an academic career thus far? The aim of this study was to explain the career choice processes of and provide a theoretical perspective on Black African women engineers' career choice processes as grounded in the experiences of the participants. Through the working streamlined model the findings of this study respond to the research questions.

### How Did the Women Make Career Choices?

The women in this study experienced their career choice as a guided and streamlined process driven primarily by their socio-economic status and their academic competencies in mathematics and science at the pre-tertiary level as recognized by influential key community figures stakeholders in their educational paths. Teachers identify students with high academic

competencies in mathematics and science and guide the students towards engineering careers. These academic competencies presented the women with opportunities to be exposed to information about and experiences related to engineering. The pre-choice exposure opportunities consisted of site visits to mines and career expos where the women received information that highlighted the financial benefits and value of engineers in solving problems within South African society. As most of the women came from low-income households both financial and job security were important as these would allow them to take care of their family responsibilities. Engineering then became appealing as a career choice given the expectation of guaranteed employment and financial rewards.

In addition to promises of future benefits, selecting engineering increased the possibility that one would be able to participate in post-secondary education through the bursary funds provided by industry, especially for the women whose families could not afford to send them to higher education. Financial resources were important both in the earlier selection of a career in engineering and as a much needed resource for one's family when one finally became an engineer in the future. Thus the process of career selection involved a weighing of the opportunity costs of engineering in relation to the financial rewards that a career in engineering an easy fit for their mathematics and science skills.

However, despite the women's individual selection of engineering as a career, the process was highly influenced by numerous stakeholders especially teachers, family members, and industry which provided higher education financial sponsorship. Thus for the women in this study, career choice was a guided process involving input from the community beginning with teachers who tracked students into particular fields through encouraging the selection of

mathematics and science subjects in early grades. The communal nature of career choice also involved the women consulting with family and friends about the work that engineers do in an effort to make an informed career decision.

The women's reliance on different community stakeholders resulted in the selection of a career in engineering with limited and sometimes no understanding of what such a career choice meant or entailed. Even though the individual carried out the act of deciding to pursue an engineering career, the community influences superseded individual preferences in building up to the final choice. The communal nature of career choice is aligned with African feminism's idea of community-embedded decision-making where African women's needs are intertwined with community needs. The women made career choices within predefined constraints imposed by their socio-political and economic statuses. Similar to Hallstein's (1999) concept of constrained agency as highlighted in Chapter 5, the women in my study exercised their individual agency within structural socio-historical, economic, and community constraints of a post-apartheid South Africa. The socio-economic and socio-political standing as Black people in a post-apartheid context where racial differences remain salient influenced the schools Black African women attended and the career opportunities they were made aware of.

For Black African women engineers in South Africa, career choice was a streamlined process constrained by various external events and considerations that the women experienced along the way. In navigating their streamlined pathway Black African women strategically relinquished their agency to community stakeholders and the structural forces encouraging engineering in order to advance in their career with the least resistance. Thus for Black African women engineers in South Africa career choice was not only streamlined but involved the utilization of strategically constrained individual agency to achieve desired career outcomes. By

referring to the strategic nature of constrained agency I acknowledge that Black women are not passive recipients of imposed choices. Research on women in STEM in the U.S. found that even in the face of feeling isolated in science environments women of color "did not passively accept these circumstances. Instead they took action in forming the paths to their careers via specific navigational strategies" (Ko, Kachchaf, Hodari, & Ong, 2014, p. 179). In my study one strategy involved relinquishing control when it facilitated entry into higher education and secure careers in engineering, via the path of least resistance.

### What Factors Have Influenced Their Career Choices?

The career choices of Black women engineers in South Africa were influenced by four broad areas, namely, individual competencies and interests, influential stakeholders, prospects of future rewards and their associated value to the community, and the awareness of opportunities available for higher education funding.

Individual competencies and interests include the women's academic excellence in mathematics and science as previously discussed. These competencies made early consideration of engineering a possibility as it allowed for the women to be tracked towards science subjects, prerequisites for pursuing engineering in higher education in South Africa. In addition to academic competencies the women eventually later found positive links between their individual characteristics and their new career pathway in engineering. Some of the characteristic traits included enjoying problem solving, liking challenges, and wanting to be pioneers in all aspects of their life, which attracted them to engineering as women were underrepresented in the field. Later career decisions began to focus on individual interests and the desire to engage in new challenging endeavors from acquiring a new job in engineering or to pursuing a degree in a new non-engineering field.

The influence of other stakeholders including teachers and family members has been previously discussed. Teachers in school were key stakeholders in the career choices of the Black women engineers in this study. Teachers identified students' academic competencies and encouraged the consideration of engineering as a career. For some women the presence of both male and female mentors and supportive supervisory staff influenced women's decisions to stay in engineering and pursue advancement in their respective places of work. For one woman in particular male mentors motivated and created specific opportunities for promotion and exposure to other aspects of corporate engineering. In higher education while lecturers and professors were influential in encouraging students to pursue postgraduate degrees, which ensured that the women remained engaged with engineering higher education even after working in industry, the professors did not market the academy itself as a possible career pathway in engineering.

Throughout their career pathways beginning in their pre-tertiary schooling, Black African women received information about engineering industry and the benefits to be gained from a career in engineering. For individuals who consider family status and responsibilities, the value of an engineering career included financial benefits useful for taking care of family needs. In making career choices Black women took into consideration their family responsibilities and obligations. Most of the women were the first in their families to attend higher education and the first to have the opportunity to get a well paying job. Family circumstances included having younger siblings, parents, or children at home who were reliant on them for financial assistance. As shown in chapter 4 through Dean Paul, institutional leaders are now acknowledging their awareness of Black African women's absence in academia as not due to the absence of qualified candidates as previous narratives claimed (Mabokela, 2000), instead that family responsibilities

among first generation Black students means eligible students are not pursuing academic jobs, confirming my initial assumptions when I began this study.

My findings confirm other research that describes careers as "interrelated with one's life roles in family, community and leisure" (Chen, 1998, p. 439). In thinking about their careers Black women engineers remained cognizant of the value of their success as engineers in industry for the families and communities from which they came. The women referenced the legacy of apartheid that had limited the career opportunities for their parents. As the born-free generation<sup>12</sup> they felt a responsibility to achieve more than their parents were able to do under an oppressive system. Engineering was the embodiment of an apartheid system of exclusion that they were interested in infiltrating and establishing a legacy as one of the first Black women in the field.

Career choices were also informed by the immediate financial and work opportunities that were available throughout one's career path. In the early phase the availability of bursaries provided by industry to primarily support engineering education made the selection of engineering a more lucrative option. As mentioned previously, without the financial backing from industry most of the women would not have been able to attend postsecondary education. Thus the availability of financial support during one's higher education studies and the guarantee of employment as part of the bursary obligations directly influenced the women's selection of engineering. In the middle and later phases changes to places of work arose from being headhunted by other companies and senior staff within existing places of work. As individuals became secure both in terms of employment and finances, pursuing postgraduate degrees in engineering and non-engineering fields became a possibility.

<sup>&</sup>lt;sup>12</sup> Born-free generation is a term used to describe individuals born after independence in a new democratic South Africa.

Except for one woman who pursued her Honor's degree fulltime most of the women were able to pursue postgraduate studies while remaining employed. Two women eventually left their jobs to study fulltime with one of the two women remaining engaged in consultancy work. For the women in this study, job and income security remained the priority considerations when making career decisions. The women pursued opportunities that safeguarded such securities.

## Why Have Their Career Choices Not Included Academia?

Understanding the ways Black African women engineers make career choices is important to begin to explain why the academy has not been a part of their career pathway thus far. In making career choices the academy did not emerge as a consideration for all but two of the women in this study. Throughout Black African women's career pathways in engineering the academy represented a transitory space on the path to a real career afterward in industry. The academy was viewed as a training ground to gain the necessary qualifications for a job in industry (Mangcu, 2014b). Information about careers in engineering included the notion that attending postsecondary education to gain a qualification in engineering was a necessary process towards obtaining a job in industry (or government).

Black African women also equated higher education with pre-tertiary schooling in that it was a place where one has to pass through before moving on to better opportunities in higher education. Equating higher education with schools also meant that academics were viewed merely as teachers. Given the legacy of apartheid, during which Black African women's career options were limited to teaching and nursing in post-apartheid South Africa, where more opportunities became available, teaching was less prestigious and not appealing for these women.

Furthermore, Black women perceived teaching as far removed from the practice of engineering. One woman noted that if they had wanted to be a teacher they would have pursued a degree in education, instead they picked engineering because they wanted to invent. Higher education represented a theoretical space where engineering was not practiced but the theory of engineering was taught. Teaching did not support their immediate career desires to engage in practical work and to achieve more than their family members and Black people generally had been able to do during apartheid.

Black women were also reluctant to become teachers in higher education because they felt inadequately prepared to impart knowledge to other students. Despite being confident in their ability to become engineers in industry, Black women did not feel ready to enter academic careers. "People who have a low sense of efficacy for accomplishing a task may avoid it; those who believe they are capable should participate readily" (Schunk, 1991, p. 208). On one hand, Black women's reluctance to become teachers reflects low self-efficacy with regards to academic careers. On the other hand their reluctance could be a response to a stereotype threat around the negative perceptions these women had of Black lecturers during their own studies.

Dean Paul shared how the lack of information about academe is a result of Black student's first generation status where their family members had neither attended nor worked in higher education.

It's not just Black women by the way it would be Black academics as well. A lot of those folks would be first generation university graduates and I think that one of the things that we need to recognize is that its incredibly hard if you're first generation to go into academia...I think academia is quite a foreign kind of a thing its like, 'what is this thing?'

it doesn't look like a profession, it doesn't look like my career I haven't [had] family in that and I'm not really familiar with it so its kind of like not a natural [option].

The absence of information about what a job in the academy involves allowed for the inaccurate perceptions about the academy as only involving teaching or not being connected to practice to be solidified as fact.

In addition to equating academic work with teaching, the women in this study discussed how through their actions and attitudes towards their work, lecturers, and professors created negative perceptions about the academy as a place of work further discouraging the women from pursuing academic careers. Furthermore the women's educational experiences in higher education where White males were overrepresented and Black women were absent created the perception that higher education was not a welcoming space for Black women. Reiterating literature discussed in Chapter 2, the perception of academe as unwelcoming leads to those in the pipeline seeking employment in other places "rather than pursue and academic career" (*The Journal of Blacks In Higher Education*, 2007, para. 18). The Black African women in this study had reconciled early in their higher education process that engineering academe was a White space Black people had to survive, obtain their degrees and leave to work in industry. The transition to industry work was presented as a natural process in the progression of one's career in engineering further highlighting how career pathways were streamlined towards industry.

Finally due to the close links between higher education and industry which included industry sponsored bursaries and the curriculum requirement for engineering students to participate in vacation work in industry as a prerequisite for graduating, students were able to develop familiarity with engineering work in industry spaces. The familiarity with industry work coupled with the lack of information and familiarity with academic work made industry a

comfortable option for the women. In addition the bursary obligations to work for the sponsoring organization meant the women were employed immediately after graduating, further streamlining the women's career pathways in industry solidifying their industry associations and leaving little room to consider alternative careers like the academy.

The higher salaries in industry relative to the academy made leaving industry to return to a lower paying higher education career less probable in the beginning of one's career when job and financial security and the prestige of the job were more important. The longer the women were in industry and as the women felt they were now adequately prepared to teach, considerations of working in academe part-time increased but the shift to a full-time career in higher education was still not viewed as an option.

The next section discusses how the working grounded theory model relates to literature discussed in Chapter 2 and additional literature I used to help make sense of the grounded theory findings.

### **Relationship Of Grounded Theory Findings To Literature**

### **Factors Influencing Career Choices of Black Women**

The research findings show that career choice is influenced by a myriad of external and internal factors blending "structural, cultural and individualistic explanations" (Woolnough, Guo, & Leite, 1997) encouraging Black African women to pursue and persist in engineering industry careers. Similar to Jawitz and Case's research in 1998 the women in my study were influenced by external factors including schoolteachers who served as socializers encouraging Black African women to pursue engineering and who organized pre-choice activities to allow Black African women to engage with engineering careers in industry. Teacher's encouragement of Black women to pursue engineering shows a change in South African school culture where previously girls were "often actively discouraged from studying science and from considering careers in science" (Martineau, 1997, p. 389).

Internal factors influencing engineering career choice included the women's academic competencies in mathematics and science and Black African women's personal characteristics as people who are attracted to challenges and were motivated to prove that they could become engineers when social narratives told them engineering was for men (Jawitz & Case, 1998). However the influence of social identities and the desire to "prove a point" often came as an afterthought when one had somewhat already committed to pursuing engineering and was not the impetus in most cases for deciding to become an engineer. The afterthought given to the fit between one's choice and personality is indicative of a philosophical argument that choices are often void of conscious judgment. Holton (2006) argues, "judgment follows from a choice" (p. 9) such that "agents can come to find out something about the world – in particular about which choice is best – by looking at what they have chosen" (p. 10). The linking of one's personality to the choice of engineering as an afterthought is indicative of this philosophical perspective of choice. Black African women were only able to judge if they made the right choice after the choice had already been made. As has been shown some were positive about their choice, others expressed some regrets particularly when the choice was informed by financial rewards and not based on interests or personal characteristics in the first phase of career choice.

Structural factors included the socio-economic statuses of Black African families as mostly low income with limited access to funding for higher education, increasing Black African women's reliance on company sponsorship. Furthermore the post-apartheid socio-political arena, which includes affirmative action policies, influenced industry's active recruitment of competent Black African women into engineering (Republic of South Africa, 1998). However at the

individual level the post-apartheid socio-political arena also motivated Black women to pursue fields like engineering that had previously excluded women and Black people (Cruise, 2011; Martineau, 1997; Moshupi, 2013).

Another finding not highlighted in Jawitz and Case's (1998) work is the significant influence industry funding has on Black African women's decision to pursue engineering. Once again the information about industry funding is presented through teachers or directly from industry recruiters who visit schools scouting academically competent students, usually attending predominantly low-income Black schools. The immediate reward of sponsorship for higher education seems to override other considerations about what accepting funding from industry will require later. In South Africa "for all young adults educational attainment and outcomes are still heavily dependent on financial resources" (Branson, Leibbrandt, & Zuze, 2009, p. 4), thus one's academic competencies alone do not guarantee access to higher education.

Therefore for Black African women who excel in science subjects, the prospect of attending postsecondary education influences career choice more than the financial rewards associated with engineering. Black African women in South Africa with high academic competencies want to further their education and an engineering career pathway is one compromise that provides an easier route to higher education with the hope of securing a better life thereafter (Firfirey & Caolissen, 2010).

#### **Industry Bursaries Streamlining Careers in Industry**

Higher education leaders attribute the underrepresentation of Black African women in academia to the competition between higher education and industry for a limited pool of qualified engineers. While this is true, an additional reason that emerged from my research is that the cooperation between education and industry to support the education of new engineers

actually contributes to Black African women following industry-focused pathways. First, the women in this study revealed that they participated in vacation work during their studies. This contact with industry careers represents the self-efficacy concept of task performance, which creates familiarity and comfort with industry work, increasing Black African women's self-efficacy of their ability to work in industry (Hacektt & Betz, 1981; Jawitz & Case, 1998). Second and most influential are the bursaries, which carry an additional obligation to work for the sponsoring company immediately after graduating with the first degree. The work obligation means most new engineers have guaranteed employment with substantial financial perks, making a return to a lower paying academic job improbable. While other studies have highlighted the influence of sponsorship on pursuing higher education, the way in which sponsorship streamlines career choice and essentially hinders the consideration and pursuit of alternative careers like academia has not been previously noted until this study.

In Australia and England where similar company sponsorship exists, students were motivated to choose scientific and technological careers by the "ease of entry to higher education for science and engineering" and the "possibility of sponsorship in higher education" as occurs in South Africa (Woolnough et al., 1997, p. 116). While most newly graduated engineers go to industry, in some cases companies do not have immediate need for all workers. In my study one participant mentioned that her friend who worked in industry had been placed in a postsecondary college to teach mathematics classes part-time through an arrangement made with the company and the post-secondary institution.

Another participant mentioned that as industry hiring is beginning to slow down due to economic instability in mining, it is likely that new graduates will have to consider alternative career paths including higher education. However, even if partnerships with industry were to be
established to allow for engineers to work as lecturers on a part-time basis, the mission of South African higher education to achieve world-class status through publications is incompatible with part-time scholars (Altbach, 2013). Therefore the sustainability of such a partnership is uncertain and unlikely to last. Furthermore, as highlighted by both institutional Deans,

The academy has got another challenge as well and I think that is that I wish I could appoint all the people that I identify as having the potential but I don't have the cash. So you kind like gotta wait for these old professors to bugger of before you, it sounds

terrible but my crisis is how would I get people in if I cant get people out? (Paul) The challenge of academic staff of retirement age refusing to leave means even if there are Black people interested in academic careers, institutions do not have the positions or the budget to recruit anyone until some people leave. Other institutions have policies and practices in place to encourage retirement; Bridgette shared how her faculty addresses this challenge.

We are trying our best. The policy is to say at 65 you retire. But of course, there's professors, and they've got very good academic profiles so they will write a motivation and they will send it through for extension. So we try to just say no, as a faculty management, we just say no. We just want to grow our own timber. Sorry, we can't extend a contract. We will extend it once but that's it...with the contract[s] that we extend, for people who are [in] retirement, we extend on the basis that you groom the young generation. So we pair you with a young junior lecturer, then you need to work with this person, research as well. You need to help the person to also become, to where you are [in] five years. And if we don't get output from you with these researchers also then we don't see any work done. We're not gonna[renew the contract].

Even when policies are in place, the additional 5 years retired academics are allowed to petition to remain in the institution translates to another 5 years of a predominantly White male status quo in engineering as the few available resources cannot be allocated exclusively to increasing and retaining diversity hires.

#### **Career Choice as Strategically Constrained Individual Agency**

Career choice defined as "choosing one occupation over another" (Agarwala, 2008, p. 363) requires two conditions to be present: first, the availability of alternative career options, and second, an individual preference between the available options (Agarwala, 2008). Most of the women in my study indicated that they had considered either medicine or accounting as career alternatives. However, individual preference was overridden by teacher influence, tracking academically competent students into science subjects and into engineering careers.

The constraints on individual agency in making career choices reflects other South African research showing that "students from lower socio-economic families are not given adequate space to make independent decisions on their careers" (Shumba & Naong, 2012, p. 169). Other research from the United States confirms that "gender, SES and academic performance interact to shape postsecondary educational choices" and career choices (Trusty, Robinson, Plata, & Ng, 2000). Limited financial resources impact the prospect of attending higher education but also influence the types of careers the family or community view as acceptable should limited resources be expended.

Family members played supporting roles to career choices already informed by schoolteachers, who sometimes pushed students into engineering even when students indicated interests in other areas. While teachers reduced individual agency in career choice, teachers also exposed Black African women to engineering as a career option the women may not have

otherwise considered and helped in securing financial resources to fund higher education. In South Africa industry provides financial support for students pursuing engineering degrees. For students from low-income households advancing to higher education is largely dependent on the bursaries and other sponsorship students are able to secure (Wangenge-Ouma, 2012). Teachers' awareness of students' academic competencies that make such funding opportunities available may lead to careers in engineering being encouraged over other careers. Given the circumstances Black African women career choices can easily be streamlined in the direction of available funding.

In addition to career choice being a guided process streamlined towards engineering industry, career choice is also a communal process. For each woman in this study the decision to pursue an engineering degree while in high school was the first career choice moment with subsequent career decisions made in one's career path reinforcing or modifying this choice. Reinforcement involved pursuing engineering-related activities such as postgraduate education in engineering or a new job in engineering. Modification involved pursuing non-engineering related post-graduate degrees and jobs while still remaining connected to engineering as one's main career.

Community influences included direct encouragement from teachers in school to pursue engineering, the family and friends who provided supportive information about engineering as a career and the people or society who through discouraging academic careers inadvertently advocated for industry jobs. The centrality of teachers in subject choice and subsequent career choice of Black women engineers deviates from other South African career research. In most studies on career choice teachers occupied a secondary role to family and friends in influencing the career choices of Black students (Shumba & Naong, 2012). However, in my study family

members and peers had marginal influence on the women's career choice, only providing additional information about engineering when requested. Parents and sibling support have been found to be important for positively reinforcing the career development of African American adolescents (Constantine, Wallace, & Kindaichi, 2005). In this case their marginal support merely reinforced career choices already decided largely by teacher influence.

Parents' limited influence on career choice in this study was likely due to the fact that most of the women came from low-income households and were the first in their families to attend higher education, and with exception for one woman, were among the first in their families to pursue engineering. As a result teachers, who are figures of intellectual authority, easily filled the parental and guidance counselor roles shaping the career development of students. Contrary to existing career research (Shumba & Naong, 2012), for Black African women engineers, the role of teachers in career choices supersedes family influences. In my study the guidance provided by teachers and industry recruiters, pushed students into particular career options, which was problematic for some students who indicated their interest in other careers other than engineering. Teacher guidance in these cases limited the individual agency of the students to make career choices that aligned with their personal preferences. This guided decision early in one's career may explain why women began to explore and pursue non-engineering careers later in their career paths towards areas of personal interest.

My initial assumption was that degree choice does not appropriately reflect one's career choice. The findings in this study contradict my assertion confirming that career choices are indeed made prior to individuals entering postsecondary education. Not only was school subject choice being a significant determining factor (Shumba & Naong, 2012), my study concluded that school choices are also career choices. However, unlike other studies and theories that assume an

individualistic decision-making process where external actors merely provide information to the individual to make the final decision, my study shows that career choice is not an individual process. Instead different stakeholders including teachers, school principals, industry and industry recruiters, and members of society, as Rose mentioned, all play an active role in directing the selection of particular actions within contextual structural circumstances, providing particular options for Black African women to choose from. The limited options provided effectively streamline Black African women's careers into engineering.

However, in presenting Black African women's career choice as streamlined I wanted to be sure not to diminish their agency. In a reflexive memo during analysis I noted,

#### Analysis Memo #3: December 28, 2016

I am thinking about my willingness to relinquish the agency of these women in my analysis. I realized that Black women were indeed aware of their status and the need to attend higher education and if industry funding and teachers were useful in getting to that place then they were willing to appear to relinquish their agency to achieve their goals. While on the surface it may appear as constrained – and perhaps it was – their stories especially in relation to the second phase and beyond seemed to be a strategic constrained agency. Knowing when to let others take over for their benefit and how to navigate within the different spaces to ones benefit. How dare I take away their power! Perhaps I should consider "strategic agency" vs. constrained agency – operates the same on the surface but underlying it is women's understanding of the need to capitalize on available opportunities and if that means appearing to relinquish one's agency - they are tactful in doing so to achieve their desired outcome.

Instead as choices are limited, individuals are still able to decide to conform to the constraints on their agency, or they may choose to reject the constraints and make alternative career choices having to accept the consequences of each choice. I argue that rejecting the predetermined choices would represent true agency with choice. However, conforming to streamlined career pathways represents agency without choice. Holton (2006) refers to this absence of choice as the *"unexercised capacity* [sic] to choose" (p. 13). Holton (2006) provides a description of agency without choice as,

...typically *unchosen* actions, which is to say that when an agent chooses they have the unexercised capacity to choose both how, and whether to choose. That is they have the capacity which they typically do not exercise, to make an effective choice to choose differently, and to make an effective choice not to choose: to put the choice off, perhaps never to make it at all. (p. 14)

Black African women engineers strategically relinquish their choice but not their agency to conform to streamlined career pathways presented by community and industry stakeholders, contextual structures, and circumstances. In a post-apartheid society where most Black families are still unable to afford the high cost of higher education one can understand the motivation to pursue a career where funding is provided and high financial rewards are promised in the future.

#### Why Not Academia?

As discussed in Chapter 2, research attributes Black women's underrepresentation in academe to the hostility of higher education institutions. The findings of this study indicate that Black African women indeed experience the higher education space as unwelcoming. However, the women noted similar race-gendered challenges in industry but committed to pursuing careers in industry and persisting. Therefore the argument that an unwelcoming space deters Black women from pursuing a career is nullified. A more plausible explanation for the underrepresentation of Black African women in the academy emerged from the findings showing that Black African women engineers do not view the academy as a place of work. Instead, because industry was viewed as a real working space legitimizing one's identity as a practicing engineer, Black women were willing to bear the hostility of industry in ways they did not seem open to tolerating in academe. Other research shows that Black South African women chose engineering because they wanted to "prove themselves in a career traditionally dominated by

white males" (Jawitz & Case, 1998, p. 239). However, even with an awareness of the absence of Black women academic staff in engineering, the women in my study did not feel compelled to become pioneers in academe in the same way they were passionate about breaking into industry as one of the first women (Jawitz & Case, 1998).

The reluctance to break the glass ceiling for Black African women in engineering academe can be attributed to the noticeable absence of Black women mentors in the academy and Black African women's perception Whiteness in academia was the norm, and Black representation an anomaly. In a space where White women were viewed as struggling to "break out," the prospects for Black women excelling in academia were perceived to be impossible. In South African higher education "White bodies become somatic norms", whiteness is unmarked "a habit only invisible to those who inhabit it or those who get so used to its inhabitance that they learn not to see it" (Badat, 2015, p. 81). Black African women engineers were accustomed to the norm of whiteness but also expressed that transformation of the academy was an illegitimate endeavor as institutional leaders were not really interested in changing the status quo of White, male dominance. White people were seen as recruiting, grooming, and hiring other White people for academic roles. "Unwritten rules in academia tend to be handed down from one generation of scholars to another and communicated informally through networking systems" (Christiansen, Macagno-Shang, & Staley, 1989, p. 58). As one participant shared,

The lecturers decide who they want as lecturers by the time that we graduate...so if I come there and I'm like you know what I would love to teach this, but this guy has been groomed already for this position...how are you gonna come in and destabilize that foundation? (Tumelo)

Black people were not made aware of the rules of academia with many women indicating limited understanding of what academics do. These feelings of exclusion and not being selected became the facts Black African women used to determine that academia was not for them and that perhaps the academy itself did not want them. In addition to other women's challenges in academe deterring Black African women from considering academic careers, their own negative experiences as students reinforced the idea that academe is not a welcoming space for Black women (Christiansen et al., 1989; Collins, 2000).

Researchers state that women mentors provide other women with a "realistic picture of the professional work atmosphere" in academe (Christiansen et al., 1989, p. 58). Christiansen et al. argue that the "notion of 'women learning from women' speaks to the importance of the 'connected self' in career development" (p. 58). This means that women mentored by other women are better able to identify themselves in an academic career than when male mentors are involved. Therefore the absence of Black African women in engineering academe hinders younger Black women from seeing themselves in similar careers and my findings confirm this assertion. However, my study also provides new insights to understand why Black African women are absent among engineering academic staff. Instead of identifying with academe as a career space, the Black African women in my study developed a temporary connection to higher education as students in a transitional space destined for industry jobs. "Learning spaces are often places of transition and transformation where individuals experience a shift in their perspectives of life worlds" (Archer & Parker, 2016). However, for Black African women whose career choice into engineering was guided by various stakeholders and essentially streamlined towards industry work the learning space is indeed a transition but rarely transformational. The circumstances of career choice, which often involve obligations to industry and predefined career

trajectories after graduation, mean that even if Black African women wish to change and pursue other careers, such options are not immediately available. As a result Black African women relinquish their agency and follow the streamlined path of least resistance towards industry careers.

In 2014 in response to an article by Mangcu (2014a) exposing the lack of transformation at the University of Cape Town, the Vice Chancellor of the university Max Price responded (2014) arguing first that the absence of Black women and the gross underrepresentation of Black people among the professoriate at UCT reflects a national problem. Price goes on to provide explanations of the problem including the oft-used argument that it "takes more than 20 years from getting a PhD to becoming a professor" (para. 5). Thus the representation of professors currently reflects a proportion of qualified candidates in a post-1994 context. Sadly this echoes existing stock narratives used by institutional leaders about the lack of qualified Black people without acknowledging the unwelcoming institutional culture and environment that affects Black people.

Price (2014) offers a second reason, which I argue is more appropriate and accurate that is, few PhD graduates "choose academic careers over offers from the new government, civil service and corporates" (para. 5). As my study shows, indeed Black African women did not seem to view academic careers as viable or credible for real engineers. However, as I have also shown the seeking opportunities in industry is influenced in-part by the negative experiences in higher education where Black African women receive the message that they do not belong and "whiteness continues to be ingrained as a standard of academic potential in South African universities" (Mangcu, 2014a, para. 22). What are the implications for the findings discussed?

#### Implications

The findings from this study have implications for both theory and practice to increase Black African women's representation in engineering academe. First I discuss theoretical implications and the opportunities the streamlined career choice model provides to reconceptualize career choice. Next I discuss implications for practice at both the school and higher education levels in terms of career planning programs, socialization in higher education, and higher education engagement with alumni and industry. Finally implications for future research are presented.

#### **Implications for Theory**

Theoretically the findings show that the idea of career choice or career decision-making needs to be reconsidered and re-conceptualized especially for Black African women in the South African context. The idea of a streamlined career choice process and the socio-political, economic and circumstantial constraints on individual agency in making career decisions means that career choice is more of a guided than a self-driven process. For the women in this study self-efficacy was more dependent on teachers' persuasion than individual familiarity with engineering activities. In fact most of the participants indicated that they pursued engineering careers despite not really understanding what engineering entailed. The positive affirmation from teachers and to a lesser extent from family members instilled the belief that engineering was the only career option. Black African women selected the career they were encouraged to pursue despite having other career interests. For Black African women career choice was less of an individual choice and more of a streamlined and guided community decision. Therefore career planning programs need to think about engaging with the different community stakeholders

influencing individual choices to ensure that information about different career options like academic careers is readily accessible.

The findings provide an additional consideration to the pipeline metaphor as used in describing the underrepresentation of Black African women in STEM careers. The pipeline metaphor assumes that the low representation in engineering is due to Black African women being lost along the pipeline from pre-tertiary to postsecondary and to the workplace. However the focus on loss masks the fact that in addition to some people being lost along the pipeline, there are others who persist (Mlambo & Mabokela, 2016). The participants in this study were motivated to persist along the pipeline through to careers in industry because they felt they had to "make it work." The socio-political and economic constraints that initially determined their career choice continued to impact their considerations along the pipeline. Therefore the factors influencing career choice are not momentary considerations but continue to influence career decisions as one progresses along the pipeline or pathway.

The explanatory value of the streamlined career choice model for Black African women engineers may extend to other applied fields such as medicine. As noted in previous chapters women studying medicine and transitioning to different careers in medicine have similar experiences to the Black African engineers in my study. In Lawrence et al.'s (2003) study about South African women, social-cultural considerations including social expectations for women as child bearers and tenders deterred medical students from full-time medical careers. Another study by Borges et al. (2013) found those who followed careers into academic medicine were considered by their peers as not being real doctors, further confirming the idea that academia is not considered a place of work. Exploring how the current model explains other fields will assist

in moving this substantive theory about Black African South African women engineers to a formal theory of career choice processes.

Finally this study shows that career choice encompasses both linear and a non-linear processes. In the early phase when the first career choice moment occurs, the process follows a more linear pathway from teachers identifying student competencies, securing industry bursaries, attending higher education to pursue engineering, and beginning a career in industry. As individuals become more stable and secure in engineering they engage in different activities within and outside of engineering from switching jobs, engaging with mentors, and pursuing personal interests. However, because careers in engineering are streamlined, individuals explore various branches connected to the main pathway in industry engineering. Therefore as I argue in Chapter 1, understanding career choice and addressing the underrepresentation of Black African women in engineering academia requires a joint pipeline and pathway perspective. The use of the two perspectives takes into account how social and institutional structures influence the numerical representation of women entering and persisting in engineering careers in both industry and the academy.

### **Implications for Practice**

#### Career planning programs

Schoolteachers' encouragement of Black African women students towards science is a significant factor influencing career choice in engineering (Woolnough et al., 1997). Woolnough et al., state, "teachers are more important than the curriculum they teach. Students need to be inspired by their teachers and challenged and stimulated by the science they do if any of them are going to want to continue with their science into higher education and careers" (p. 119). Greater connections between teachers in schools and higher education science and engineering

academics will ensure that school teachers have sufficient information about engineering and engineering academe to be able to identify capable students and encourage them not only to pursue engineering but to consider careers in academia as well (Woolnough et al., 1997). Unfortunately in South Africa the separation of the ministry of education into basic (school level) and postsecondary level has furthered the divide between the two sectors. However, this study confirms that career choices are made in school, therefore resources need to be invested to increase interaction with schoolteachers who are central to the career choices of Black women.

#### Higher education career planning

There needs to a be a reconsideration about the ways Black African women engineers in industry can get involved in higher education to increase their visibility in these spaces. As research universities are moving to become world-class universities they are changing the minimum requirements for entry-level academic staff. Where honor's degrees were sufficient for entry, now master's degrees are the minimum allowing one to become a junior lecturer with the requirement to obtain a PhD within a 3 to 5 year period after employment. Perhaps increasing part-time presence in vocation-focused spaces where a larger number of Black women from low-income households are found will change the image of academic staff as being all White. This also allows those in industry to gain experience of one aspect of academic life (teaching), which is a required skill, and to demystify the fear of teaching many Black African women hold. In the same way that industry vacation work increases familiarity and self-efficacy through task performance, part-time interactions in higher education makes academe less of an enigma.

The interaction with industry will also ensure that at the second career choice moment where individuals can be persuaded to consider alternative career paths, higher education shows

up as a possible option. Individuals will be better able to understand what is needed to excel in academe and with more information, feel less apprehensive about it as an option.

### Socialization in higher education

Existing scholarship in South Africa and around the world sees postgraduate education as the moment of socialization for academic careers (Austin, 2002; Herman, 2010; Perna, 2004). The findings of this study indicate that the idea of academic socialization needs to be extended to include all undergraduate education as the undergraduate experience greatly influences the understanding and perception of the academy as a place of work. In the United States research shows that participation in undergraduate research in STEM increases student persistence and consideration of pursuing graduate studies (Eagan, 2013). In South Africa undergraduate research is obligatory only for the completion of the final projects in the last year of one's degree. Therefore apart from this curriculum required project, or the few cases where students are teaching (departmental) assistants or tutors, students are generally not exposed to academic research and rarely interact with academic staff beyond the classroom. Woolnough et al. (1997) note, "involvement of students with extra-curricular activities such as science competitions, projects and school-industry links can act as important stimulants to students ... triggering their motivation" towards science and engineering careers (p. 119). Increasing opportunities for undergraduate students to participate in research working with academic staff provides another opportunity for students to become familiar with academic work.

Practical examples of undergraduate socialization include recruiting students to engage in academic staff led research in their first year. Tasking students with desktop literature reviews, locating relevant articles and compiling annotated bibliographies will introduces students to the research-related work of academic staff. In the science and engineering spaces where lab work is

necessary, students can participate as note takers or equipment organizers to gain comfort in the lab outside of one's school-related requirements. As students progress to second, third and fourth years more responsibilities can be allocated related to invigilating and grading tests for junior levels or assisting with classroom management on days when class quizzes occur. These direct tasks will increase self-efficacy through task performance. However, as my study shows verbal persuasion has more influence on Black African women's career pathways into both industry and the academy. As students engage in all of these tasks, academic staff leading the students needs to continue to provide positive feedback to the students and affirm their capabilities as individuals who can one day also become academic staff. Through expressing confidence in their abilities Black African women and other minoritized populations in engineering may begin to envision higher education as a possible place of work.

Socialization at the undergraduate level should also involve active marketing of academe as a career in the same way that industry career expos operate. Educators have unlimited access to undergraduate students for about 4 to 5 years which is ample time to market the academy. Students' disposition as learners in an education space means educators have a captive audience willing to listen. Capitalizing on a ready audience may encourage one or two students to think about studying further and entering the professoriate.

Academic socialization should also be extended to pre-tertiary levels as knowledge about careers in school influences career choices. Although students may still have industry obligations to fulfill immediately after graduating from university, early knowledge about academe could be useful in guiding engineering alumni to higher education in the third phase of their careers where a second career choice moment is most likely to take place.

#### Funding higher education

My study shows industry bursaries play a central role in streamlining the career choices of Black African women engineers in South Africa. Given the apartheid higher education history of segregation and exclusion, non-White students who previously had restricted access value higher education as necessary for social elevation (Mlambo & Wawrzynski, *under review*). Most Black students come from low socio-economic backgrounds and are seldom able to afford the high cost of tertiary education. As shown, the availability of funds to further one's education is welcomed unquestioned. If increasing representation of Black African women in engineering academe is the goal, higher education should adopt industry recruitment practices and provide similar financial sponsorship to attract an retain more students into academic careers.

Unfortunately higher education continues to rely on government subsidies and with the dwindling allocation of financial resources engineering departments also rely on industry funds to function. The co-dependent relationship between industry and higher education has been positive in producing engineers for the country. However the production of engineers for industry needs has created a deficit in academia. Creating agreements with industry where some funding is provided to engineering departments to foster the next generation of academics, perhaps through matching government contributions will increase the funding available to recruit and retain non-White and women engineers in higher education. Higher education essentially creates the engineers required in industry and so holds some negotiating power. Strategically leveraging that power to obtain funds to recruit and retain young academics is necessary.

#### **Implications for Future Research**

The research revealed a number of implications for future research around the disruptive nature of research and considerations for future research on Black African women in engineering, STEM, and the academy.

Through interview conversations with participants I learned that Black African women do not view the academy as a place of work. However, through our conversations and in explaining the purpose of my research to understand why the academy has not been a career choice thus far, participants indicated that the interview had made them think about the academy as a possible career for them, albeit on a part-time basis for now. As the women's career choices were significantly influenced by the information they were provided by teachers and other stakeholders invested in the women's education, my research provided an opportunity to gain information about academia they had previously not been exposed to. Research disrupts the status quo and provides an opportunity for change (Paris & Winn, 2014). My research provided an opportunity for Black African women engineers to reflect on their career pathways and to become aware of how different factors influenced their career trajectory. Therefore future research involving school age Black African women may expose them to new career information and influence their curiosity about academic careers as occurred in this study.

As discussed, Black African women engineers do not view the academy as a place of work. Research is required that explores the factors and considerations Black African women and other non-White women have when considering STEM careers, and more importantly the perceptions they hold about the academy as a place of work. Understanding how STEM undergraduate and graduate students think about their careers will provide more insights into the

career considerations made during one's academic journey and help in crafting interventions that will attract these students to academia.

Given teachers' central influence in tracking Black African women towards engineering careers, it is helpful to understand how teachers make the decision to guide academically competent students towards particular careers over others. In addition, contrary to Bandura's self-efficacy theory stating that involvement in activities is the most influential for self-efficacy, my research showed that verbal persuasion is actually more influential for Black African women engineers. Examining what other individuals who picked engineering careers recall as being influential in motivating them to pursue engineering careers may reveal new findings that help shape the teaching and learning practices in schools to encourage more students from underrepresented groups to pursue STEM careers.

Similar research needs to be conducted with different underrepresented groups in different contexts. This study focused on Black African women, mostly from low socioeconomic status backgrounds located in a particular geographic area in South Africa. Replicating this research with different population groups and in different global locations may reveal interesting similarities and differences that allow for comparison and creation of global solutions to the global phenomenon of the underrepresentation of minoritized populations in STEM academic fields.

Finally the use of constructivist grounded theory in this study was useful in centering the lives of Black African women who are often relegated to the margins of society. As discussed in chapter 3 most Western-based theories use the lives of White, heterosexual male (and sometimes females) as the objective standard. Constructivist grounded theory exposes theory as neither *acontextual* nor value neutral, advocating for theories to emerge from the data not externally

imposed. In addressing the global nature of underrepresentation of Black African women and other minoritized groups in science and engineering, uniformity is easy to assume. Instead constructivist grounded theory encourages researchers to approach each context as unique. Allowing for the data to tell the story may reveal unexpected findings adding to knowledge about the phenomenon. While theory verification narrows one's perspective, theory creation through constructivist grounded theory is unfiltered and unhindered. Thus researchers of global issues such as engineering diversity (or the absence of) should remain open to new information in every context.

#### **Study Constraints and Considerations for Future Research**

There are some considerations that need to be taken into account with regards to the design and procedures of this study and the use of the working model that emerged from this study to guide future research. First this study was conducted with Black African women engineers located in one geographic area in South Africa. The purpose of this study was to understand the career choice processes and to create a substantive theory or model explaining the choices of these specific participants. As highlighted in Chapter 3, the constructivist paradigm guiding this study operates from a relativist ontology acknowledging the multiplicity of realities and knowledge as dialogical, co-created by participants and the researcher. More importantly reality emerges from this co-creative interaction and its "temporal, cultural, and structural contexts" (Charmaz, 2000, p. 524). Therefore the working model is not meant to be generalizable to all Black African women engineers.

In an effort to ground the model in the experiences and voices of the women in this study, I made every attempt to restrict the influence of my worldview on the findings. Constructivist grounded theory encourages the researcher to be transparent about the worldviews they bring to

the research, but the purpose of a grounded theory study is to use the data gathered to create a framework, theory, or model. As a result the conceptual framework was largely irrelevant to explain the findings. Specifically my view of the world informed by African feminism(s) and assumed racism and sexism would be salient factor deterring Black African women from pursuing academic careers. This was not supported by the findings, which showed instead that gender had a marginal effect on their decision to pursue engineering. Although racism was experienced both in industry and academe, the women were amenable to pursuing industry careers but not academic careers. Experiences of race in academia were perceived as indicating that Black people were not welcome in institutional spaces but similar experiences in industry strengthened the women's resolve to be pioneers and prove that they belong in engineering industry. The view of academia as not being a place of work, tangentially supported by the perception of academia unwelcoming to Black women, not race-gendered positionalities, deterred Black African women from academic careers.

Despite the limited utility of my conceptual framework, as the researcher I directly influenced the product of this research. I designed the study, conducted the interviews, and engaged with participants in co-constructing meaning. I also had the final privilege to analyze and interpret the data deciding how to retell the life stories they shared with me in developing a working model based on their experiences. This means that another researcher engaging with the same participants may come to unique conclusions on the same topic. However, through practicing reflexivity I endeavored to ensure the participants' voices were central at all times throughout the research process. Reflexivity means "being up-front about how, as researcher, you came to be telling another's story in your own words, and through an interpretive frame built upon your (other) experiences, assumptions and individual knowledge of human life" (Shacklock

& Thorp, 2005, p. 157). Engaging in member checking allowed me to share the transcripts and the working model with participants to obtain their feedback and clarify questions or concerns they had with each aspect of the model. Involving participants at all stages of data analysis is a useful and necessary check on our privilege as holders of the pen telling the story (Shacklock & Thorp, 2005).

Due to the limited availability of participants and time considerations for data collection, participants were only interviewed once. Constructivist grounded theory encourages, where possible, multiple interviews be conducted with the second interview reserved for sharing tentative theoretical ideas with the participants (Charmaz, 2014). However, Charmaz (2014) also notes that single interviews provide sufficient data to "create something grand" (p. 108). To account for the single interview I scheduled at least 90 minutes with each participant and used the opportunity to cover as many topics of conversation as possible. Furthermore, following constructivist grounded theory data collection methods, previous interviews informed additional questions that I posed to new participants. As discussed in Chapter 3 this process of including "new lines of inquiry into later interviews that reflect our developing analyses" is referred to as theoretical sampling (Charmaz, 2014, p. 103). Additionally member checking for both individual interview transcripts and the working model was used with opportunities for feedback and clarification provided through email communication during the write-up phase of this study.

Although socio-economic status was not a demographic question asked in the interview agenda, most of the participants shared that they came from low socio-economic status backgrounds. The socio-political and economic status of most of the participants may explain why bursary funding to attend higher education was a salient factor influencing career decisions. A deliberate analysis of family income levels, parent's level of education, and other demographic

factors could have provided more insights into the career choices the women made. Perhaps participants from medium to high-income families may have revealed other factors influencing their choice of engineering. At least two participants indicated they came from economically comfortable family backgrounds and impressing one's family and establishing one's own identity separate from family were important motivating factors for pursuing engineering. An indepth exploration of how family income influences career choice is absent from this study but is something to consider for future research.

Finally with exception for one woman who was working in a corporate non-engineering role, the study focused on participants who chose engineering and ultimately remained in engineering. Charting the career trajectories of Black African women who left engineering to pursue other non-engineering careers but still not in academia may provide better insights into why the academy is not a career choice even after working in industry. However, this study is useful in providing an explanation for how Black African women make early career decisions to pursue engineering and how the different decisions they make along their career pathways contribute to persistence in engineering industry careers. Future research can then focus on the process of leaving engineering and what factors influence the choice of non-engineering careers that may still not include the academy.

#### **Strengths Of The Study**

The strength of this study is in the use of grounded theory as both methodological and analytical framework to produce a context specific model grounded in the experiences of Black African women engineers in South Africa. The use of a constructivist grounded theory methodological framework loosely guided by and African feminism(s) centered Black African, South African women engineers' lives to understand their career choices. I used memos after

each interview, during analysis and when writing up. Memos not only ensured I remained engaged with the data throughout the entire research process but also that I was reflective and reflexive, making sure my worldview did not obscure the voices of the participants in this study. Through member checking participants were able to provide input to the working model. As a result the findings of this study reflect the experiences of the participants. The findings also provide a context specific and relevant model explaining the career choice processes and considerations of these participants. Thus the study provides useful context-relevant evidence to inform practices for career planning programs and higher education institutions for attracting Black African women engineers into academic careers.

More importantly through the centering of Black African women's lives, this grounded theory study elevated participants life stories to the level of theory. As highlighted in previous chapters, Black African women's narratives are often grouped with research on all Black people or with White women (Reid, 2009). By bringing the lives of Black African women from the margins of scholarship this study is an exercise in humanizing research appropriately acknowledging that Black African women hold knowledge about their own lives (Freire, 1996; Paris, 2011).

Furthermore, this study is an exercise in decolonizing research. Through the creation of a theory/model explaining the choices of Black African women, grounded in their voices is an act of self-determination. Linda Tuhiwai Smith (1999) notes, "a critical aspect of the struggle for self-determination has involved questions relating to our history as indigenous peoples and a critique of how we, as the Other, have been represented or excluded from various accounts" as such "every issue has been approached by indigenous peoples with a view to *re*writing and *re*-righting our position in history. Indigenous people want to tell our own stories, write our own

versions, in our own ways, for our own purposes" (p. 29). In the same way that African feminism(s) emerged to reclaim African women's narratives of resistance that had been colonized by Western scholars, this study with Black African women engineers in South Africa shows that theories can emerge from indigenous spaces with more contextually relevant explanatory power than can be achieved through merely validating Western-based frameworks.

The study meets all the criteria for trustworthiness as articulated by Charmaz (2014). The model and the findings are useful for explaining Black African women's career choices. The findings reveal new insights about career choice as being a communal, guided, and streamlined process where Black African women's agency is constrained. Through member checking, participants indicated that the model resonates with their lives, and they were able to identify themselves as currently experiencing particular phases of the model. Finally through memos, I was able to acknowledge when my own biases and worldviews as the researcher may affect different aspects of the study and made efforts to ensure that meaning was co-constructed and my privilege was constrained in reporting the findings.

#### Conclusion

In concluding this chapter I provide brief remarks on four broad findings that emerged from this study. First, career choice is temporally progressive, involving close interaction between various events, considerations and consequences occurring in four phases closely linked to relatively poignant life moments including pre-tertiary schooling, postsecondary education, the world of work culminating in retirement and post-retirement.

Second, career choice is influenced by one's socio-political and cultural positions in a wider socio-historical context. The Black African women in this study represented the majority status of Black African, women in South Africa as coming from predominantly low-income

backgrounds with identifiable academic competencies in mathematics and science subjects existing in a post-apartheid socio-historical context. These dispositions limit the resources and choices available to Black African women and facilitate a reliance on one's teachers and other community stakeholders to guide career decision-making. The necessary involvement of community stakeholders in the career choice process requires a reconceptualization of career choice a communal process and not an individual endeavor as most Western-based career theories espouse.

Third, in addition to teacher influence, the choice of engineering as a career is largely influenced by the sponsorship provided by engineering industry. The availability of bursaries to pursue postsecondary education in engineering essentially streamlines the career choice process of Black African women whose aforementioned socio-political dispositions offer few known alternative avenues to attend higher education. The desire to further one's education and elevate one's family and community to a better socio-economic status contributes to Black African women's constrained agency in career choices, where Black African women strategically relinquish their individual agency and submit to the opportunities and resources a streamlined process provide. Engineering provides a pathway to higher education, social mobility and over time, financial and job security for one to pursue other career paths of interest including career expansion into business through MBA qualifications.

Finally, contrary to research stating that an unwelcoming higher education space deters Black African women from academic careers, this study shows that the hostility of the workplace is not enough to hinder the pursuit of a career. In this study, despite experiencing industry as hostile, Black African women were willing to enter industry spaces often motivated by the idea of being a pioneer woman in a predominantly male space. This study found that instead, Black

African women do not view the academy as a legitimate place of work as an engineer. Higher education spaces are seen as transitory spaces whose function is to prepare engineers for real work in industry. Thus in the absence of efforts to market academe as a career, higher education institutions will continue to lose eligible and capable Black African women engineers to industry with few likely to return after serving their bursary obligations.

The study shows that for Black African women, socio-political and economic circumstances impact career choices. Specifically community stakeholders and industry practices streamline academically competent Black African women into engineering even if the women express other career interests. This study challenges the conceptualization of 'career choice' as an individual, self-driven act. Instead the limitations imposed by social circumstances on individual and communal socio-political characteristics as Black African, woman, predominantly low-income and marginalized constrain Black African women's career options and choices, effectively streamlining their careers towards engineering industry jobs.

APPENDICES

# Appendix A: Interview Agendas and Recruitment Letters

## **Demographic information**

a. First and last name.

b. Higher education institution attended, engineering degree obtained, and year of graduation (include specific sub-field and level of postgraduate degree).

c. Current job and number of years in industry (include name of company/academic institution, position in the company/academic institution, number of years working).

# **ALUMNI INTERVIEW QUESTIONS**

- 1. Tell me about your career path from childhood to today?
- 2. What motivated you to become an engineer?
  - Tell me about your engineering specialization and how you came to that option?
  - How did you find and secure this job?
  - Who were some influential people in your education and career path?
- 3. What is important to you in your job as an engineer?
  - What are some motivating factors at your job?
  - What are the pros of working where you work now?
- 4. What were some things you considered when making your career decision?
  - How did you make your decision about taking on this job?
  - What were some of the things you were looking for in a career?
  - What are some things you would still like to have/experience in your career?
- 5. How would you describe your higher education experience?

- Tell me about your department and your interaction with professors/lecturers/other students?

- How would you describe your experience as a Black African woman in engineering at your university?

- 6. In what ways (if any) did your university experience influence your career choice?What led you to pick a career in industry rather than academia?
- 7. What are some of your thoughts on the current representation of Black African women in engineering higher education careers?
- 8. What are your future career aspirations?
- 9. Is there anything we did not discuss yet that you would like to talk about?

# **ADMINISTRATIVE STAFF INTERVIEW QUESTIONS**

- 1. Tell me about the recruitment process for academic staff at your institution?
- 2. What are some of the criteria you use to identify potential academic staff?
- 3. Are there differences in recruitment criteria for different departments?
- 4. Can you share how you account for affirmative action policies in your recruitment process?
- 5. What has been your experience in recruiting Black women?
- 6. What are some of your thoughts on the current representation of Black African women in engineering higher education careers?

- 7. What do you think are some of the reasons Black African women are underrepresented in engineering higher education academic careers?
- 8. What do you think is needed to attract more Black African women into higher education academic careers?
- 9. Is there anything we did not discuss yet that you would like to talk about?

# PARTICIPANT RECRUITMENT LETTER - ALUMNI

# Greetings,

My name is Yeukai Mlambo, I am a Ph.D. candidate at Michigan State University in the Department of Educational Administration in the United States. I am conducting a research study entitled *Why Not Academia? Understanding the Career Choices of Black African Women Engineers in South Africa: A Grounded Theory Study.* The purpose of the study is to understand the career choices of Black women engineers that have led to careers outside of higher education. The aim is to build a theory of Black women's career choice that is based on South African women.

Through your previous institutions' alumni office, you have been identified as someone who would be eligible to participate in this study. You are eligible to participate if you have:

- 1. Graduated with a postgraduate engineering degree in the past 20 years (Honours, Master's or Ph.D.)
- 2. Currently working outside of higher education and have worked there for at least 2 years.
- 3. Identify as Black African, South African and a woman.
- 4. Have not worked in higher education as an academic staff member so far.

The names of the participants will be confidential and pseudonyms will be used to ensure your identity is confidential. Participation will include two interviews lasting between thirty to ninety minutes at a time and place that is convenient to you. The first interview questions will focus on the life experiences and factors that have influenced your career choices thus far. The second interview will be a follow-up where preliminary findings will be shared with you for your input and ideas.

Participation is voluntary and your decision to participate or not will have no effect on your relationship to your previous institution. Should you choose to participate and are eligible; as a token of participation for your time you will receive a \$10USD cash token at the end of the first interview. Your experiences will help in building a theory for use in South Africa, and will help in the recruitment and retention of other Black women into engineering in the future.

If you are interested in finding out more about this study and/or participating kindly contact me at: South African Cellphone Number (including Whatsapp): +27 (XXX)-XXX-XXXX or by email at  $\underline{m^{****}@msu.edu}$ 

Please feel free to contact me if you have any questions or comments. Thank you for your time and consideration and I look forward to hearing from you soon regarding your participation in this study.

Sincerely

Yeukai. A. Mlambo Doctoral Candidate and Graduate Research Assistant Department of Educational Administration Higher, Adult and Lifelong Education Michigan State University

# PARTICIPANT RECRUITMENT LETTER – ADMINISTRATIVE STAFF

Greetings,

My name is Yeukai Mlambo, I am a Ph.D. candidate at Michigan State University in the Department of Educational Administration in the United States. I am conducting a research study entitled *Why Not Academia? Understanding the Career Choices of Black African Women Engineers in South Africa: A Grounded Theory Study.* The purpose of the study is to understand the career choices of Black women engineers that have led to careers outside of higher education. The aim is to build a theory of Black women's career choice that is based on South African women.

As an administrative staff member involved with recruitment and hiring of academic staff at your institution, your insights into hiring processes will help in better understanding how the university operates. Your real name will not be used in the study and pseudonyms will be used to ensure your identity is confidential. Participation will include one interview lasting between thirty to ninety minutes at a time and place that is convenient to you. The interview questions will focus on the hiring processes of academic staff at your institution to help in understanding some of the criteria required to qualify as a potential academic staff member. Additional questions will focus on your experiences (or those of your department) in recruiting Black women academic staff in engineering at your institution.

Participation is voluntary and your decision to participate or not will have no effect on your relationship to your institution. Should you choose to participate and are eligible; as a token of participation for your time you will receive a small cash token at the end of the first interview. Your experiences will help in building a theory for use in South Africa, and will help in the recruitment and retention of other Black women into engineering in the future.

If you are interested in finding out more about this study and/or participating kindly contact me at: South African Cellphone Number: +27 (XXX)-XXX-XXXX or by email at <u>m\*\*\*@msu.edu</u>

Please feel free to contact me if you have any questions or comments. Thank you for your time and consideration and I look forward to hearing from you soon regarding your participation in this study.

Sincerely

Yeukai. A. Mlambo Doctoral Candidate and Graduate Research Assistant Department of Educational Administration Higher, Adult and Lifelong Education

## **Appendix B: Gatekeeper Letter**

Date

### Dear \_\_\_\_\_(Name of university Alumni Office Representative)

My name is Yeukai Mlambo and I am currently beginning research for my doctoral dissertation in the Department of Educational Administration at Michigan State University. My research titled "*Why Not Academia? Understanding the Career Choices of Black African Women Engineers in South Africa: A Grounded Theory Study*" aims to understand the career choices of Black African women engineers currently working in industry. The hope is to better understand the processes that lead to a career in industry, rather than the academy. This research will contribute to scholarship and strategies on the recruitment and retention of Black women in STEM academia in South Africa.

Subject to approval by the Michigan State University ethics committee this study will involve indepth interviews with Black African women engineers currently working in industry. The final goal of the study is to create a substantive theory to describe the career choices of this particular population of engineers.

I am writing to ask your permission to be allowed access to your engineering alumni mailing list through your institutions alumni office. The mailing list will allow me to recruit potential participants for this study. This should not take a large amount of time and can be conducted at a convenient time for those involved. The criteria for population I wish to target with your mailing list include **Black African women who**:

- 1. Graduated with engineering post-graduate degrees in the past 20 years (includes Honors, Master's and PhD's),
- 2. Currently work in industry,
- 3. Have worked in industry for at least 2 years.

All interview data and results will be kept confidential and your institution will not be identified in any reports or publications. However, the results will be made available to all participants who wish to view them.

I will be in Gauteng in **June of 2016** to begin to engage with the data collection process. Kindly advise on the appropriate individuals to contact regarding my request and what requirements you may have to allow me to access this data.

Should you have any advice or questions kindly contact me at: <u>m\*\*\*@msu.edu</u>

Sincerely

### Yeukai A. Mlambo

Doctoral Candidate, Higher, Adult and Lifelong Education Program Michigan State University Department of Educational Administration REFERENCES

#### REFERENCES

- Academy of Science of South Africa [ASSAf]. (2010). *The PhD Study: An evidence based study on how to meet the demands of high-level skills in an emerging economy*. ASSAf Consensus Report South Africa: ASSAf and the Department of Science and Technology.
- African National Congress [ANC]. (1994). *A policy framework for education and training*. Retrieved from <u>http://www.anc.org.za/show.php?id=263%3E</u>
- African Women in Science and Engineering. (2015). *Welcome to African Women in Science and Engineering*. Retrieved from <u>http://www.aawse.org/</u>
- Agarwala, T. (2008). Factors influencing career choice of management students in India. *Career Development International*, 13(4), 362-376.
- Ahikire, J. (2014). African feminism in the 21<sup>st</sup> century: A reflection on Uganda's victories, battles and reversals. *Feminist Africa: Pan Africanism and Feminism, 19*, 7-23.
- All Africa. (January, 2016). South Africa: Upcoming 2015 Matric results requires careful scrutiny! *All Africa*. Retrieved from <u>http://allafrica.com/stories/201601050255.html</u>
- Alonso, R.R. (2012). Work in progress: Understanding the experiences of women of color in engineering, presented at *Frontiers in Education Conference*, Seattle Washington, 2012.
- Altbach, P. G. (2013). Advancing the national and global knowledge economy: The role of research universities in developing countries. *Studies in Higher Education*, *38*(3), 316-330.
- Annells, M. M. (1997). Grounded theory method, part II: Options for the users of the method. *Nursing Inquiry*, *4*(3), 176-180.
- Archer, A., & Parker, S. (2016). Transitional and transformational spaces: Mentoring young academics through writing centers. *Education as Change*, 20(1), 43-58.
- Armenti, C. (2004). May babies and postenure babies: maternal decisions of women professors. *The Review of Higher Education*, 27(2), 211-231.
- Austin, A. E. (2002). Preparing the next generation of faculty: Graduate school as socialization to the academic career. *The Journal of Higher Education*, 73(1), 94-122.
- Babbie, E. (2005). *The basics of social research (3<sup>rd</sup> ed.)*. Toronto, Canada: Thomson Wadsworth.
- Badat, S. (2010). *The challenges of transformation in higher education and training institutions in South Africa*. Retrieved from

http://www.ru.ac.za/media/rhodesuniversity/content/vc/documents/The%20Challenges% 20of%20Transformation%20in%20Higher%20Eduaction%20and%20Trai.ning%20Instit utions%20in%20South%20AfrjcaLpdf

- Badat, S. (2015). Deciphering the meanings and explaining the South African higher education student protests of 2015-16. *Pax Academia*, 1&2, 71-106.
- Bandura, A. (1990). Perceived self-efficacy in the exercise of personal agency. *Applied Sport Psychology*, *2*, 128-163.
- Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, *52*, 1-26.
- Beede, D., Julian, T., Langdon, D., McKittrick, G., Khan, B., & Dorris, M. (2011). *Women in STEM: A gender gap to innovation* (ESA Issue Brief#04-11). Retrieved from <u>http://www.esa.doc.gov/sites/default/files/womeninstemagaptoinnovation8311.pdf</u>
- Bimrose, J., Watson, M., McMahon, M., Hassler, S., Tomassini, M., & Suzanne, P. A. (2014). The problem with women? Challenges posed by gender for career guidance practice. *International Journal of Educational and Vocational Guidance*, 14(1), 77-88.
- Bisseker, C. (January, 2015). Matric results: Weak where it counts. *Financial Mail*. Retrieved from <u>http://www.financialmail.co.za/features/2015/01/15/matric-results-weak-where-it-counts</u>
- Blickenstaff, J. C. (2005). Women and science careers: leaky pipeline or gender filter? *Gender* and Education, 17(4), 369-386.
- Bojuwoye, O., & Mbanjwa, S. (2006). Factors impacting on career choices of technikon students from previously disadvantaged high schools. *Journal of Psychology in Africa, 16*(1), 3-16.
- Borges, N. J., Grover, A. C., Navarro, A. M., Raque-Bogdan, T. L., & Elton, C. (2013). International women physicians' perspectives on choosing an academic medicine career. *Perspectives on Medical Education*, 2(3), 156-161.
- Boshoff, N. (2005). The representation of women academics in higher education in South Africa: Progress in the pipeline? *South African Journal of Higher Education*, 19(2), 359-377.
- Branson, N., Leibbrandt, M., & Zuze, T. L. (2009). *The demand for tertiary education in South Africa*. Final Report produced for the Southern Africa Labour and Development Research Unit, University of Cape Town.
- Breckenridge, J., & Jones, D. (2009). Demystifying theoretical sampling in grounded theory research. *Grounded Theory Review*, 2(8). Retrieved from <a href="http://groundedtheoryreview.com/2009/06/30/847/">http://groundedtheoryreview.com/2009/06/30/847/</a>

- Burden, J., & Roodt, G. (2007). Grounded theory and its application in a recent study on organisational redesign: Some reflections and guidelines. *South African Journal of Resource Management*, 5(3), 11-18.
- Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching*, 44(8), 1187-1218.
- Case, J. (2007). Alienation and engagement: Exploring students' experiences of studying engineering. *Teaching in Higher Education*, 12(1), 119-133.
- Case, J., & Jawitz, J. (2004). Using situated cognition theory in researching student experience of the workplace. *Journal of Research in Science Teaching*, *41*(5), 415-431.
- Castillo, R., Grazzi, M., & Tacsir, E. (2014). *Women in science and technology: What does the literature say?* (Technical Note No. IDB-TN-637). Retrieved from <a href="https://publications.iadb.org/bitstream/handle/11319/6047/CTI%20TN%20Women%20in%20Science%20and%20Technology.pdf?sequence=1">https://publications.iadb.org/bitstream/handle/11319/6047/CTI%20TN%20Women%20in%20Science%20and%20Technology.pdf?sequence=1</a>
- Charmaz, K. (2000). Grounded theory: Objectivist and constructivist methods. In N. Denzin & Y. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed.). (pp. 509-535). Thousand Oaks, CA: Sage.
- Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. Thousand Oaks, CA: Sage Publications Inc.
- Charmaz, K. (2008). Constructionism and the grounded theory. In J. A. Holstein & J. F. Gubrium (Eds.), *Handbook of constructionist research* (pp. 397-412). NY, New York: The Guilford Press.
- Charmaz, K. (2012). The power and potential of grounded theory. *Medical Sociology Online*, *6*(3), 2-15.
- Charmaz, K. (2014). *Constructing grounded theory (2<sup>nd</sup> ed.)*. Thousand Oaks, CA: Sage Publications Inc.
- Chen, C. P. (1998). Understanding career development: A convergence of perspectives. *Journal* of Vocational Education and Training, 50(3), 437-461.
- Chen, X. (2015). STEM attrition among high-performing college students in the United States: Scope and potential causes. *Journal of Technology and Science Education*, 5(1). doi:10.3926/jotse.136
- Choongo, M. (2014). Women and girls are the answer to innovation in Africa. *The World Bank*. Retrieved from <u>http://blogs.worldbank.org/nasikiliza/women-and-girls-are-answer-innovation-africa</u>
- Christiansen, M. D., Macagano-Shang, L., Staley, K. H., Stamler, V. L., & Johnson, M. (1989). Perceptions of the wok environment and implications for women's career choice: A survey of university faculty women. *The Career Development Quarterly*, 38, (1), 57-64.
- City Press. (April, 2014). SA produces fewer doctorates than a single university in Brazil. *News* 24. Retrieved from <u>http://www.news24.com/Archives/City-Press/SA-produces-fewer-doctorates-than-a-single-university-in-Brazil-20150429</u>
- Coe, N., & Jordhus-Lier, D. (2010). Constrained agency? Re-evaluating the geographies of labour. *Progress in Human Geography*, *35*(2), 211-233.
- Collins English Dictionary. (2014). *Streamlined*. Collins English Dictionary Complete and Unabridged 12<sup>th</sup> Edition. Retrieved, December 25, 2016 from, http://www.thefreedictionary.com/streamlined
- Collins, P. H. (2000). Black feminist thought: Knowledge consciousness, and the politics of empowerment (2<sup>nd</sup> ed.). New York, NY: Routledge
- Constantine, M. G., Wallace, B. C., & Kindaichi, M. M. (2005). Examining contextual factors in the career decision status of African American adolescents. *Journal of Career Assessment*, *13*(3), 307-319.
- Council on Higher Education. (2016). *Vital stats: Public higher education 2014*. Pretoria, South Africa: Council on Higher Education.
- Crenshaw, K. (1989). Demarginalizing the intersection of race and sex: A Black feminist critique of anti-discrimination doctrine, feminist theory and antiracist politics. *HeinOnline U. Chicago Legal F 139 1989*.
- Cruise, J. A. (2011). The gender and racial transformation of mining engineering in South Africa. *The Journal of Southern African Institute of Mining and Metallurgy*, 111, 217-224.
- Curtis, J. W. (2011). *Persistent inequity: Gender and Academic employment,* prepared for New Voices in Pay Equity, An Event for Equal Pay Day, April 11, 2011. Retrieved from <a href="http://www.aaup.org/NR/rdonlyres/08E023AB-E6D8-4DBD-99A0-24E5EB73A760/0/persistent\_inequity.pdf">http://www.aaup.org/NR/rdonlyres/08E023AB-E6D8-4DBD-99A0-24E5EB73A760/0/persistent\_inequity.pdf</a>
- de la Rey, C. M. (1999) *Career narratives of women professors in South Africa*. Doctoral Thesis, University of Cape Town, South Africa.

- Denzin, N. K., & Lincoln, Y. S. (2005). Introduction: The discipline and practice of qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage Handbook of Qualitative Research Third Edition* (pp. 1-32). Thousand Oaks, CA: Sage Publications.
- Department of Arts, Culture, Science and Technology. (1996). *White paper on science and technology*. Pretoria, South Africa: DACST.
- Department of Education. (1997). White Paper for the Transformation of Higher Education. Retrieved from <u>http://www.che.ac.za/sites/default/files/publications/White Paper3.pdf</u>
- Department of Further Education, Employment, Science and Technology [DFEEST]. (2013). *Female participation in STEM study and work in South Australia 2012*. Adelaide, South Australia: DFEEST
- Department of Higher Education and Training (DHET). (2016). *Statistics on post-school education and training in South Africa: 2014*. Pretoria, South Africa: Department of Higher Education and Training.
- Dodge, E., & Welderufael, M. (2014). Factors that influence career choice in South African township high school students. (Master's Thesis). Dominican University of California.
- Du Plessis, Y., & Barkhuizen, N. (2015). Exploring the career path barriers of women professional engineers in a South African context. *South African Journal of Labour Relations*, *39*(1), 38-57.
- Dunn, D., Gerlach, J. M., & Hyle, A. E. (2014). Gender and leadership: Reflections of women in higher education administration. *International Journal of Leadership and Change*, 2(1), 9-18.
- Eagan Jr., M. K., Hurtado, S., Chang, M. J., Garcia, G. A., Herrera, F. A., & Garibay, J. C. (2013). Making a difference in science education: The impact of undergraduate research programs. *American Educational Research Journal*, 50(4), 683-713.
- Ebunoluwa, S. M. (2009). Feminism: The quest for an African variant. *The Journal of Pan African Studies, 3*(1), 227-234.
- Equal Education. (January, 2015). On the 2014 Matric results. *Equal Education*. Retrieved from <u>https://www.equaleducation.org.za/article/2015-01-07-on-the-2014-matric-results</u>
- Fealing, K. H., & Myers, Jr., S. L. (2012). Pathways v. pipelines to broadening participation in the STEM workforce, presented at the Southern Economic Association Meetings, Washington Marriott Wardman Park, Washington, D.C., November 20, 2011.
- Finlay, L. (2002). "Outing the researcher: The provenance, process and practice of reflexivity. *Qualitative Health Research*, 12(4), 531-545.

- Firefirey, N., & Carolissen, R. (2010). "I keep myself clean...at least when you see me you don't know I am poor": Student experiences of poverty in South African higher education. South African Journal of Higher Education, 24(6), 987-1002.
- Fisher, G. (2011). *Improving throughput in the engineering bachelors degree. Report to the Engineering Council of South Africa.* Toronto, Canada: Glen Fisher Consulting.
- Ford, K. (2010). *Reframing a sense of self: A constructivist grounded theory study of children's admission to hospital for surgery* (Doctoral dissertation). University of Tasmania, Australia.
- Forrier, A., Sels, L., & Stynen, D. (2009). Career mobility at the intersection between agent and structure: A conceptual model. *Journal of Organizational Psychology*, *82*, 739-759.
- Freire, P. (1996). Pedagogy of the oppressed. London, England: Penguin Books.
- Fylan, F. (2005). Semi-structured interviewing. In J. Miles & P. Gilbert (Eds.), A handbook of research methods for clinical and health psychology, (pp. 65-77). New York, NY: Oxford University Press.
- Galloway, S.N. (2012). *African American women making race work in science, technology, engineering and math (STEM)* (Doctoral dissertation). University of North Carolina at Chapel Hill, NC.
- Ghezeljeh, T. N., & Emami, A. (2009). Grounded theory: methodology and philosophical perspective. *Researcher*, 17(1), 15-23.
- Glaser, B. G., & Strauss, A. L. (2008). *The discovery of grounded theory: Strategies for qualitative research*. Piscataway, NJ: Aldine Transaction Publishers
- Glaser, B. G., & Strauss, A. L. (2006). *The discovery of grounded theory: Strategies for qualitative research*. Piscataway, NJ: Aldine Transaction Publishers.
- Goldblatt, H., Karnieli-Miller, O., & Neumann, M. (2011). Sharing qualitative research findings with participants: Study experiences of methodological and ethical dilemmas. *Patient Education and Counselling*, *82*, 389-395.
- Green, K. (2014). Doing double dutch methodology: Playing with the practice of participant observer. In D. Paris & M. T. Winn (Eds.), *Humanizing research: Decolonizing qualitative inquiry with youth and communities* (pp. 147-159). Los Angeles, CA: Sage Publications Inc.
- Grove, J. (May, 2013). Global gender index 2013: Glass ceiling remains in place for female academics. *Times Higher Education*. Retrieved from <u>https://www.timeshighereducation.com/features/global-gender-index-2013/2003517.article</u>

- Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *The landscape of qualitative research: Theories and issues* (pp. 195-220). Thousand Oaks, CA: Sage.
- Guerra, M. (November, 2013). Fact sheet: The state of African American women in the United States. *Centers for American Progress*. Retrieved from <a href="https://www.americanprogress.org/issues/race/report/2013/11/07/79165/fact-sheet-the-state-of-african-american-women-in-the-united-states/">https://www.americanprogress.org/issues/race/report/2013/11/07/79165/fact-sheet-the-state-of-african-american-women-in-the-united-states/</a>
- Hackett, G., & Betz, N. E. (1981). A self-efficacy approach to the career development of women. *Journal of Vocational Behavior, 18*, 326-339.
- Hall, W. A., & Callery, P. (2001). Enhancing the rigor of grounded theory: Incorporating reflexivity and relationality. *Qualitative Health Research*, 11(2), 257-272.
- Hallberg, L. R-M. (2006). The "core-category" of gorunded theory: Making constant comparisons. *International Journal of Qualitative Studies on Health and Well-being, 1*, 141-148.
- Hallstein, D. L. O. (1999). A postmodern caring: Feminist standpoint theories, revisioned caring, and communication ethics. *Western Journal of Communication*, 63(1), 32-56.
- Hatch, J. A., & Wisniewski, R. (1995). *Life history and narrative: questions, issues, and exemplary works* (p. 113-136). In J. A. Hatch & R. Wisniewski (Eds.), London, UK: The Falmer Press.
- Henderson, T. L., Hunter, A. G., & Hildreth, G. J. (2010). Outsiders within the academy: Strategies for resistance and mentoring African American women. *Michigan Family Review*, 14, 28-41.
- Herman, C. (2010). Elusive equity in doctoral education in South Africa. *Journal of Education and Work, 24*(1-2), 163-184. doi:10.1080/13639080.2010.534773.
- Herman, C. (2011). Expanding doctoral education in South Africa: Pipeline or pipedream? *Higher Education Research and Development, 30*(4), 505-517.
- Higham, R. (2012). Place, race and exclusion: University student voices in post-apartheid South Africa. International Journal of Inclusive Education, 16(5-6), 485-501. doi:10.1080/13603116.2012.655498
- Holland, J. L. (1996). Exploring careers with a typology: What we have learned and some new directions. *American Psychologist*, *51*(4), 397-406.

Holton, R. (2006). The act of choice. Philosophers' Imprint, 6(3), 1-15.

- Huyer, S. (2015). Is the gender gap narrowing in science and engineering?. In UNESCO Science Report: Towards 2030 (pp. 85-103). Paris, France: UNESCO.
- Jaeger, A. J., Haley, K. J., Ampaw, F. D., & Levin, J. S. (2013). Understanding the career choice for underrepresented minority doctoral students in science and engineering. *Journal of Women and Minorities in Science and Engineering*, 19(1), 1-16.
- Jagacinki, C.M., LeBold, W.K., Linden, K.W., & Shell, K.D. (1985). Factors influencing the choice of an engineering career. *IEEE Transactions on Education*, *E-28*(1), 36-42
- Jawitz, J., & Case, J. (1998). Exploring the reasons South African students give for studying engineering. *International Journal of Engineering Education*, 14(4), 235-240.
- Jawitz, J., Case, J., & Tshabalala, M. (2000). Why not engineering? The process of career choice amongst South African female students. *International Journal of Engineering Education*, 16(6), 470-475.
- Johnson, A. (2007). Unintended consequences: How science professors discourage women of color. *Science Education*, *91*(5), 805-821.
- Johnson, S. (2015). Education and international competitiveness. *Journal of Initial Teacher Inquiry*, 1, 21-23.
- Jones, M., & Alony, I. (2011). Guiding the use of grounded theory in doctoral studies An example from the Australian Film Industry. *International Journal of Doctoral Studies, 6,* 95-114.
- Karikari, A. A. (2008). *Experiences of women in higher education: A study of women faculty and administrators in selected public universities in Ghana* (Doctoral dissertation). Ohio University, Athens, OH.
- Kasente, D. H. (2012). Processes influencing gender differences in access to post secondary institutions in Uganda (Doctoral thesis). Kenyatta University, Nairobi, Kenya.
- Kerby, S. (2012). The state of women of color in the United States. *Center for American Progress.* Retrieved from <u>https://www.americanprogress.org/issues/race/report/2012/07/17/11923/the-state-of-</u> <u>women-of-colo r- in-th e-united -states/</u>
- King, K. L. (2001). Stumbling toward racial inclusion: The story of transformation at the University of Witswatersrand. In R. O. Mabokela & K. L. King (Eds.), *Apartheid no more: Case studies of Southern African universities in the process of transformation* (pp. 73-90). Westport, CT: Greenwood Publishing Group, Inc.
- Kinloch, V., & San Pedro, T. (2014). The space between listening and storying: Foundations for projects in humanization. In D. Paris & M. T. Winn (Eds.), *Humanizing research:*

*decolonizing qualitative inquiry with youth and communities*, (pp. 21-42). Thousand Oaks, CA: Sage Publications Inc.

- Ko, L. T., Kachchaf, R. R., Hodari, A. K., & Ong, M. (2014). Agency of women of color in physics and astronomy: Strategies for persistence and success. *Journal of Women and Minorities in Science and Engineering*, 20(2), 171-195.
- Kolawole, M. E. M. (2004). Re-conceptualizing African gender theory: Feminism, womanism, and the Arere metaphor. In S. Arnfred (Ed.), *Re-thinking sexualities in Africa*, (pp. 251–266). Uppsala: Sweden: The Nordic Africa Institute.
- Krumboltz, J. D., Mitchelle, A. M., & Jones, G. B. (1976). A social learning theory of career selection. *The Counseling Psychologist*, 6(1), 71-81.
- Lawrence, J. L., Poole, P., & Diener, S. (2003). Critical factors in career decision making for women medical graduates. *Medical Education*, 37, 319-327.
- Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior*, 45(1), 79-122.
- Levers, M. D. (2013). Philosophical paradigms, grounded theory, and perspectives on emergence. *SAGE Open, October-December*, 1-6. doi: 10.1177/2158244013517243
- Lewis, B. F., & Collins, A. (2001). Interpretive investigation of the science-related career decisions of three African American college students. *Journal of Research in Science Teaching*, 38(5), 599-621.
- Luke, C. (2001). *Globalization and women in academia: North/west-south/east*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Mabokela, R. O. (2000). "We cannot find qualified Blacks": Faculty diversification programs at South African universities. *Comparative Education*, *36*(1), 95-112.
- Mabokela, R. O. (2002). Reflections of Black women faculty in South African universities. The *Review of Higher Education*, 25(2), 185-205.
- Mabokela, R. O. (2003). "Donkeys of the university": organizational culture and its impact on South African women administrators. *Higher Education, 46*(2), 129-145.
- Mabokela, R. O., & Mawila, K. F. N. (2004). The impact of race, gender, and culture in South African higher education. *Comparative Education Review*, 48(4), 396-416.
- Mabokela, R. O., & Mlambo, Y. A. (2015). "The older women are men:" Navigating the academic terrain, perspectives from Ghana. *Higher Education*, *69*, 759-778. doi:10.1007/s10734-014-9804-3

- Mabokela, R. O., & Mlambo, Y. A. (in-press). Access and equity and South African higher education: A review of policis after 20 years of democracy. *Comparative Education Review*
- Mahoney, R., Katona, C., McParland, M., Noble, L., & Livingston, G. (2004). Shortage specialties: Changes in career intentions from medical student to newly qualified doctor. *Medical Teacher*, 26(7), 650-654.
- Mangcu, X. (July, 2014a). Ripping the veil off UCT's whiter shades of pale. Sunday Times. Retrieved from <u>http://www.timeslive.co.za/sundaytimes/2014/07/06/Ripping-the-veil-off-UCTs-whiter-shades-of-pale</u>
- Mangcu, X. (July, 2014b). 10 steps to develop Black professors. *City Press*. Retrieved from <u>https://www.uct.ac.za/usr/news/2014/10%20steps%20to%20develop%20black%20profes</u> <u>sors.pdf</u>
- Mangaliso, M. P. (2001). Building competitive advantage from ubuntu: Management lessons from South Africa. *Academy of Management Executive*, 15(3), 23-34.
- Martin, P., & Barnard, A. (2013). The experience of women in male-dominated occupations: A constructivie grounded theory inquiry. SA Journal of Industrial Psychology/SA Tydskrif vir Bedyfsielkunde, 39(2). Retreived from <u>http://dx.doi.org/10.4102/sajip.v39i2.1099</u>
- Martineau, R. (1997). Women and education in South Africa: Factors influencing women's education progress and their entry into traditionally male-dominated fields. *The Journal of Negro Education*, 66(4), 383-395.
- Martinez, A. (2014). A plea for critical race theory counterstory: Stock story versus counterstory dialogues concerning Alejandra's "fit" in the academy. *Composition Studies*, *42*(2), 33-55.
- McKay, D. R. (2016). What is a career? *The Balance*. Retrieved December 25, 2016 from https://www.thebalance.com/what-is-a-career-525497
- Mekgwe, P. (2008). Theorizing African feminism(s). *Quest: An African Journal of Philosophy/Revue Africaine de Philosophie, XX*, 11-22.
- Menon, K. (2015). Supply and demand in South Africa. In S. Schwartzman, R. Pinheiro & P. Pillay (Eds.), *Higher education in the BRICS countries: Investigating the pact between higher education and society* (pp. 171-191). Springer.
- Mikell, G. (1995). African feminism: Toward a new politics of representation. *Feminist Studies*, 21(2), 405-424.

- Miles, S. (2012). *Left behind: The status of Black women in higher education administration* (Doctoral dissertation). Florida State University, Tallahassee, FL.
- Mills, J., Bonner, A., & Francis, K. (2006a). The development of constructivist grounded theory. *International Journal of Qualitative Methods*, 5(1), Article 3. Retreived from <u>https://www.ualberta.ca/~iiqm/backissues/5\_1/PDF/MILLS.PDF</u>
- Mills, J., Bonner, A., & Francis, K. (2006b). Adopting a constructivist approach to grounded theory: Implications for research design. *International Journal of Nursing Practice*, *12*(1), 8-13.
- Ministry of Education. (2001). *National Plan for Higher Education*. Pretoria, South Africa: Ministry of Education.
- Mlambo, Y. (2011). *Women in engineering academia: Reasons for commitment to the field* (Master's thesis). University of Pretoria, South Africa.
- Mlambo, Y. A. (2016). Interrogating work-life balance discourses: An alternative explanation for Black, African, female, international students in the United States. In K.C. Mansfield, A.D. Welton, & P. L. Lee (Eds), *Identity intersectionalities, mentoring, and work-life (Im)balance: Educators (re)negotiate the personal, professional, and political* (pp. 217-229). Charlotte, NC: Information Age Publishing, Inc.
- Mlambo, Y. A., & Mabokela, R. O. (2016). 'It's more flexible': Persistence of women engineers in the academy. *European Journal of Engineering Education*. doi:10.1080/03043797.2016.1158790
- Mlambo, Y. A., & Wawrzynski, M. (under review).
- Morley, L. (2005). Gender equity in Commonwealth higher education. *Women's Studies International Forum, 28,* 209-221.
- Morley, L., & Crossouard, B. (2014). *Women in higher education leadership in South Asia: Rejection, refusal, reluctance, revisioning.* Center for Higher Education and Equity Research, University of Sussex.
- Moses, Y. T. (1989). Black women in academe: Issues and strategies. *Project on the Status and Education of Women*. Washington, D.C.: Association of American Colleges.
- Moshupi, M. M. (2013). Career development experiences of women in senior leadership positions within civil engineering industry (Master's thesis). University of South Africa, Pretoria, South Africa.
- National Center for Education Statistics. (2015). *The condition of education 2015* (NCES 2015-144). U.S. Department of Education, National Center for Education Statistics. Washington, DC. Retrieved from <u>https://nces.ed.gov/programs/coe/indicator\_cuf.asp</u>

National Student Financial Aid Scheme, 2016, http://www.nsfas.org.za/content/bursaries.html

- Nel, W. (2012). Conversations among Black staff members at a historically White Afrikaans university campus on issues of race, social justice and reconciliation. *Perspectives in Education*, 30(3), 1-12.
- Netswera, F. G., Rankhumise, E. M., & Mavundla, T. R. (2005). Employee retention factors for South African higher education institutions: A case study. *SA Journal of Human Resource Management*, 3(2), 36-40.
- Nkealah, N. N. (2006). Conceptualizing feminism(s) in Africa: The challenges facing African women writers and critics. *English Academy Review*, 23(1), 133-141. doi:10.1080/10131750608540431
- Nyamidie, J. K. E. (1999). *African proverbs, saying and stories*. Retrieved from <u>http://www.afriprov.org/african-proverb-of-the-month/25-1999proverbs/146-sep1999.html</u>
- O'donnell, M. (March, 2011). Engineering student intake rises, but schooling pipeline remains a binding constraint. *Creamer Media, Engineering News*. Retrieved from <u>http://www.engineeringnews.co.za/article/engineering-student-intake-rises-but-schooling-pipeline-remains-a-binding-constraint-2011-03-11</u>
- Obers, N. (2014). Career success for women academics in higher education: Choices and challenges. *SAJHE*, *28*(3), 1107-1122.
- Odhav, K. (2009). South African post-apartheid higher education policy and its marginalisations: 1994-2002. *SA-eDUC Journal*, *6*(10), 33-57.
- Ogude, N. A., Nevhutalu, P., & Reddy, V. (1997). An overview of women in science and technology in South Africa. *Gates: An International Journal Promoting Greater Access to Technology, Engineering and Science, 4*(1), 20-25.
- Ogundipe-Leslie, M. (1994). *Re-creating ourselves: African women and critical transformations*. Trenton: Africa World Press.
- Ong, M. (2010). The mini-symposium on women of color in science, technology, engineering, and mathematics (STEM): A summary of events, findings, and suggestions. Cambridge, MA: TERC. Retrieved from <u>https://www.nsf.gov/od/oia/activities/ceose/reports/TERC\_mini\_symp\_rprt\_hires.pdf</u>
- Onishi, N. (Sept, 2015). Students in South Africa protest slow pace of change. *The New York Times*. Retrieved from <u>http://www.nytimes.com/2015/09/09/world/africa/student-protests-in-south-africa-highlight-dissatisfaction-with-pace-of-change.html</u>

- Palys, T. (2008). Purposive sampling. In L. M. Given (Ed.), *The Sage Encyclopedia of Qualitative Research Methods* (Vol. 2) (pp. 698-698). Los Angeles, CA: Sage.
- Paris, D. (2011). 'A friend who understand fully': Notes on humanizing research in multiethnic youth community. *International Journal of Qualitative Studies in Education*, 24(2), 137-149.
- Paris, D., Winn, M. T. (Eds.). (2014). *Humanizing research: Decolonizing qualitative inquiry with youth and communities.* Los Angeles, CA: Sage.
- Patton, M. Q. (1999). Enhancing the quality and credibility of qualitative analysis. *Health Services Research*, *34*(5 Pt. 2), 1189-1208.
- Perna, L. W. (2004). Understanding the decision to enroll in graduate school: Sex and racial/ethnic group differences. *The Journal of Higher Education*, 75(5), 487-527.
- Personal Communication. (November, 2015). *HEMIS Higher Education Data Analyzer:* Engineering graduates figures - National data.
- Perumal, J. (2003). Identifying and responding to barriers impacting women educators: Reflections by feminist educators on institutional constraints. *South African Journal of Higher Education*, 17(1), 74-82.
- Petersen, N., & Gravett, S. (2000). The experiences of women academics at a South African university. *South African Journal of Higher Education*, 14(3), 169-176.
- Porter, C. J. (2013). *Identity development in Black undergraduate women: A grounded theory study* (Doctoral dissertation). University of Georgia. Athens: Georgia.
- Portnoi, L. (2003). Implications of the Employment Equity Act for the higher education sector. South African Journal of Higher Education, 17(2), 79-85.
- Portnoi, L. (2009a). Cultivating the next generation of academics in South Africa. *Africa Education Review*, 6(2), 187-207.
- Portnoi, L. (2009b). To be or not to be an academic: South African graduate students' vocational choices. *International Journal of Educational Development*, 29, 406-414. doi:10.1016/j.ijedudev.2009.01.005
- Powell, A. (September, 2016). South Africa universities close amid violent tuition protests. *Voice of America*. Retrieved from, http://www.voanews.com/a/south-africa-unniversitiesclose-violent-tuition-protests/3525696.html
- Powell, A., Bagihole, B., & Dainty, A. (2009). How women engineers do and undo gender: Consequences for gender equality. *Gender, Work and Organization*, 16(4), 411-428.

- Price, M. (July, 2014). Staff transformation at UCT. *University of Cape Town, Daily News*. Retrieved from <u>https://www.uct.ac.za/dailynews/?id=8752</u>
- Prior, D. (2007). Decolonising research: A shift toward reconciliation. *Nursing Inquiry, 14*(2), 162-168.
- Rabe, M., & Rugunanan, P. (2012). Exploring gender and race amongst female sociologists exiting academia in South Africa. *Gender and Education*, 24(5), 553-566. doi:10.1080/09540253.2011.630313
- Reddy, T. (2004). Higher education and social transformation South African case study. Council on Higher Education, Pretoria, South Africa. Retrieved from <u>http://www.che.ac.za/sites/default/files/publications/HEandSocialTransformationReport\_25Feb2004.pdf</u>
- Reddy, T. (2006). Higher education and social transformation in South Africa since the fall of apartheid. *Cahiers de la recherche sur l'éducation et les savoirs* [En ligne], 5, para. 1-49. Retreived from <u>https://cres.revues.org/1118#quotation</u>
- Reed, B., & Case, J. (2003). Factors influencing learners' choice of Mechanical Engineering as a career. African Journal of Research in Mathematics, Science and Technology Education, 7, 73-83.
- Reid, E. L. (2009). *Exploring the experiences of African American women in an undergraduate research program designed to address the underrepresentation of women and minorities in neuroscience: A qualitative analysis* (Doctoral dissertation). Georgia State University, Atlanta, GA.
- Remler, D. K., & Van Ryzin, G. G. (2011). *Research methods in practice: Strategies for description and causation*. Los Angeles, CA: Sage.
- Republic of South Africa. (1998). *Employment Equity Act No. 55, 1998*. Cape Town, South Africa.
- Rothstein, J., & Rouse, C. E. (2007). *Constrained after college: Student loans and early career* occupational choices (Working Paper 13117). Retrieved from National Bureau of Economic Research: <u>http://www.nber.org/papers/w13117.pdf</u>
- Roy, P. (2014). Domains of influence on academics' careers" narratives from Black African, Coloured, and Indian women academics in post-apartheid South Africa. (Doctoral dissertation). Michigan State University, East Lansing, MI.
- Salo, E. R., Liersch, F., Mohlakoana-Motopi, L., & Maree, M. (2014). Carrots or sticks? A study on incentives to attract and retain women in science, engineering and technology in South Africa. In B. Thege, S. Popescu-Willigmann, R. Pioch, & S. Badri-Höher (Eds.), *Paths to career and success for women in science: Findings from international research* (pp. 163-190). Kiel, Germany: Springer Fachmedien Wiesbaden.

- Savigny, H. (2014). Women, know your limits: cultural sexism in academia. *Gender and Education*, 26(7), 794-809.
- Sbaraini, A., Carter, S. M., Evans, R. W., & Blinkhorn, A. (2011). How to do a grounded theory study: A worked example of a study of dental practices. *Medical Research Methodology*, 11(128), 1-10. doi:10.1186/1471-2288-11-128
- Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist, 26*(2-4), 207-231. doi: 10.1080/00461520.1991.9653133
- Schurink, W. J. (2003). Qualitative research in management and organizational studies with reference to recent South African research. South African Journal of Human Resource Management, 1(3), 2-14.
- Schuurman, M.K., Pangborn, R.N., & McClintic, R.D. (2005). The influence of workplace experience during college on early post graduation careers of undergraduate engineering students. *Women in Engineering ProActive Network*.
- Shacklock, G., & Thorp, L. (2005). Life history and narrative approaches (pp. 156-163). In B. Somekh., & C. Lewin. (Eds.), *Research methods in the social sciences*. London, UK: Sage Publications.
- Shaikh, Z. A., Shaikh, M. Z., & Khan, M. H. (2015). A survey to assess the female sexual harassment in the higher educational institutes of Karachi, Pakistan. In R. Omar, H. Bahrom & G. de Mello (Eds.), *Islamic perspectives relating to business, arts, culture and communication: Proceedings of the 1<sup>st</sup> ICIBACC 2014* (pp. 441-449). Singapore: Springer.
- Shaw, E. (1999). A guide to the qualitative research process: Evidence from a small firm study. Qualitative Market Research: *An International Journal*, *2*(2), 59-70.
- Shilliam, R. (2015). Black academia: The doors have been opened but the architecture remains the same. In C. Alexander & J. Arday (Eds.), *Aiming higher – Race, inequality and diversity in the academy* (pp. 32-34). London, UK: Runnymede.
- Shumba, A., & Naong, M. (2012). Factors influencing students' career choice and aspirations in South Africa. *Journal of Social Science*, *33*(2), 169-178.
- Smith, L. T. (1999). *Decolonizing methodologies: Research and indigenous people*. New York, NY: Palgrave Macmillan.
- Smith, L. T. (2012). *Decolonizing methodologies: Research and indigenous peoples*, (2<sup>nd</sup> ed.). New York, NY: Palgrave Macmillan.

- Solórzano, D. G., & Yosso, T. J. (2002). Critical race methodology: Counter-storytelling as an analytical framework for education research. *Qualitative Inquiry*, 8(1), 23-44.
- Soudien, C. (2008). The intersection of race and class in the South African university: Student experiences. *South African Journal of Higher Education, 22*(3), 662-678.
- Southern African Development Community [SADC]. (2012). *Member states*. Retrieved from http://www.sadc.int/member-states/
- Statistics South Africa. (2014). *Mid-year population estimates: 2014*. Pretoria, South Africa: Statistics South Africa.
- Steady, F. C. (1996). African Feminism: A Worldwide Perspective. In R. Terborg-Penn & A. B. Rushing (Eds.), *Women in Africa and the African Diaspora: A Reader* (2nd ed.). (pp. 3-22). Washington, D.C.: Howard University Press.
- Steady, F. C. (2005). An investigative framework for gender research in Africa in the new millennium. In O. Oyewumi (Ed.), *African gender studies: A reader* (pp. 313-331). Basingstoke, Great Britain: Palgrave Macmillan.
- Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, 69(5), 797-811.
- Strauss, A., & Corbin, J. (1990). Basics of qualitative research: Techniques and procedures for developing grounded theory (Vol. 15). Newbury Park, CA: Sage.
- Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (2<sup>nd</sup> ed.). Thousand Oaks, CA: Sage.
- Super, D. (1980). A life span, life-space approach to career development. *Journal of Vocational Behaviour, 16,* 282-298.
- The Guardian (October, 2014). Why are there so few black professors in South Africa? *The Guardian*. Retrieved from <u>http://www.theguardian.com/world/2014/oct/06/south-africa-race-black-professors</u>
- The Journal of Blacks in Higher Education (JBHE). (2007). The snail-like progress of Blacks into faculty ranks in higher education. *Journal of Blacks in Higher Education*. Retrieved from <u>http://www.jbhe.com/news\_views/54\_black-faculty-progress.html</u>
- Thomas, D. (1996). Education across generations in South Africa. *The American Economic Review*, *86*(2), 330-334.
- Thomas, N., Bystydzienski, J., & Desai, A. (2015). Changing institutional culture through peer mentoring of women STEM faculty. *Innovative Higher Education*, 40, 143-157.

- Trusty, J., Robinson, C. R., Plata, M., & Ng, K. (2000). Effects of gender, socioeconomic status, and early academic performance on postsecondary educational choice. *Journal of Counselling and Development*, 78(4), 463-472.
- Turner, C.S.V. (2002). Women of color in academe: Living with multiple marginality. *The Journal of Higher Education*, 73(1), 74-93.
- U.S. Department of Education. (2015). Michigan State University agrees to change its response to complaints of sexual harassment, sexual violence. Retrieved from, <u>https://www.ed.gov/news/press-releases/michigan-state-university-agrees-change-its-response-complaints-sexual-harassment-sexual-violence</u>
- United Nations. (2015). *Goal 3: Promote gender equality and empower women*. Retrieved from <u>http://www.un.org/millenniumgoals/gender.shtml</u>
- United Nations Development Programme. (2015). *Goal 5: Gender equality*. Sustainable Development Goals. Retrieved from <u>http://www.undp.org/content/undp/en/home/mdgoverview/post-2015-development-agenda/goal-5.html</u>
- United Nations Educational, Scientific and Cultural Organization [UNESCO] (2012). *World Atlas gender education*. Retrieved from <u>http://www.uis.unesco.org/Education/Documents/unesco-world-atlas-gender-education-2012.pdf</u>
- United Nations Educational, Scientific and Cultural Organization Institute for Statistics [UIS] (2007). Head counts and headaches measuring women in science. *A World of Science*, 5(2), April June, 21-23. Retrieved from <u>http://www.unesco.org/science/doc/E21\_23.pdf</u>
- United Nations Educational, Scientific and Cultural Organization. (2013). *Engineering in Africa*. Retrieved from <u>http://www.unesco.org/new/en/unesco/events/prizes-and-</u>celebrations/international-weeks/unesco-africa-engineering-week/
- van den Brink, M., & Stoobe, L. (2009). Dong gender in academic education: The paradox of visibility. *Gender, Work and Organization, 16*(4), 451-470.
- Wane, N. (2011). African indigenous feminist thought: An anti-colonial project. In N. Wane, A. Kempf & M. Simmons (Eds), *The politics of Cultural Knowledge* (pp. 7-21). Sense Publishers
- Wangenge-Ouma, G. (2012). Tuition fees and the challenge of making higher education a popular commodity in South Africa. *Higher Education*, *64*, 831-844.
- Watson, M. B., Foxcroft, C. D., Horn, M. A., & Stead, G. B. (1997). Occupational aspirations of Black South African adolescents. *Psychological Reports*, *80*, 627-635.

- Watson, M.B., Stead, G.B., & DeJager, A.C. (1995). The career development of black and white South African university students. *International Journal for the Advancement of Counselling*, 18, 39-47.
- Wilson-Strydom, M., & Fongwa, S. N. (2012). *A profile of higher education in Southern Africa Volume 1: A regional perspective*. Johannesburg, SA: Southern African Regional Universities Association (SARUA).
- Wolf-Wendel, L. E., & Ward, K. (2006). Academic life and motherhood: Variations by institutional type. *Higher Education*, *52*, 487-521.
- Women in Science and Engineering [WISE]. (2015). *Women in the STEM workforce*. Retrieved from <u>https://www.wisecampaign.org.uk/resources/2015/09/women-in-the-stem-workforce</u>
- Woolnough, B. E., Guo, Y., Leite, M. S., de Almeida, M. J., Ryu, T., Wang, Z., & Young, D. (1997). Factors affecting student choice of career in science and engineering: Parallel studies in Australia, Canada, China, England, Japan and Portugal. *Research in Science & Technology Education*, 15(1), 105-121. doi: 10.1080/0263514970150108
- Worku, Z. (2014). A study of the labour market in South Africa. *European Journal of Research in Social Sciences*, 2(4), 106-121.
- World Bank. (2016). The Little Data Book on Gender 2016. Washington, D.C.: World Bank.
- World Economic Forum. (2014). *The global competitiveness report 2014-2015*. Geneva, Switzerland: World Economic Forum.
- Zhang, Y., & Wildemuth, B. (2009). Qualitative analysis of content. In B. Wildemuth (Ed.), Applications of coail research methods to questions in information and library science (pp. 308-319). Santa Barbara, CA: Greenwood Press.
- Zulu, C. (2003). Gender representation patterns in higher education management in South Africa. South African Journal of Higher Education, 17(1), 98-104.