



Women leadership success and roles in science, technology, engineering and mathematics in Africa

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DECLARATION

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DEDICATION

To my three physical companions

Oluwatoba,

Oluwatomisin,

Oluwatokesi

&

The loving memories of my mum, Madam Abosede Comfort Ademuyiwa and my dad, Pa Ademola Daniel Ademuyiwa.

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WOMEN LEADERSHIP SUCCESS AND ROLES IN *SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS* (STEM) IN AFRICA

ABSTRACT

Background

There is a need for African women leadership in Science, Technology, Engineering and Mathematics (STEM) to arise. Women in comparison to their men counterparts do not climb up the leadership ladder rapidly due to what is termed a glass ceiling obstacle. There is therefore a need for African women in STEM to arise up to these challenges. This study aims to explore the inhibiting and enabling factors contributing to Africa women's leadership success in STEM.

Methods

A qualitative approach was followed using online open-ended questions, seeking for narratives from African Women leaders on their roles and experiences of career success in STEM. Data were collected from a non-probability, purposive sample of African women leaders in STEM from West, East, North and Southern African research institutes and universities. Participants (P) occupied leadership positions such as Director, Dean, and Principal Officer in the field of STEM. Forty-two (42) women participated representing 12 African countries. Narratives were analysed through content analysis seeking for patterns and themes.

Research Findings

A common thread exists in the tone and life experiences of the African women leaders in STEM. The women all shared a passion for STEM. There are diverse organisations in STEM, however the majority of participants (96%) were from higher education institutions. Scholarship, supportive organisational structure, commitment, hard work, and tenacity were all experienced as enablers of career paths process and their attained positions. The level of education also contributed to achieving leadership position. Senior professors, senior colleagues (male and female), husbands, PhD supervisors, and the personal self, stand out to

be sources of inspiration for women in their STEM leadership journeys. Successful leadership in STEM is about a balance of career with family life, goal setting, problem solving, and openness to new ideas, embracing diversity, collaboration, STEM research expertise, and mentorship skills.

The study found that African women leaders in STEM face enormous challenges of gender discrimination, family demands, insubordination, underrating women, conspiracy against women, lack of cooperation, socio-cultural issues, and lower salaries. The biases emanate from the view in some African societies that women should not issue instructions to men. STEM leadership transformation experiences revolve around skills, boldness, determination, and being above standards. Among many other things, the values, goals and strategies women STEM leaders manifest include the desire to grow, self-actualisation, honesty, good listening skills, sharing responsibilities, staying focused, being a role model, driving state-of-the art research, striving for the truth, upholding integrity, maintaining financial integrity, accountability and hard work.

It is evident that African women experience that they are less accepted than males in STEM leadership roles in a number of African countries. The role of a successful African women leader in STEM should be able to balance career with her family and having a goal set for herself to pursue STEM as a career choice.

Conclusions

Although leadership positions were found to be challenging, most women participants agreed that when one is focused and adheres to the values of honesty and integrity, achieving career success and earning respect of colleagues and subordinates becomes easier attainable. This research further highlights the leadership roles and styles of African women in their various STEM organisations with recommendations for organisational policies and future studies. Limitations and managerial implications were highlighted.

Key words: Career paths, career progression, female scientists, gender imbalance, glass ceiling, manager, organisation, professionals

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CHAPTER 1: INTRODUCTION TO THE STUDY

1.1 Introduction and Background

Many explanations have been posited as to the fact that every woman would like to be upwardly mobile to the extent of being a leader (Ibarra *et al.*, 2013). It is doubtful if anyone will be an exception to that. Such women need mentoring and leadership education, to be able to take decisive action, come up with ideas and express them forthrightly. The qualities and experiences people associate with leadership include acquisition of a novel skill set and competencies, adjusting one's style to the prerequisite of that office, a need to be motivated, recognized (affirmation) and encouraged (Ibarra *et al.*, 2013). The subject of gender bias as seen nowadays within organisations and all over muddle up the fairness in the craving of many women to become a leader in any society, be it to occupy leadership positions in higher education institutions in science, technology, engineering and mathematics (STEM).

Career progressive international positions no doubt usually comes with a 'follower spouse' without a career and can easily move -- a family status quo mostly seen in men than for women (Braseby, 2010; Klenke, 1997). On the whole, being a woman brings complexity of personality in the African context as there is strife between modernization to break even and have equity or to stay traditional, sometimes uneducated and unexposed in the naïve self (Klenke, 1997). Klenke (1997) said the perspective in a family/community prescribes the leadership type and behaviour a female member of that family/community should manifest. Klenke also stated that wider cultural, civic, or global forces mould a given context (family, workplace, community). Organisational context denotes the range of an entity, for instance, the main organisation having an entity or more. Klenke mentioned the novel related elements that are dire for the existence of 21st century organisations. As establishments are coming up with subsidiaries, change is bound to happen but there are serious issues that may not be overlooked in the framework in which many present leaders function (Klenke, 1997).

Women's acceptance and involvement in science, technology and development especially in the leadership positions still leaves much to be desired. In 2016, the United Nations proclaimed February 11 as the International Day of Women and Girls in Science in an attempt to both

involve and promote more prominent involvement of women and girls in the fields of science and technology (Akter *et al.*, 2017). It has been documented that not as much as one in every three researchers generally are women (Madry *et al.*, 2018). Key factors such as the availability of opportunity, access to education, institutional leadership and emotional intelligence could play important roles in boosting women's participation in STEM leadership within Africa (Maree *et al.*, 2006; Mayer *et al.*, 2017). The aim of this review is not only to determine and understand women's leadership roles in STEM in Africa but also to articulate the problem and make suggestions in responding to it.

1.2 Women's Emergence as Leaders

Furst and Reeves, (2008) have contended that women's growth to leadership is attributable to the dealings of perceived individual disposition and according to (Sharma & Tarp, 2018) the locus of control. Illustrating three viewpoints on the effects of individual disposition and masculinity or femininity in the rise to leadership, Wille *et al.*, (2018) investigated the possible effect of sex difference among executives and among those who are not in executive positions. It was discovered that gender differences in leadership traits were not as obvious among executives as observed among those in the lower cadre. More also, traits like conscientiousness and extraversion distinguished the leaders from those being lead for both sexes. All directors are apt to exhibit an exemplary 'leader personality' focused on being assertive, firm and strategic. Altogether, hierarchical level dissimilarities in disposition were more obvious among female gender than male (Wille *et al.*, 2018). Findings that unlike religiosity the proportion of women in state-owned institutions is low and hence the ascendancy of female to board members (Chizema *et al.*, 2015).

According to Dambrin and Lambert, taking an instinctive examination into the paucity of womenfolk at the top hierarchical stages of accountancy, reflectivity practice shows that certain misleading studies are damaging to what women represent (Dambrin & Lambert, 2012) and also pointed out the havoc in biased stance. It is possible for women to score more than men in terms of self-assessment on individual differences in awareness, and thoughtfulness; women are more courteous, meticulous, and outspoken, willing to learn, understanding, mannish, girlish, agentic, willing to share, and self-absorbed; and reported more positive relations with others (Goh *et al.*, 2016).

The contextual factors that may influence when women are likely to show forth as leaders was unpacked through the complicated interactions between individual gender, group gender composition, and group personality composition (Lemoine *et al.*, 2016) and showed that individual level gender does not interact with group gender composition to foretell leadership emergence, implying suggesting that in a group that has more men, they hardly choose men as leaders, and likewise women do not emerge as leaders in a group with more women (Lemoine *et al.*, 2016). However, group extraversion alters leader emergence patterns in groups with more men.

The 'queen bee' theory explains the adaptation of women leaders into male-dominated organisations (i.e., organisations in which most top positions are held by men) by distancing themselves from junior women is in itself a result of the gender unfair perception that women experience at work (Derks *et al.*, 2016). The research gave several explanations that (1) queen bee behaviour is a response to the discrimination and social identity threat that women may experience in male-dominated organisations; and (2) queen bee behaviour is not a typically feminine response but part of a general self-group distancing response that is also found in other marginalized societies (Derks *et al.*, 2016).

The Big 5 personality traits are unswervingly related to transformational leadership sub-dimensions and to the overall measure, and are secondarily related to leader enactment. Interestingly, however, different combinations of the personality traits are differentially related to the transformational leadership behaviours. For illustration, whereas inspirational motivation is related to all personality traits, only openness to knowledge and agreeableness affect individualised deliberation (Derks *et al.*, 2016). The investigation on how hypothetical leaders' gender interacts with anger and sadness expression and followers' attributions for their emotional expression on evaluations made by followers showed people evaluated the competence of male and female leaders differently depending on their emotional displays (anger vs. sadness) (Schaubroeck & Shao, 2012).

Sexual category and values may impact individuals' opinions of their connection to others such that people understand themselves in relation to shedding light on personality within cultural contexts (Ott-Holland *et al.*, 2014). A multilevel investigation on distinctive profile similarity Furr, (2008) revealed that both sexual category and values play a role in perceived self-other similarity. So therefore, women and those from highly collectivistic cultures saw themselves as more similar to others. Country-level analysis based on self-other similarity correlations e.g.

(Srivastava *et al.*, 2010) within each country revealed that cultural assertiveness uniquely predicted this assumed similarity. The outcomes elucidate people's personal view in relation to others and add to the knowledge of personality within cultural settings.

A recent theoretical model pinpoints individual, interpersonal, and organisational circumstances that profile women leaders' experience and incite a paradox mind set versus a dilemma mind set as a reaction to agency-communion tensions (Zheng *et al.*, 2018). Women leaders in STEM can face concomitant and yet conflicting requests for both agency and communion, as a result of the incongruence of their leadership and gender role demands. The paradox mind set assists women leaders to build psychological strength, identity coexistence, and leadership effectiveness, whereas those who adopt a dilemma mind set experience depleted resilience, identity separation, and lowered leadership effectiveness (Zheng *et al.*, 2018). More anecdotal than observational data exists as to the influence of any of these four culture dimensions of Hofstede (power distance, individualism/collectivism, uncertainty avoidance, and masculinity/femininity) plus extended- vs. short-term orientation dimension on leadership (Scandura & Dorfman, 2004).

The classical example of leadership came from the study of White men (Parker, 1996). It is a paramilitary model of mechanism and competitive behaviour based on White men (Loden, 1985) because they were the people who managed successfully and women/Blacks were not recognised - they were invisible. With the influx of women into management in the 1960s and 70s it was generally hypothesised that women, who were seen in terms of social category stereotypes, must adapt (Kanter, 1977). Roadblocks notwithstanding, a number of women have attained high administrative positions, allowing researchers to explore factors linked with their achievement.

1.3 Problem Statement

The general problem is that the authority of male leaders in developing countries, such as Africa as a continent, is not questioned, however, a number of examples in published work alluded to it that female leaders are habitually confronted, and their buff, expertise or performance are questioned, by their counterparts (Ladegaard, 2011) and this is also relevant in STEM.

The specific problem is that a plethora of research exists on leadership behaviour (Ladegaard, 2011) but very few studies specifically address African women leadership behaviour within STEM in African countries. Their career path barriers or successes in becoming leaders within STEM in Africa are also not published. Indeed progress has been made, for example some nations of the world now have substantial numbers of female as part of their board members, yet some have none (Chizema *et al.*, 2015).

Women rising to top management positions are far beyond the singular challenges of being a woman in the workplace and includes wider societal impacts. Global links, swelling social investment and enhanced enthusiasm help, but do not have provisions for the established and public prejudices that weaken prospects for women leaders in STEM. Changes in the approach that women view opportunities in the workplace, and in the manner that policy makers and employers respond have been suggested and the significance of welcoming diversity more extensively, not just from a sexual category viewpoint, was highlighted (McLaughlin *et al.*, 2017). There is therefore a need to identify factors that influence career path success of women as STEM leaders (Zimmerer & Yasin, 1998).

1.4 Research Questions

The principal research question of this study is: *What are the experiences of African women regarding their leadership success and roles in STEM careers in Africa?*

The sub-research questions in this study were:

1. (a) What does the career path of a woman in STEM look like and how does she attain the leadership position? (b) Who inspires a woman in STEM in her leadership journey?
2. (a) What does successful leadership in STEM mean to woman leaders in STEM? (b) What characteristics does a woman possess that make her an effective leader in STEM?
3. (a) What are the common challenges faced by a woman in STEM in her position as a leader in STEM? (b) What biases or stereotypes if any does she encounter in her position as a leader? (c) What are some experiences that have transformed or changed a woman in STEM as a leader?

4. (a) How do her values, goals and strategies manifest in her leadership role? (b) What is the professional environment like to a woman in STEM? (c) How does the organisational culture facilitate or hinder the leadership style of a woman?

1.5 Research Objectives

The research objectives of this study were as follows:

- 1) Investigate the career path, and sources of inspiration of African women in STEM towards attainment of leadership position
- 2) Investigate characteristics of successful and effective women leadership in STEM
- 3) Explore the common challenges, biases or stereotypes faced by women STEM leaders in Africa
- 4) Assess the organisational culture which facilitates or hinders women leadership style in STEM

1.6 Outline of the Research Approach and Methodology

Narrative research as a qualitative approach was used (Czarniawska, 2004). A total of 54 women from African countries were envisaged to be involved in the study. Each participant was purposively selected for her leadership role and career success in STEM. They were from four geographic zones of Africa: North, West, East and South.

Semi-structured self-administered questionnaires (see Annexure A) were delivered by email to collect data in the phenomenology study per question. Participants were contacted with the help of link research scholars in the different institutions, and in a few instances by telephone call where there was no link person available.

Narrative data were studied to conceptualise the content of the answer provided per question by each participant. Codes were given to relevant portions of text and themes were allocated to answer research questions. Early analysis of the data in the organisation of the information is important in order to have a substantial understanding of the connections that exist in the midst of the feedbacks obtained from the discussion of the later phases (Pflanz, 2011).

1.7 Academic Value and Contribution

The aim of this survey is not only to explore and understand African women leadership success and roles in STEM, but also to articulate the problem and make suggestions in responding to it.

1.8 Definition of the Key Terms

The listed are the most important key terminologies used in the study:

Women leadership roles in this study consist of women holding the following positions: Coordinators (e.g. Private Sector Engagement Coordinator), Deans, Directors (DGs, Deputy DG's, Hub Directors, corporate services), Head of Departments, Location leaders, Managers (e.g. Initiative managers), Platform leaders, Principal scientists, Program leaders, Project leaders, Regional representatives, Research chairs, Specialists (e.g. communications specialists, gender specialists, GIS specialists, Human Resources Development Specialists, Bioinformatics specialists, Germplasm specialists), Team leaders and Unit heads.

Women in STEM in this research consist of women in positions of leadership, STEM graduates in management position, or senior female researchers.

Institutions of higher learning in this study consist mainly of universities but also include national research institutes.

P#no/Country/Age (e.g. P1/Ghana/55-64) implies participant number 1, a national of Ghana, and of the age bracket 55-64.

In Table 1.1 below, the abbreviations that are used often in this research are listed.

Table 1-1: List of abbreviations used in the document

Abbreviation	Meaning
CGIAR	Consultative Group for International Agricultural Research
OWSD	Organisation for Women in Science for the Developing World
STEM	Science, Technology, Engineering and Mathematics

1.9 Outline of the Study

Table 1-2 displays the flow of the contents of the rest of this research report, accompanied by a short summary of each subsequent chapter.

Table 1-2: An outline of the study with descriptions of chapter contents

Chapter 2	This chapter contains an exploration of the theoretical framework of the study particularly as it relates to women in STEM leadership.
Chapter 3	In this chapter, the study approach utilized in the study is described in detail and its use is justified. Further, the research concept and route taken, the research design, and the sampling method are explained. The data collection method of using a semi-structured questionnaire (see Annexure A), and the data analysis method in the form of a thematic/content analysis are described. Attention is also given to the precautions taken in order to guarantee the quality and rigour of the research as well as to abide by the ethical standards of research.
Chapter 4	This chapter presents a discussion of the research results and observations. It brings to the fore the themes and subthemes that emerged from the data analysis of the filled questionnaire samples. Using verbatim quotes from the participants' responses, substantiation of the findings is provided to support the themes.
Chapter 5	In this chapter, which concludes the study, the titles obtained during the data analysis are interpreted as the achievement of the stated objectives of this research. Furthermore, the limitations of the research are referred to and recommendations for further research are made including managerial implications.

1.10 Summary

Chapter 1 introduced the study by sketching a background to researching women in STEM leadership success. The need for such research was highlighted by painting a dismal picture of African women in STEM accomplishment - this despite extensive participation of women in

STEM in Africa. Hence the importance and benefits of conducting this study were substantiated.

The next chapter contains an examination of the existing literature pertinent to this study. A review of this literature is regarded as a critical resource and a basis for knowledge advancement.

In conclusion, Table 1-3 presents an outline of the arrangements of this dissertation.

Table 1-3: The structure of the dissertation

Chapter 1	Introduction to the study
Chapter 2	Literature review
Chapter 3	Research methodology: Rationale and application
Chapter 4	Research findings
Chapter 5	Conclusions and recommendations

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In response to the rising view of possible drop in individual doing hard science and the challenges women face in occupying leadership positions, this chapter attempts to marry the views under several personality characters. Leaders have different personality traits which can be evident in their leadership style. Some of the personality traits discussed in this chapter are leaders who communicate openly, leaders who are risk taker, leaders who share burdens with subordinates, and leaders who demonstrate integrity. Integrity is a moral concept in leadership although it is not totally exclusive. Personality traits are associated to transformational leadership and the entire measures are directly related to the performance of a leader. Interestingly, combination of different personality traits is dependent on the behaviour of the said leader. Therefore, effective performance of a leader through different personality trait is important because it is one of the yard stick to determine the competence of a leader.

2.2 Women's Leadership in Context

Klenke, (1997) gave account on the hurdle women face when they try to attain a leadership role and the reason for their poor representation in leadership positions at numerous income generating and non-profit organisations. It is evident that when women attain leadership positions, they are often assessed less favourably than their male equals with the same level of backgrounds and knowledge gathered and are paid significantly lower than their male equals. This is obvious in North America and in Britain (Commission, 2007).

The perception that women are not suitable for leadership often hinders them from seeking to attain such positions. Glass ceiling (Hymowitz & Schellhardt, 1986) denotes an imperceptible obstruction to the advancement of women and interest group in management. It is an invisible barrier that seems strong to hold women back from top management jobs simply because they are women despite having the relevant job skills, education or experience (Morrison & Von Glinow, 1990; Powell & Butterfield, 1994). Thus, even those women who despite all odds rose

through the ranks finally crashed into another barrier whereas their male counterparts progressed hastily into management roles by means of 'glass escalators' (Williams, 1992). For women, they could not break through the glass ceiling despite having the executive suite within their reach. Many women find it extremely difficult to move up organisational hierarchy and are usually faced with strict requirements for promotion. This situation brought about a popular metaphor termed the ¹glass ceiling. There is recent evidence of insinuating women breaking through the glass ceiling in many organisations (Dreher, 2003). In a study by Goodman *et al.*, (2003) in their quest to know what kinds of organizations do women make it to the top, it was observed that women are likely to break the glass ceiling in organisations with low salary structure for their management or women with lower or expected incomes. Women who occupy lower management positions and higher management turnover are also likely to break the glass ceiling with great attention on the development and promotion of employees. This study showed that institutions that lack structural characteristics and practices is a hindrance and make it quite hard for women to break the glass ceiling.

When women peradventure reach the top executive positions, they encounter yet another barrier termed the 'glass wall'. The glass wall is a double-pane barrier which seems unseen that surround great senior male administrators. The glass wall metaphor indicates that after breaking the glass ceiling with promotion to senior management positions in companies, women are encumbered with yet additional hurdle which comes with bigger task and prevents women from rising to the top of their respective career.

¹ "a situation in which progress, esp. promotion, appears to be possible but restrictions or discrimination create a barrier that prevents it" (Collins Concise Dictionary: 2004: 609).

There is another concept identified as the ‘‘glass cliff’’ which was posited by (Ryan *et al.*, 2016). It implies women find themselves in leadership positions in organisations or departments in crisis. This concept is risky for any woman who holds that position because it is extremely dangerous: bad performance attracts attention to their circumstances and the board of directors (Haslam & Ryan, 2008). Klenke, (1997) identified that women in leadership positions may advance to higher levels if new leadership paradigms and new organisational structures may be put in place that are more agreeable to women’s evolution as leaders or newly improved industries that offer greater gender equality.

The chief executive officer (CEO) of an organisation sits at the apex having unlimited power, force and authority where information flows from top-bottom. The leadership style is a command and control method where everything lies in the hands of the CEO. Klenke, (1997) discussed how women rose to leadership positions facing many hurdles on the way in pursuit of their dreams and reason for inadequate representation in leadership roles. Women are often treated less favourably to their male colleagues with the same academic qualifications, backgrounds and experience. This is obvious in the United States and in the United Kingdom (Commission, 2007). Overall, the higher the rank in STEM the less likely it is to be occupied by a woman, making women particularly underrepresented in leadership positions (Valian, 1999). Personality traits are associated to transformational leadership and the entire measures are directly related to the performance of a leader. Interestingly, combination of different personality traits is dependent on the behaviour of the said leader (Deinert *et al.*, 2015).

2.3 Women in STEM Divisions’ Leadership Positions

There are several research works available for gender inequality especially in the science, technology, engineering, and mathematics (STEM) areas. On the other hands, there are no much available reviews on the gender inequality in the areas pertaining to leadership (McCullough, 2011; Moss-Racusin *et al.*, 2012). Generally, women in science and areas that are technical who have aspiration of attaining leadership positions in the STEM encounter few barriers. Certainly, there are two basic sets of challenges they face in various fields; firstly, women that wish to occupy leadership positions in the fields of STEM are confronted with a dual challenge, which have to do with overcoming difficulties gotten from both of their selected

content field and the position they aspired; or secondly, women who are able to steer the obstacles in their field of content successfully are better situated to steer the obstacles on the pathway to leadership successfully. Furthermore, unavailability of much review on women occupying leadership positions in STEM suggests that this query is not answered and also not relatively explored. Few of the available research many a time lay emphasis mostly on the problems that are described and not the fundamental reasons. In the academy, there have been reports indicating the number of women occupying leadership positions in STEM (Niemeier & González, 2004). Using the data obtained from the Association of American Universities, 90% of engineering department reported in the sample had male as the head of department while it had 2.5% as the female heads (other gender not being reported). Whereas it was a little better in the mathematical and physical sciences which presents male and female department heads as 88% and 5.5% respectively. In addition, at an IUPAP International Conference on Women in Physics, the deficiency of women occupying leadership positions in physics was a topic discussed and there was a paper produced stating motives and ways through which women's leadership in physics could be advanced (McCullough, 2011). In the preparation of women for leadership positions, some of the items listed were; unbiased processes of selection, responsibilities of industry and academics. In 2005, another paper followed it up making new opinions for the significance of incorporating women into leadership position in physics (Williams *et al.*, 2005). Nevertheless, fundamental reasons for the deficiency of women in these leadership positions are not well discussed. Female faculty at Johns Hopkins University was interviewed and this included women from science, engineering and medicine, from the interview it was discovered that the style of leadership, obligations in the family and partialities which include lack of acknowledgment were crucial factors women suggested for the reason why they were being underrepresented in the leadership position in the STEM (Dominici *et al.*, 2009). It was observed that the nature of hierarchy in the academic departments of medical school could also impede advancement of women in the leadership attainment (Conrad *et al.*, 2010).

2.4 Leaders Who Communicate Openly

Talves, (2016) studied the pattern that promotes gender hierarchies and inequalities along with the domination and boundaries women face in positions of authority. It is obvious that women have many coping and resilience methods in surmounting career obstacles in organisations.

There is a friction between self-positing and academic excellence in women with a career in science operating in gendered organisations with respect to gender neutrality, trivialising and superiority strategies. The moderating role of gender was documented along with the impact of supervisor incivility on employee cynicism, favouritism/nepotism, and withdrawal in work place. In a way to reduce the questionable practices of organisational politics and workplace victimisation and how to keep employees productive despite the social stressors, the Job Demand Resources framework were used to show important implications on the wellness of employees (Abubakar *et al.*, 2017). For example, information gathered from key staff working in 3-star hotels in Northern Cyprus, it was observed that: (i) favouritism/nepotism has a good impact on employee cynicism and work withdrawal; (ii) employee cynicism has good impact on work withdrawal; (iii) employee cynicism mediates the relationship between favouritism/nepotism, and work withdrawal; (iv) women are affected 6.7 times more in employee cynicism on work withdrawal; (v) the effect of favouritism/nepotism on work withdrawal reported about 2.1 times stronger for men to women (Abubakar *et al.*, 2017).

2.5 Leaders Who Take Risks

There are two types of biases militating against women leader according to the literature. The biases are agentic deficiency and agentic penalty. Agentic deficiency is an insinuation that women have limited leadership potential while agentic penalty is a negative behaviour against women with a descriptive, prescriptive and proscriptive stereotypes on which the biases affect women across race (Rosette *et al.*, 2016). Agentic deficiencies and penalties is determinant on the agency that is under consideration and its association to the stereotypes with the target's gender and racial group (Rosette *et al.*, 2016). For a gender and leadership study, findings suggest two dimension of agency, namely competence and dominance which align closely with agentic deficiency and agentic penalty (Rosette *et al.*, 2016). When there is a specific racial and gender stereotype aligning with a particular agency, we can gain a more thorough understanding on how agentic biases affect women's progression to leadership positions (Rosette *et al.*, 2016). Two types of agentic bias are most aptly and succinctly depicted in role congruity theory (Eagly, 2005): (1) an agentic deficiency indicating the consciousness that women are insufficiently agentic to occupy leadership roles (Eagly & Heilman, 2016) and (2) an agentic penalty, being the social and economic backward reaction women face for behaving

in an agentic manner that is unusual with their perceived gender role (Brescoll, 2016; Eagly, 2005).

Men and women have different innate preferences pertaining to democracy, just in the same way as women tend to be more risk-averse (Schubert *et al.*, 1999). Consequently, agentic bias against women should be attenuated by the extent to which the descriptive stereotypes for them are perceived as congruent with agentic-competence.

2.6 Leaders Who Share Burdens With Subordinates

Women who hold sensitive positions in authority find it challenging to see the attainment of authenticity, where followers see the legitimacy of their leaders to promote a certain set of values on their behalf. It was suggested that women leader development should focus on achieving geniuses of leaders (Eagly, 2005). Often, women in executive positions legitimize their claims to be in the upper tiers of leadership either by navigating through well institutionalized paths of career advancement (e.g., high performance in line jobs) and self-advocating with the gatekeepers of the social hierarchy (e.g., bosses, investors) or by pioneering (Bowles, 2012). In pioneering accounts, women articulated a body of support and followership around well thought strategic ideas and leadership (Bowles, 2012). Besides, when the claims made by women in authority were not verified, they devise another narrative identity to review their aspirations and legitimisation strategies (Bowles, 2012). Narrative identity most times motivates women to shift from one type of account to another, particularly from navigating to pioneering (Bowles, 2012). Black women leaders face a burden of being punished for making mistakes while on the job. This was revealed in a study by Rosette and Livingston, 2012, titled “Effects of organisational performance on leaders with single versus dual-subordinate identities”. Women in leadership positions contribute immensely to organisations, but at the same time they are poorly represented in corporate leadership positions. Women who despite all odds break the glass ceiling debacle often experience shorter tenures than their male counterparts. This is a major disservice to successful women in authority (Glass & Cook, 2016). A research carried out on the spousal support for career women in managerial position calls attention to families. Furthermore, a career woman in managerial position is vague (flourishing, irrelevant, deficient or inconsistent) and evolves over the career. In addition, a male spouse has a positive influence on the career of their wife manager if they are willing to break the traditional gender order and support his wife in various forms (Heikkinen *et al.*, 2014).

Rwanda's development policy has an initiation which focuses on socio-economic transformation with a special focus on agriculture and gender equality. Women and men are integrated into the agricultural production system. As an aftermath of the transformation that occurred in the rural labour market, it showed informal sector wage employment for field agricultural workers from the same work, men earn 20% more than women despite women playing a significant role in the rural labour market and doing the majority of the work. The agricultural transformation is deemed gender specific (Liben & Bigler, 2017).

Data from the National Study of the Changing Workforce in 2012 showed the act of constrained against women career where it was reported that female supervisors are compelled to promote the career of men. This is a contradiction to the assumption that female bosses encourage the career of their female folks (Maume, 2011).

Looking at business etiquette (Morand, 1998), observed that norms of address are yet to be made uniform, buttressing the fact that women have traditionally less authority over men in many office settings, because speech and interaction patterns are gender-based stereotypes. For example, women managers are conscious of the situation in which their subordinates call them by their first name but call the male bosses by the title-last-name (Morand, 1998).

2.7 Leaders Who Demonstrate Integrity

Employees within the workgroup who happen to be promoted into leadership roles experience psychological conflict. This can result into vulnerability of being abused or appalling to exert their authority over equals and subservient friends (Unsworth *et al.*, 2018). There is a mind battle with being a leader and at the same time a friend to a subordinate in the hierarchy of the organisation. The psychological conflict can be managed using a number of strategies which include terminating the relationship, creating a separation, overlapping of roles, abandon responsibility, and using friendship to lead. A person's leader distinctiveness (either being "the boss", just a role, or a weak or non-existent leader identity) is a result of the choice of function and the kind of psychological conflict. Thus it must be noted that those in leadership roles are also 'people' and not just 'leaders' in a job (Unsworth *et al.*, 2018).

Authentic leaders are faced with numerous obstacles. The problems include how construct are understood and measured. Authentic leadership has a follower's perception of how legitimate a leader is and this is spurred on by moral judgements. A follower could help elaborate leadership dynamics by focussing on the moral component in condition such as ethical relativism, thereby reducing the concern on presumed moral components. The value system of leaders and follower depends on the authenticity of leaders even in situations where clear universal moral standards are lacking. Before a trusted person can be marked as a leader, the follower must embrace such person using moral legitimacy to that particular leader (Sidani & Rowe, 2018).

Findings have shown that followers that rate their leaders as showing more open dialogue, also rate themselves as someone engaged more in their work. Therefore, the awareness of a leader's integrity depends on the relationship. A third-party follower performance has a good relationship to the engagement of such follower (Vogelgesang *et al.*, 2013). The engagement performance of third-party ratings of follower is positively related (Aaldering & Vliegenthart, 2016; Vogelgesang *et al.*, 2013). Research findings indicate that effectiveness of a leader is not necessarily an expression of irrationality, although leadership effectiveness remains strong.

Effective performance of a leader is important in order to study the competence of a leader. The position of a leader's traits in relation to performance and ability has been largely neglected. Vogelgesang *et al.* (2013) studied the theory of character-competence entanglement which shows the link between character and competence over a period of time. The utmost level of entanglement has a profound and more persistent connection. This has jointly reinforced effect among a highly advanced leader characters and advanced leader competence, whereas when it comes to low entanglement the character of a leader can be activated for a limited period in a certain context to help fortify the relationship between performance and competence. The main suggestion from Vogelgesang is that high character-competent will turn to extraordinary performance as time goes on. Additionally, character-competence entanglement relies on natural occurring learning favourable circumstance and the process of learning-by-living in organisations (Vogelgesang *et al.*, 2013).

Integrity is a moral concept although it is fundamental but not totally exclusive as presented in leadership. A leader's integrity is instituted on values which is identity-conferring commitments. It has to do with ethical meaning which identify the cognitive important structures to avoid confusion surrounding integrity quality (Bauman, 2013).

2.8 Summary

This literature study provided a review of women in leadership position and factors that inhibit or enable career success. There is a sharp difference in women in STEM in Africa compared to their equals in separate part of the globe.

This work enjoins all stakeholders on how the burden of women in STEM can be reduced using an equal learning environment. It informs us of the different coping methods women in STEM leadership have used to sustain their position in leadership. It also stresses the various biases and stereotypes women in STEM face in an African context.

In comparing present day organisations which are flat and less hierarchy in nature to the traditional organisations, women in leadership positions are often collaborators, conciliators or builders in those organisations. They are motivated leaders with flexible leadership styles which at the long run be good for the organisation. It is imperative to make and maximize great policy for the good of female and other stakeholders in STEM.

CHAPTER 3: RESEARCH METHODOLOGY: RATIONALE AND APPLICATIONS

3.1 Introduction

This chapter will discuss the methodology used in this study in alignment with the research questions. This study uses a qualitative approach to study women leadership success and roles in STEM in Africa. Quantitative methods may be inadequate to connote the precise leadership success and roles (Avolio *et al.*, 2009; Bryman, 2004; Parry *et al.*, 2014; Pratt, 2009), because the deeper meaning and experiences of leaders within a particular context cannot be determined through quantitative but through qualitative methods (Creswell, 2009). The phenomenology study used a self-administered open-ended questionnaire with female STEM researchers from North Africa (Egypt), West Africa (Cameroon, Ghana, Nigeria), East Africa (Sudan, Uganda, Kenya, Rwanda), and Southern Africa (Malawi, South Africa, Zimbabwe). This permitted the exploration of how female managers experience their progression in leadership success in those African countries.

The methodology and rationale stated include the process of obtaining the informed and relevant ethical consideration. Outlined below are the study context and research design, participants' selection approaches, data collection and analysis methods.

3.2 Research Paradigm and Study Design

The study followed interpretivism paradigm, which is also called phenomenological philosophical paradigm, to understand STEM in Africa. According to Levy (2006), interpretivism explores the complexity of social phenomena with a view to gaining understanding. It also allows the research to be on understanding what is happening in a given context, thus, this study sought to understand women leadership success and roles in STEM in Africa. In addition the phenomenological paradigm was used in this study mainly due to the novelty of the research topic in female leadership in Africa, consequently the researcher feels that a qualitative approach would be appropriate to test for detailed levels of understanding, an approach which would make way for other strategies to the study. The researcher also chose the phenomenological methodology because this paradigm seeks to describe and translate the

meaning of phenomena, an objective that the researcher values especially with an exploratory study of this nature (Collis *et al.*, 2003)

The study followed explorative research design. As Wild and Diggines (2013) posit, exploratory research is necessary when more information and insight about a problem, opportunity or phenomenon, and especially to collect data that can contribute to more meaningful research questions. Moreover, the explorative research design helps to collect data that is required to address the research questions in this study. For example, more information is required to understand how female leadership roles and successes in STEM in Africa.

Considering the findings of Welman *et al.* (2005), the way in which information is gathered from research participants can be viewed as research design. Additionally, Kumar (2019) ascertained that research design encompasses the way information will be obtained, analysed and deduced. Hence research design is the pillar of the whole research since it provides levels and guidelines to be considered throughout the study. The study employed a qualitative research approach with an interpretive philosophy. Individual contextual meaning with self-reflexivity was stressed in this qualitative research. Via open-ended self-administered questions adopted, pieces of information were gathered, data were analysed, and emergence of patterns was considered and compared with theories that are already in existence (Creswell, 2009).

3.3 Population and Sampling

In homogenous populations as was the case in this study, the participants are all female in leadership positions within the STEM field, thus a lesser number of samples will suffice. An average of one woman is envisaged to be involved in the study per African country so it was possible to have 54 women in all if we could access all countries in Africa.

The sample group for this study consisted of female STEM employees who are working in positions of leadership in research institutes and universities in 54 African countries; however three countries in central Africa could not be accessed.

In this study, the unit of analysis included all females who occupy leadership/senior management positions in the 51 countries in Africa. The systematic process of choosing cases

for inclusion in the study from interested participants in the population is referred to as sampling.

A non-probability, purposive and convenient sampling strategy was used. The unit of analysis of this study possess experience similar to that of the central phenomenon, which is an African women leader in STEM (e.g., Dean, Director, Head of Department, etc.) in STEM institutions in 51 African Countries.

Forty-two (42) responses were returned unspoiled from 12 African countries. Participants were from four geographic zones of Africa: North, West, East and South. The participants were from North Africa (Egypt), West Africa (Cameroon, Ghana, Nigeria), East Africa (Sudan, Uganda, Kenya, Rwanda), and Southern Africa (Malawi, South Africa, Zimbabwe). No participant could be traced from Central Africa. The participants involvement ranged from science education, engineering, health sciences, physical sciences, biological sciences, to allied sciences, hence different histories, and vocation with 42 years (Standard Deviation = 20.695) of professional expertise on average. Additional demographic data is shown in Table 4-1 – see Chapter 4.

3.3.2.1 Inclusion criteria

The participants in the study were carefully chosen to be African women leaders in STEM and thus qualified to be participants in the study.

3.3.2.2 Exclusion criteria

Those who were working as part-time or visiting fellows of the organisation, those who had less than two years working experience in STEM, top managers with less than five years working experience and male employees were excluded from participating.

3.5 Data Collection

Possible participants were reached and requested to be part of the study. Contact was made by email, telephone calls and tête-à-tête discussion (during the researcher's visit to Kenya, Nigeria, Rwanda and Sudan in 2018).

A self-administered open-ended questionnaire (See Annexure A) was used to collect data. The questionnaire consisted of three sections:

Section A - Declaration

Section B - Demography

Section C - Seven Open-ended questions

The main part of the questionnaire (Section C) was an open-ended self-administered questionnaire that covered questions concerning leadership success and roles in STEM. Further questions focused on their own leadership style, characteristics, challenges, and transformational experiences. Each questionnaire also addresses demographic and job-related information. The questionnaires were administered on-line through email. Interviews could not be done with individuals because of the busy nature of the calibre of participants, the non-availability of time, the bureaucracy to penetrate their offices, and the dispersed geographical locations on the continent of Africa. Bearing this in mind, biases or any other issues of ethics were not condoned to have any effect on the study. The questions were broad enough to afford the participants flexibility to answer according to their idea and perspective. The questionnaire consisted of a demographic part to describe the sample group and seven main open questions for narratives (Refer to Annexure A). The participants were considered as instruments of data collection that facilitated the researcher to acquire answers to her questions since the goal of the research was to get responses from the participants. The structure of the research questions made it possible to obtain precise purposed, useable data collection for the study (Saunders *et al.*, 2007).

For the process of obtaining informed consent (See Refer Annexure B) an information letter seeking the consent of individual women who decided to take part in the study was specified on top of the self-administered open-ended question questionnaire. The letter outlined information to be considered through the period of the investigation and included the protocol of North-West University.

3.6 Data Analysis

Qualitative data analysis is an art involving documentation, conceptualisation, coding and categorising, probing relationships, visualising data and validating conclusions; the information to be analysed are text and not numbers. There are no specific testing of variables and hypotheses in as qualitative analysis (Morrill *et al.*, 2000).

The information gathered were in the form of transcripts by the participant (Mero-Jaffe, 2011; Poland, 1995), received as email attachments. Concept analysis was done by organising/categorisation the written scripts into concepts by observing the commonality, peculiarity and uniqueness in the tone of responses revealed in the narratives. For the connection of the data to show how one concept may impact another all data were taken apart (deconstruct) and finally put back together (reconstruct) in a more meaningful manner.

Pattern categorisation provided contrasts and comparisons in the data and assisted the researcher to focus on complex threads of data and to investigate it deeper (Polkinghorne, 2005; Thomas, 2010). Subsequently, qualitative analysis is not once-off action, but a continuous and iterative process which demands that the researcher always reflect on the data that has been attained ensuring trustworthiness.

3.7 Trustworthiness

To ensure highest data quality, the researcher followed the analysis in a guided manner. In the results obtained from this study, consistency and accuracy of the total population presentation were ensured (Ochs, 1979; Poland, 1995).

3.8 Ethical Considerations

The researcher is obliged to follow several ethical considerations during various phases of the project work. Ethics are principles, rules or procedures that control and endorse moral acceptability or unacceptability of a particular behaviour (Leedy & Ormrod, 2001). It was noted that the participants were assured privacy and anonymity throughout the study. Ethical clearance was provided by the NWU ethical committee. Informed consent was sought from all participants.

3.9 Summary

In this chapter, the study design and the approach were outlined. It gave adequate information of the study context, research sample, the data collection, the data analysis method and the ethical considerations observed by the researcher. Thus, making study design important because it provides levels and guidelines to be considered in the study. The study employed a qualitative research approach with an interpretative philosophy through administering of open ended questionnaires with forty-two respondents from female STEM researchers in Africa. A non-probability, purposive and convenient sampling strategy was used. The unit of analysis of this study possess experience like that of the central phenomenon, which is an African women leader (e.g., Dean, Director, Head of Department, etc.) in STEM institutions in 51 African Countries. Qualitative data analysis is an art involving documentation, conceptualisation, coding and categorising, probing relationships, visualising data and validating conclusions. Trustworthiness and ethical considerations were also put into consideration by the researcher. Chapter 4 will indicate the analysis, present and discuss the findings from the research.

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CHAPTER 4: RESEARCH FINDINGS

4.1 Introduction

In this chapter the results of the data analysis are shown below. Specific research questions were used and the research findings are presented.

Demographically, the participants belonged to diverse posts and designations in their organisations as lecturers, professors and researchers in combination with being either a dean, head of department and principal officer. Their qualifications were MSc, PhD or equivalent. This 'Phenomenology study is a qualitative research method that is used to describe how human beings experience a certain phenomenon. It allows the researcher to delve into the perceptions, perspectives, understandings, and feelings of those people who have actually experienced or lived the phenomenon or situation of interest'

4.2 Organisations in STEM and participants' profile

Participants' expertise ranged from science education, engineering, health sciences, physical sciences, biological sciences, to allied sciences. A graphic illustration of the participants' countries is depicted in Figure 4-1. Participants from Kenya, South Africa and Nigeria are prominent in the study because the research got the opportunity to be there in person. These are areas that are good representation of East, Southern and West Africa.

Participants totalling forty-two were from East, North, South, and West Africa with East Africa having participants from Kenya, Rwanda, Sudan, and Uganda while Egypt was the only country that participated in North Africa. Participants in Southern Africa were from Malawi, Lesotho, and South Africa. Similarly, participants from Benin, Cameroon, Ghana, and Nigeria represented the West Africa region. The demographic of the participants was based on designation, education, years in leadership, and age (Table 4-1).

Of the forty-two respondents, nineteen participants are in management position such as dean, director, and head of department. Thirty-four respondents have the highest academic qualification (PhD). Twenty-three respondents have 2-5 years' experience in leadership

position while the highest number of participants, fourteen in number, are between the ages of bracket of 45-54.

Table 4-1: Demographic table (Designation, Education, Years in leadership, Age)

Item	East				North	South			West			
	Kenya	Rwanda	Sudan	Uganda	Egypt	Malawi	Lesotho	S. Africa	Benin	Cameroun	Ghana	Nigeria
Designation												
Dean		1						1				1
Director	2					1	1	5				3
HOD	1							1				2
Professor					1			1	1		1	4
S. Lecturer	2		2					1		1		2
Lecturer	3			2								2
Education											1	
PhD	6	1	2		1	1	1	6	1	1		14
MSc	2			2								
BSc/BTech								2				
Diploma								1				
Years in Leadership												
2-5	5	1	2	1		1		6		1		6
6-10	2			1			1	1	1		1	5
11-15												3
16-20	1				1							
21-25								1				
Above 26								1				

Age												
18-24												
25-34								1				
35-44	2			2	1			2	1	1		4
45-54	3	1	1			1	1	2				5
55-64	3		1					3			1	4
65+Older								1				1
Sub-Total	8	1	2	2	1	1	1	9	1	1	1	14
Total	42											

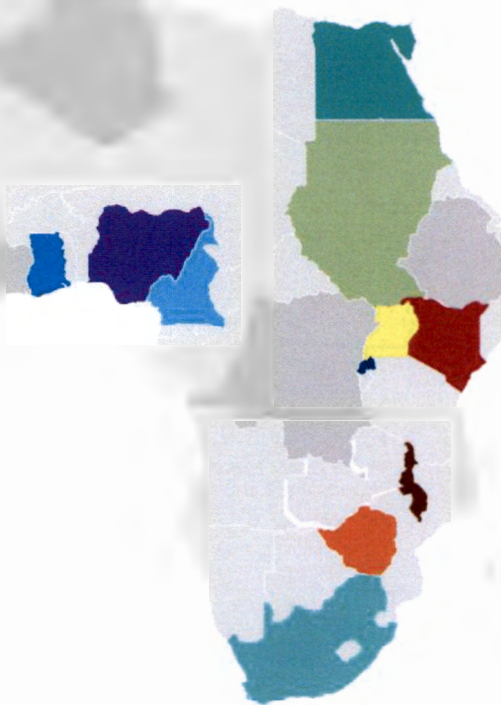
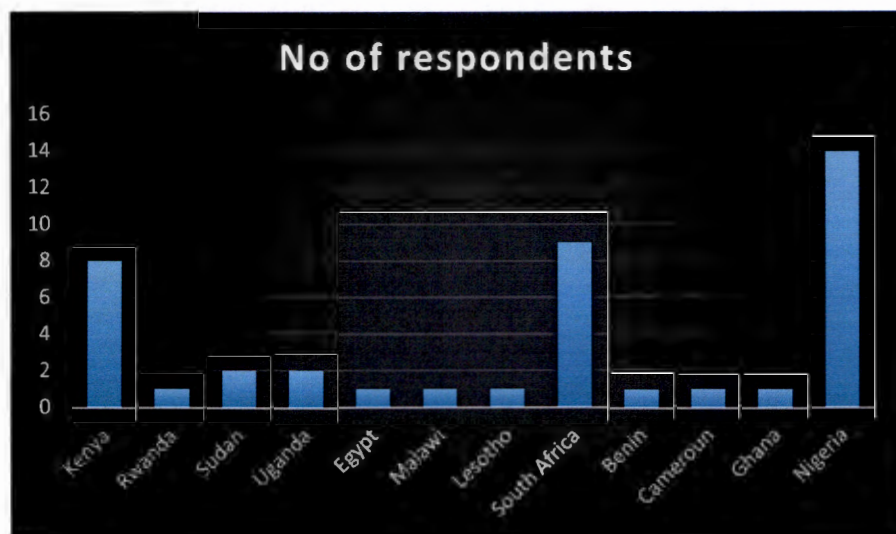


Figure 4-1. Participants and countries: Above shows participants were from North Africa (Egypt), West Africa (Cameroun, Ghana, Nigeria), East Africa (Sudan, Uganda, Kenya, Rwanda), and Southern Africa (Malawi, South Africa, Zimbabwe). No response was received from Central Africa. (Source: This work).

4.3 Addressing research objective 1: To investigate the career path, and sources of inspiration of women in STEM towards attainment of leadership positions

In this section the following –sub-research questions will be dealt with...

4.3.1 Career path and the attained position

4.3.1.1 Scholarship

Some of the participants' career paths (depicted in Fig 4-2) indicated award of full **scholarship** from basic school to university level as a result of meritorious performance. For an example,

“during my high school education, *I topped the class* and some guys arranged to beat me up. As a result I could not join the pure mathematics class because I was the only lady who opted to do that course” (P1/Ghana/55-64).

4.3.1.2 Organisational structure in place

It was found many women rose through the career path as a result of **supportive organisational structure in place**, e.g. from being a high school teacher for seven years to becoming a section head. In many other instances they started as a junior lecturer or assistant lecturer (depending on the country) but got promoted through the ranks until becoming a professor after earning their masters and doctorate degrees.

Furthermore, many saw the doctoral degree as the benchmark to their career path.

“I got employed as an assistant lecturer. I rose through the ranks until 2012 when as a senior lecturer; I was made the Students Industrial Work Experience Scheme (SIWES) coordinator for the Crop Science and Technology Department in Agriculture and Agricultural Technology School, in charge of all years two and four students, totalling about nine hundred students. (P36/Nigeria/35-44)

“*Armed with a PhD* my career was therefore a default - I am a lecturer and researcher – and the leadership position as the Director of the School of Environmental and Health Science the position was advertised and I responded to an advertisement” (P27/South Africa/65-74)

“I started as a *nursing student and rose to become Head* of Department of Nursing” (P5/Nigeria/45-54)

“My career started as a part-time assistant instructor (2009-2011) in which I succeeded to demonstrate my teaching skills. *After completing my PhD in 2011, I got a permanent position* as a Lecturer in one of our private universities what is unfortunately out of my resident town (Yaounde). So, I needed to travel for about 8 hours by car per week to keep in touch with my family. Later on, by the grace of God, I got the same position in the public university in my resident town and I felt like out of the gear. I vigorously continued working with the same motivation defining my goal to attain. A year later, I was promoted as a Senior Lecturer resulting on all works I have done in a year relating to research and teaching. Then, time to time, I started to be involved in some administrative services and since 2014; I am the one in charge of discipline, survey and evaluation of the classes in my department. I am working now to improve and complete the requirements to apply for the associate professor grade. However, the way is still far and I trust in it despite” (P40/Cameroun/35-44).

Many attested to the fact that the present position started with being Head of Department through an **appointment**. Another seemingly obvious path is via institutional or organisational restructuring processes. In addition, others got into their occupied position through standard application after applying for advertised positions and being interviewed, while a few others were posted to act in another institution.

This study attempted to find out the career paths of the participants and how they attained the positions they currently have. The majority of the participants indicated that their career paths started whilst **working in an academic institute**. The following statement captures aptly how the career paths of the participants started:

“I started as a junior lecturer. I then studied for my Masters and PhD and *was promoted through the ranks until being a Professor*. I became acting dean through the restructuring process and then applied and got the position of Deputy Dean”. (P3/South Africa/55-64)

Similarly, other participants were in line with the following:

“I started as an assistant lecturer and rose to become professor. During the course of my career I have been doing administration and consultation work for organisations within and outside Nigeria” (P5/Nigeria/45-54).

The above extracts testify that the **level of education influence the career path for women**. Women occupy leadership positions in the Education Department because of the level of schooling and skills they possess. The above extract shows that some superiors act as role models and mentors in the work place, hence influencing the career paths of their subordinates.

4.3.1.3 Personal effort

In certain instances, female appointment was based on their **being approachable** and their ability to work with everyone. A number of people who rose through the career path in STEM affirm that they ended up in academia because they had nowhere else to turn to for employment.

“In my final year during my 1st degree, **I represented my group** in class to present a group term paper during which our lecturer said ‘our future lecturer’. I put in for my Masters programme immediately after National Youth Service Corp because there was nothing else to do. My performance in this encouraged me to put in for Ph.D. After this I got a job as a lecturer II. In my department I was made the exam officer and secretary of some committees and now Head of Department” (P4/Nigeria/45-54).

It has been mostly by **personal efforts** with practically no mentorship and with a lot of ups and downs, self-discipline, dedication, determination, academic excellence, aggressive research, international research exposures coupled with passion to be at the forefront. The women were busy with a series of teaching, student supervision, contributions to community development, publication of research findings, administration responsibility and consultancy with several national and international organisations, academic invitations and scientific visitations on personal recognition, membership of many professional bodies in Britain and American among others. Simultaneously some women attained the position they occupy because of their availability to volunteer in their organisations.

“**I worked hard** to ensure that I did not miss any promotion and so rose to the rank of associate professor through normal promotion exercise. I am a fellow of Science Teachers Association of Nigeria (fSTAN) due to different contributions and leadership roles I played in the organisation” (P25/Nigeria/65-74)

After one year, due to **commitment, hard work and tenacity**, I was appointed the coordinator of SIWES for the entire school comprising seven (7) departments; totalling about three (3) thousand students” (P36/Nigeria/35-44)

“I am very interested in applied Biomathematics field of research I have begun studying in this field **by my own efforts**, self-supporting and ability to skip over the restricted constraints and limited resources” (P34/Sudan/45-54)

“**I am the first** female head of my Department in its more than 50 years of existence and also, the first female Professor”. (P5/Nigeria/45-54)

“First, second and third degree in Computer Science with six children born within this time of study. It has not been easy but God saw me through” (P30/Nigeria/35-44)

“My association with Conservation Society was incidental and **I have never looked back** since I became part of the whole initiative because it has really expanded my horizons” (P8/Nigeria/45-54)

Individuals emphasises the role their attainment of **PhD** played in their career development.

“It has not been easy especially from the men who feel STEM is there area. My position came about as a result of being the highest qualified person in the Department i.e. one with a PhD” (P16/Kenya/55-64)

“My career path started as a secondary school pupil where I excelled in science subjects. I moved on to the university where I did well and made up my mind that I will be a university teacher and went ahead to study till I attained the PhD” (P19/Nigeria/55-64)

“After completing the PhD studies, I got employed as a lecturer. After 2 years, I was elected to be a Programme Leader. Overseeing the curriculum, guiding students, taking care of the examination processing and making sure all courses are being taught” (P28/Kenya/45-54)

“I finished my compulsory National Youth Service and got married immediately in 1992. Same year, I started my Master’s degree in Crop Protection. Soon after resumption of studies, I got pregnant and my husband persuaded me to take a deferment. I had the baby in 1993, nursed him for a while and went back to school. After one year late, 1995, there was strike action by lecturers and the universities were shut down. I became pregnant again and when schools resumed, I had to take a second deferment to carry the pregnancy full term, deliver, nurse and wean the child. I later resumed my

studies and in all, I spent seven years before I obtained my M.Sc. in 2001”
(P24/Nigeria/45-54)

“After joining university for undergraduate studies, I did not like the course I was admitted to (i.e. Bachelor of Education). Therefore, I vowed to work hard and ensure I attain the highest qualifications possible in education. After graduation, I was posted to teach in a secondary school in Kenya. While teaching I enrolled for Masters. I again continued teaching in secondary school for 3 years after Master’s graduation. The position of assistant lecturer was advertised in the university I did my masters. I applied for the post, interviewed and thereafter absorbed to teach. The condition for the job was that one needed to pursue a PhD, as a result I enrolled for the programme immediately and that was is how I attained my PhD” (P26/Kenya/35-44)

On self-reflection a number of individuals mentioned they lobbied their ways up the career ladder. Contrary to the above another extract captured indicated that women’s career paths are influenced by their mentors.

“Motivated by a Professor from secondary school and my sister a PhD holder”.
(P7/Nigeria/35-44)

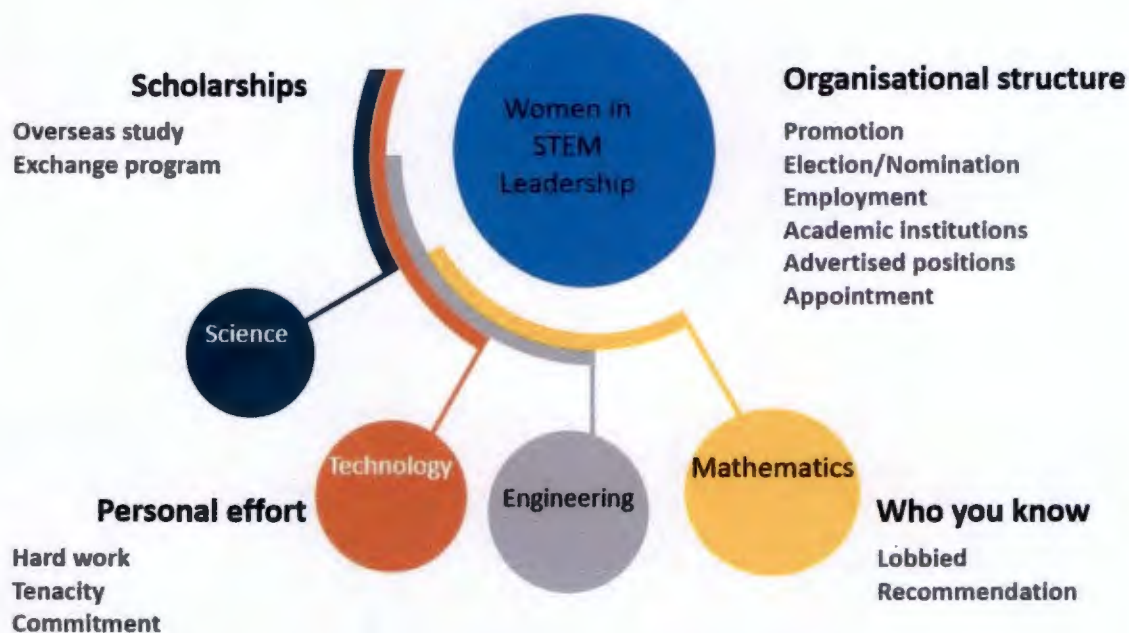


Figure 4-2. Career path and the attained position: Scholarship, organisational structure in place, commitment, hard work, tenacity, and appointment all formed tools to women’s career paths and their attained positions (Source: author’s own work).

4.3.2 Sources of inspiration of women in STEM leadership journey

In the leadership journey the participants became inspired at various stages of career development from as low as secondary school days to diverse professional heights.

Generally, motivations were from **senior professors**, family members in stem, mothers, fathers, husbands, high school principals, master’s supervisors, doctoral supervisors, mentors, vice-chancellors, deans of college, post-doctoral fellows, international scholars and **senior colleagues** who came on sabbatical placement.

“One of my female colleagues in the same field who was also my lecturer in master degree and unconsciously she also plays the role of a mentor to me”
(P40/Cameroun/35-44).

“My **husband** was/is my mentor. He was a widower, much older than I and already a Senior Lecturer when we got married. He encouraged me to reach for the highest academic qualification. He also wanted me not to be content with just being a housewife and a high school teacher, which I did for one year, 1998/1999” (P24/Nigeria/45-54)

“My **PhD supervisor** inspired my leadership journey. She was a lady and while I pursued my PhD studies, I was given a lot of responsibilities in the Department. I was in charge of the laboratory and all the students coming to the institute for industrial attachment. She was the Director of the institute where I carried out part of my research work” (P28/Kenya/45-54).

Admittedly, with the exception of fathers and husbands (mentor in some instances), participants claimed the bulk of their inspiration came from **women** in the above listed positions. For instance,

“Dr CM inspired me as she was a woman in ICT and at that time she told us that though it was a male dominated field, women can also make it if we try harder. She appointed me as a class representative and appointed me as a student assistant helping her in class”. I loved the way she interacted with all the people regardless of social and cultural background. She was able to create for herself a niche in the education arena. She is the founder principal of a government girl’s school adjacent to the State House and rose in ranks to become a Director of Education. She exhibited very high levels of integrity while she worked her way up” (P12/South Africa/25-34).

Nonetheless, a few mentioned they were inspired by **male colleagues** (note: not father or husband).

“Having woman role models who also mentors young women can help those aspiring to get into leadership positions. Mentoring can also be provided by males occupying senior management positions” (P33/Lesotho/45-54).

In contrast to the above some of the participants indicated that they drew inspiration from the books they read and having self-belief that they could achieve anything they wanted in their lives.

Albeit in many other cases they mentioned they were **self-made** with no inspiration from anyone! Common to these people are personal motivation, strong command and agility to successfully maintain excellence in STEM. Specifically, they believe in self.

“My journey was so difficult but I have learned how to struggle to pass through difficult nodes” (P34/Sudan/45-54)

“First believe in myself and then my family” (P35/Sudan/55-64)

All the above are captured pictorially in Figure 4-3.

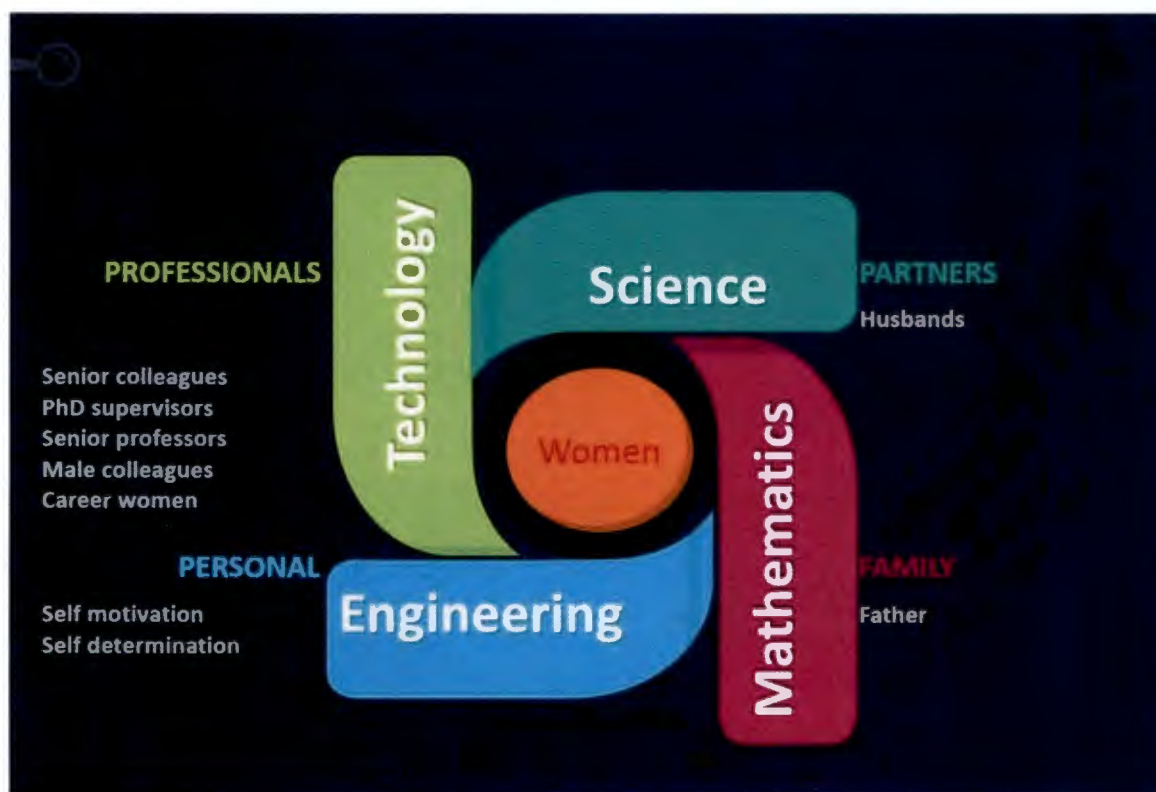


Figure 4-3. Sources of inspiration of women in STEM leadership journey: Senior professors, senior colleagues (male and female), husbands, PhD supervisors, and the personal self, stand out to be sources of inspiration for women in their STEM leadership journeys. (Source: This work).

4.3.3 Women leadership style

The following are some of the leadership capabilities obtained from participants: Leadership by example with humility, firmness, outspokenness, teamwork, inspiring others, being consultative, collegial and trying to reach consensus, flexible, free and mentor/mentee interaction, goodness, trying as much as possible to work and share ideas with those having the same inspirations.

Other leadership styles include being:

“democratic though strict, charismatic and never autocratic, encouraging team work, applying a servant-leader formula, being firm, tolerant, patient, persistent, of a cheerful persuasion, not coercive, transparent, dictatorial when necessary, not too bossy in decision making, networking, embracing suggestions from members, being goal driven (P13/South Africa/45-54), flexible, but definitely not laissez faire, communication is key, establishing quality environment to encourage effective and efficient ways of meeting the departmental objectives, vision and mission. Leadership styles ranged included democratic and visionary, free and interactive, leadership by example with humility. The above testifies that humility is one of the key qualities of successful leaders. Apart from the above some specified that they used a democratic way of leadership in their work place. Some of the responses captured in relation to the style of leadership used by women in work place were

“Working as a team can gain useful ideas” (P35/Sudan/55-64)

“Depending on the situation and the type of problem to solve, I could apply the participative style in which all partners are involved in the decision making; or the authoritarian style by just giving directives on what to do and how to do” (P40/Cameroun/35-44)

Contrary to the above, others indicated that they have adopted an **autocratic leadership style** in their organisations. For example,

“When a decision/work takes long to be done, I dictate on who need to do it and how it has to be done and when it must be accomplished” (P21/Kenya/35-44).

Besides the above leadership styles other contributors highlighted that they have used a mix of leadership styles (P8/Nigeria/45-54 and P22/Kenya/45-54).

4.3.4 Important aspects of being a woman leader

Divided feelings and opinions were expressed by the participants in regards to the influence of organisational culture on leadership ranging from ability to motivate employees, mentoring, good working conditions, personal growth of employees, humility and being goal driven. The following remarks (Fig 4-4.) were captured to support the theme

“Inspiring others, motivating the people who you work with and appreciating everybody. Trying to bring the best out in people and enabling them to do their jobs. Making people happy by rewarding them not punishing them -- mentoring and imparting knowledge on success, growth and improvement of both individuals and the organisation” (P5/Nigeria/45-54).

“I am interested in rising up younger generation and future leaders of women in science who keep the banner flying and thus taking the system to higher levels, demonstrating mainstreaming in STEM as a woman and encouraging networking among women scientists” (P10/Nigeria/55-64).

“To direct in a respectable way and make others to feel important. Including others in decision making, being supportive to their contributions and respecting their ideas” (P9/South Africa/55-64).

“Honesty, accountability, transparency and integrity. Being consistent humility and remembering that there will always be someone better than you and keeping my people happy all the time” (P26/Kenya/35-44).

“I don’t perceive myself as a “woman” but as a professional (employee) who’s able to carry out any professional assignment and duties like any other employee of the organization. I try to avoid stereotype on how I have to carry myself as a woman at work” (P33/Lesotho/45-54).

“Help and improve our societies using a scientific procedure” (P35/Sudan/55-64).

“It is important to me to make some accomplishments not only for my own interest, but also for the interest for people around me. This motivates me in the role of leader and push me to find a way for success.” (P40/Cameroun/35-44)

The following are some identified factors or qualities which are important to leaders. Such factors include inspiring and motivating people who work with you, growth and improvement of both individuals and the organisation, bringing the best out in people to enable them to do their jobs through reward and compensation, being ready to help and influence mentees, and being consistent and leading by example through honesty and integrity in whatever one is doing, with these in place, the society will change positively. Summing this up from a participant's response, she asserted:

“My interest is in encouraging networking among women scientists and mentorship of the younger ones, ensuring good working relationship with others, able to reproduce success (also P13/South Africa/45-54), goal achievement, drive for team spirit, improving and streamlining way of doing/solving issues, honesty, accountability, transparency and integrity and the ability to take charge of affairs in the establishment as the head” (P14/Nigeria/25-34)

Finally, leadership provides a wider scope of audience and influence and it affords an occasion to fashion the way people think and lives. Hence, if utilised properly this brings change to the society by show-casing hidden talents, to maximize efficiency and achieve the organisational goal.



Figure 4-4. Defining successful leadership in STEM

4.4 Addressing research objective 2: Investigate characteristics of successful and effective women leadership in STEM

Participants stated what a successful leader meant to them. To some, having a **desire to find a scientific solution to a problem in the community** and the joy of finding the solution will define a successful leader. Also, successful leaders are able to find alternative solutions, they are problem solvers even though it may be challenging in the midst of men. Additional requirements are the ability to design and execute context – specific problem-solving research while upholding international standards, ability to produce required results, making the results sustainable and also build capacities, causing the system to progress to a higher level. Such a leader also needs to be proactive, being determined to pursue goals despite all challenges and still is able to mentor the younger ones successfully. She should be creative and easily navigate through challenging situations, a good negotiator and be worthy of emulation.

“When results of anticipated objectives are realised” (P48/Uganda/35-44)

“A successful leader should be able to embrace diversity (cultural and religion) without bias, through networking, being creative and a good negotiator. They must be determined and focused to attain the goals of the organisation” (P2/Malawi/45-54)

“Being open to new ideas, and listening to other whilst encouraging teamwork and enabling others to perform their work” (P2/Malawi/45-54)

“The person who is qualified to be able to manage a group in pushing and motivating in a positive way the members to achieve a certain defined goal. I possess soft skills like generosity, kindness, gratitude and empathy, I am also a good listener and emotionally intelligent enough to be an effective leader. *I can make a mistake but that is what I think*” (P40/Cameroun/35-44).

“Being determined to produce required results, making the results sustainable and build capacities despite all challenges and is still able to mentor the young ones successfully” (P7/Nigeria/35-44)

The above excerpts confirmed the qualities that a leader must possess to be successful in an organisation. Leaders must be in a position to work with different people who come from different backgrounds (culture, race and religion). Furthermore, leaders should demonstrate good communication skills. Hence they must be willing to receive new ideas and use communication strategies to influence the workers to work together. It also showed that leaders influence their workforce; hence true leaders must have followers. This is confirmed by the extract below gathered from the participants:

“Successful leadership in STEM is when the followers are cooperating with the leader and the leader on the other hand inspires the followers to achieve greater heights. It is for this reason that successful leadership is indicated by the willingness of the workers to perform their work efficiently and effectively without being coerced” (P25/Nigeria/65-74)

“They must be **visionary, determined and focussed to attain the goals** of the organisation sticking to one objective and aiming to achieve it within a stipulated time frame. The leader should allow those in the Department to work freely and produce results. Similarly, successful leadership in STEM is the ability to coordinate, harness resources to achieve set goals and being able to deliver on my mandate within the stipulated time and in the right way” (P20/Nigeria/35-44).

But another participant says: “I cannot definitely define because leadership is relative and depending which organisation you are and who you are leading” (P27/South Africa/65-74).

On the other hand, for a woman leader to be successful according to a participant:

“She needs to be encouraged and she too needs to enable other people to perform their work because leadership is successful when the followers (subordinates) are cooperating with the leader and the leader on the other hand inspires the followers to achieve greater heights. She should be able to work together with others as a team, carry others along so as to get to the peak of the career. Similarly, successful leadership to me is the ability to lead others through to their success in career and life generally and being able to make one’s followers become successful. She is one who has risen through the ranks and made it to the peak of her career. Such a leader should be knowledgeable and at the same time open minded to new ideas, and encourages collective decision-making” (P21/Kenya/35-44)

In contrast, another participant asserted:

“I think for me you have to be a leader, also known as participative leader or shared leader. Members of the Department have to take a further participative role during the process of making choices and put it on the table for everyone to have a view” (P12/South Africa/25-34).

“Such a leader should be a mentor, a motivator and a pacesetter to the followers. She should be ready to mentor and pass on the mantle to the next leader, good at networking and being **able to guide and support young scholars in the field** of mathematics. Successful leadership in STEM also being able to reproduce herself in terms of bringing up other young students (especially female), who look up to you for guidance while being focus and productive. It is also the ability to impact on the lives of young network and to help them make meaning of their lives” (P22/Kenya/45-54).

“STEM is becoming the most important area that feed the collaboration of science and technology. So, successful leadership in STEM will enhance women efforts towards development” (P34/Sudan/45-54).

4.3.2.2 Characteristics of an effective woman leader in STEM

To start with, some are of the opinion, that it has to be innate, a number of people suggested that their strong faith in God brings assurance that they have ability in Christ who gives strength to do all things and with the resultant grace to so do.

According to others, confidence, resilience, paying attention to details, teamwork, problem solving, diligence, determination, ability to relate to people, good neighbourliness, listening ears, ability to work through a large amount of administration efficiently, leading by example, showing no favouritism, efficient self-management, time management, task management, resource management, **hard work, being democratic, authentic, innovative, investing in peer network, being a builder are key characteristics** (Figure 4-5) that make an effective leader. Also, good communication skills, ability to listen to others no matter what their view/opinion, the insight to identify and harness resources, open minded to new ideas, negotiation skills, being good at networking, a go-getter, persistent in pursuits no matter the time taken, being firm, bold, taking up challenges that may come their way especially with respect to carrying out research in a difficult terrain.

Additional characteristics listed are strong will, determination to succeed no matter the odds, not allowing discouragement from anybody, respect for people's opinion, listening to people's suggestions and utilising those which are useful, encouraging subordinates to always aspire to achieve higher, and patience. One of the participants buttressed the above points by saying:

“I take in team work and I always use the method of cooking in the kitchen: i.e. getting all the ingredients and making a good soup” and the other said: I don't think I possess them yet, but I will like to develop the skill of listening and ability to present boldly my research findings” (P7/Nigeria/35-44)

“Undoubtedly, the ability to undertake multiple roles and thinking in interdisciplinary research contribute to making an effective leader in STEM. These include honesty to colleagues, fairness, courage to ask anything even if it is uncomfortable for other colleagues, creativity in terms of ergonomics and functions/workshops and making the office lively, competence, empathy, adaptability, social intelligence, integrity, being

positive, proactive, determined and allowing freedom of exercising individual initiative within some limits” (P13/South Africa/45-54).

Consequently, as reported by one of the participants:

“Today, this has yielded positive results as I have five of my former students already completed their PhD in STEM related courses in several countries around the globe; two others are presently on their PhD, while others are doing their M.Sc. Two of my former students are presently lecturers in my Department in the university” (P24/Nigeria/45-54).

In summary, the respondents put the emphasis on humility, love, being principled and steadfast in whatever one set out to do, being focused and resilient, self-disciplined, setting goals and planning and then pursuing them carefully with prayers. On the other hand, the following qualities are needed: prioritised goals, being current, social, tenacious and refusing to give up in the face of challenges.

“Knowledge gain application, research performance application, collaborations with the others interdisciplinary approaches” (P34/Sudan/45-54),



Figure 4-5. Characteristics of effective women leader in STEM (Source: This work).

4.3.2.3 Values, goals and strategies that appear in women STEM leadership roles

Some of the values that women mentioned were filters, growth, self-actualisation, esteem from others and self. The participants highlighted that their values, goals and policies are noticeable in their leadership in the following ways: By being involved in the day to day departmental activities, delegating duties to others, maintaining good communication skills, showing respect and leading by example, discerning the motives of different individuals, being patient, good listeners and respecting diversity.

Additional values, goals and strategies include honesty both in terms of finances and in dealings with people as well as setting goals and encouraging others to go along, listening to other people's opinions and adjusting where necessary, sharing responsibility and encouraging others to be part of the leadership team.

Some were of the opinion that staying focused and being competent in whatever they do and being able to participate in coming up with solutions in solving societal problems were some of their values that have manifested in their leadership role. For instance, these values

manifested by them being honest and loyal to the organisation and being accommodative as they lead people from various countries with different socialisation backgrounds. Another person said: "One of the expectations in my profession as a lecturer is to work towards being high up in the ladder since one must strive to become a professor and take up big leadership roles in the institution. In order to achieve this, one must be focus, have goals and strategies." Thus, she concluded that the leadership at her level was working towards the goal at the end.

In addition, they also include being a role model to people under their authority. In particular, one of the participants said: Through mentorship and the followership received so far and also the responses of the mentees *manifested in her commitment to people, research, career and family*. Other values include driving research, fitting resource people into research/project based on merit and working in a team to make things work, through positive outcomes from my supervisee and change in their job and attitudes, encouraging the upcoming young researchers to key into mentorship.

Others also asserted that striving for the truth, upholding integrity, financial integrity and accountability, and sometimes making hard decisions that may not be favourable to workmates have also manifested in other peoples' leadership role. Specifically, some said:

"I uphold honesty, hard-work and never procrastinate." (P18/Nigeria/55-64).

"The desire to achieve desired goals, both short and long term, propels me to involve anyone who is likely to contribute in one way or the other in the team. This strategy helps out in the long run as the synergistic effect of the team brings about faster and more result-oriented achievements. By so doing, members become empowered and potentials become released, innovations and inventions become created. Similarly, the system and its environment become sensitised. Moreover, the organisation becomes advanced, progressive and eventually impact gains recognition from higher authorities" (P10/Nigeria/55-64).

4.5 Addressing research objective 3: Explore the common challenges, biases or stereotypes faced by women STEM leaders

4.5.1 Challenges faced in position by women as a leader in STEM

Most of the participants in the study mentioned (see Figure 4-6) gender discrimination as one of the main challenges that they face as leaders. This they suggest might have an effect on their roles as leaders in their organisations. They highlighted that they face gender discrimination from males and females. This is supported by the extracts below:

“Males say negative things about me sometimes, insubordination by some male counterparts under my leadership” (P1/Ghana/55-64)

“Women who are negative towards other women and are talkative and will always talk behind your back with the intention of pulling me down” (P9/South Africa/55-64)

“Being underrated, looked down on and being side-lined when crucial/hard decisions are to be made because I am a female” (P21/Kenya/35-44)

However, some of the participants expressed that they face other challenges which are different from the above. A few of these difficulties being confronted by women holding leadership positions are failing to unite the work force as they come from different **cultures** and have different **religion/spiritual background**. Below is an extract that captures some of the challenges faced by women in relation to culture and religion/spirituality;

Apart from the above difficulties confronted by women, a number of the participants indicated that time management, **lack of cooperation from other workers**, lack of backing from fellow women and vague understanding of the vision and objectives by workers are some of the challenges that women in leadership face.

“Lack of cooperation from colleagues is an issue especially when they want to underestimate my capability” (P20/Nigeria/35-44)

“Have to rearrange the family demands with that of the job. I must work for long hours and travel quite often” (P3/South Africa/55-64)

“I haven’t personally experienced any hindrance at any organization where I held a leadership position. However, I have realized that other family roles, especially as a

single parent, can clash with expectations from management. This is very common where a woman in leadership has to work long hours, absent from home for a long period of time and lacking extended family support. Personally, boarding school has been the best choice in making sure that I don't feel guilty of giving my child less attention" (P33/Lesotho/45-54).

Women in STEM generally face numerous challenges in upward movement. In particular, lack of cooperation from colleagues is an issue especially when they want to underestimate one's capability, being under-rated and looked down on, being side lined when crucial/hard decisions are to be made. Also, **envy**, **conspiracy** and opposition from colleagues' especially senior ones are serious challenges.

Again, the "seeming" **insubordination** from older male subordinates is also a big problem, especially the challenge of some men wanting to intimidate women at the initial stage of headship. Indeed, male counterparts sometimes said negative things about women, while others show insubordination under women's leadership. One of the participants asserted:

"Men do not regard me and they see me as a threat so I am always not flowing with them" (P23/Nigeria/55-64).

Actually, women who are leaders also face the challenges of jealousy from colleagues, negative talkative women, intimidation from senior colleagues and lack of support from other women in leadership. A woman said: "Getting people to understand one's vision and objectives of working in interdisciplinary research" (P8/Nigeria/45-54) was a challenge.

Furthermore, other challenges include: combining the **weights of family responsibilities** with the demands of the official job, the challenge of raising children while studying and working and the fact that society does not recognise these contributions to keep our society sane. According to a participant: "I have to be at work for long hours and to travel quite often, discrimination, not having same level ground to contest for anything, the opposite sex who are my colleagues feel intimidated, then comes the need of having to combine family responsibilities with giving birth to children and house care" (P6/Nigeria/45-54) and another participant categorically emphasised family responsibility (P13/South Africa/45-54).

“My main challenge is the balance between work, travelling and family care which are not always understood by all members of our senior staff” (P40/Cameroun/35-44)

In brief, women face the problem of how to contend with *jealousy* from various quarters, lack of sponsorship and empowerment, shortage of research equipment due to financial constraints, men getting higher salaries than women whereas both did the same job, working with people who are lazy and time wasters wanting to please the boss through maligning other members, lack of resources, people’s unsatisfactory nature (especially women), lack of political will by policy makers to implement policies as the need be, ethnicity and religion, level of involvement in policy formulation in some organisations, lack of team spirit from the medical team and the introduction of new methodology in any field of knowledge.

Finally, the following are assertions made by three participants concerning challenges that they face in their positions as leaders. Firstly:

“I was taught to see challenges as hurdles to be crossed to achieve goals. Therefore, have always programmed myself to handle things as they come”. Secondly: “I have not experienced much challenge in my leadership position in STEM. This may be because I make the people I work with to feel involved in whatever we do together, that way they never get to feel they are being used”. Thirdly: “Challenges I had been the ones common to any gender – but which I was always able to confront with the backing of the Dean and the support of the University especially male colleagues, I found it very easy to confide in them than to women and off course prayer!” (P20/Nigeria/35-44)



Figure 4-6. Challenges faced in position by women as a leader in STEM (Source: This work).

4.5.2 Biases or stereotypes encountered by women in STEM position as a leader

On the question regarding the biases or stereotypes encountered by women in their leadership positions, the majority of the women intimated that they have encountered gender prejudice. The following extracts captured from some of the participants indicate it:

“Voting for the positions of Dean first time. Some males refused to vote for me. Some were jealous of my rapid progress both at work and in church” (P1/Ghana/55-64)

“Man do not value decisions made by women especially if they are from the same race” (P2/Malawi/45-54)

“They do not expect me (a woman) to know how to fix the network or work with technology. People equality believe that women positions should be below after men” (P12/South Africa/25-34)

“Implicit bias related to the gender and the grade. Sometimes, people think that I am not qualified enough to be involved in a certain decision making” (P40/Cameroun/35-44)

The above attest to the widely available literature that women are not widely recognised as leaders as society gives them the responsibility to keep the home, whereas men are responsible for providing stable finances for the family. This is indicated by some of the extracts captured below:

Cultural view of men in my society that women should not issue instructions to them.

“The biggest stereotype promoted by some women is that when a woman holds a managerial position, they should start behaving and acting like men. Women are made to believe that they should toughen up and lose their femininity. Women are emotional and sometimes make irrational decisions; women like fighting and gossiping. Women are their own enemies.” (P33/Lesotho/45-54)

Indeed, the **biases or stereotypes** women may have faced as a leader in STEM may stem from the cultural view of men in my society that women should not issue instructions to them. Another, stereotype especially by men is that women are incapable and always require to be assisted.

According to one participant: “I relate to other people on an equal footing and I have not experienced problems as a leader” (P6/Nigeria/45-54). This is in contrast to another participant: “Junior male colleagues do not want to recognise one’s authority and are not ready to take instructions. Many times they try to plot my downfall while other colleagues are unnecessarily aggressive towards transformation in STEM and current trends in research. They are too comfortable reinventing the wheel and doing next to nothing.”

On the other hand, one of the participants said: “Not much and probably because in the institution that I work for, most of the leaders and bosses are ladies and so to have a lady leader is normal” (P28/Kenya/45-54) and another participant simply wrote “none” (P13/South Africa/45-54).

4.6 Addressing objective 4: Assess the organizational culture which facilitates or hinders women leadership style in STEM

4.6.1 Transformational experiences that have changed leadership of women in STEM

The researcher sought to find out what has transformed women in their roles as leaders.

One of the participants said she set clear and smart goals followed by frequent examination of the progress of work and making changes where necessary to achieve the goal.

Another said: “Being a mother makes me more aware of other people’s needs and willing to listen to their points of view” (P3/South Africa/55-64) while others said that determination, being resilient, not giving up, turning every opposing power into fuel to continue and seeking help from others who may have had such experiences in the past were helpful.

Further: “I always think ahead and also raise my head in the board room. The ability to analyse and process information proactively and thinking out of the box is also additional experience or a factor to consider. Add to these are ability to incorporate more of trans-disciplinary and inter-disciplinary research than pure and basic sciences, networking across the globe, working with people from across different cultures, appreciating different viewpoints. The above points are not only transformational, but also bring people together” (P16/Kenya/55-64).

“I have learnt from short courses outside STEM which I incorporate into STEM research, I decided to be strong and still involved them in everything I do but being watchful of them not to destroy what other people who have gone higher, I learn from previous works as well as inputs and criticisms from others” (P10/Nigeria/55-64).

“The admiration I have for successful women in STEM over the world constitutes for me a source of motivation that makes me believe that I could do better to achieve my goal. I attended a workshop for women in science in 2015 in Trieste where I met ladies who got the Elsevier prizes and suddenly decided to review my position as a leader and doubled the effort to succeed. This allowed me to perform lots of things on the professional point of view since then” (P40/Cameroun/35-44)

The above points are not only transformational, but also bring people together. However, some have also learnt from encounters with women superiors with vindictive natures while others said they have to be neutral and not allow personal feeling to show.

Notable are the statements that good leadership and fairness provided by current Executive Director, being focussed, being determined to make it, being disciplined were some participant views. However, participants also stated that not everyone will support your drive for success and not everyone wants you to succeed as a leader.

“It should be noted that in our deeper most selves we are all the same! We have the same fears, same challenges, the difference being how one faces those fears and how one tackles those challenges, dealing with people with different characteristics” (P27/South Africa/65-74).

Furthermore, one of the participants reported that as a school Coordinator, she was faced with the challenge of facing up to male colleagues when she insisted that some students who cheated during the Industrial Training Scheme must repeat the academic year. Since it was an issue that was based on integrity and principle, she insisted that these groups of students must repeat. Her male colleagues expected her to give in, but after explaining her intentions to them, they supported her and this singular act earned her their respect. However, sometimes mistakes were made and from those mistakes she learnt to improve while believing in herself.

Another person said that when she successfully defended her Master’s thesis and passed, she realised that she was as capable and just as good as any other person including men. Ever since, there was no turning back. Her other experience was being able to deliver in the tasks assigned to her on time and in the right way, and that this was appreciated by her seniors.

One of the participants similarly said: “knowing that being a leader, I understood that I must be a driving force and must carry everybody along (selflessly) having been given the opportunity to lead and also to attain academic development which have equipped me to perform maximally in my field” (P30/Nigeria/35-44). Another said her transformational experience came by changing the mind-set of some individuals.

In addition, collaboration work, external communications, the experience of being responsible, knowing that it is not always right to push responsibility onto another person, the mind-set of whatever is worth doing at all is worth doing well, not giving excuses to shun away from

responsibilities, dealing with non-cooperative individuals were responses obtained from some of the participants

However, since working with young people can be challenging, one of the participants said she has been accepted and encouraged, learned to be patient and at the same time firm. By contrast, another lady said: “Seeing young people that you mentor succeed in science” has really transformed her.

In summary, the women revealed that being empathetic, having determination, being visionary, having discipline, self believe, patience, being humble, respectful, authoritative, supportive and loving at all times has helped them to be good leaders.

4.6.2 What professional environment is like to women in STEM

The participants expressed different opinions and feelings in regards to the professional environment that they are currently working in as women who are in leadership positions.

To start with, one woman said that currently because of the high position she held, her colleagues show her a lot of respect. They also need her services particularly with PhD supervision so she is often involved in providing advice to most PhD students and review of scientific papers for publications.

Another person said there is an understanding that men and women have equal abilities and sometimes women can do better than men, and she finds there are quite a few women in the professional environment which she finds quite welcoming and conducive, even though some environments are harsh. Her professional environment is seen as friendly now because of the support from senior colleagues thereby making it habitable. It is conducive even though it is rugged, rough, tough, challenging, ugly and it is an environment for hard-work and multitasking. In particular, an academic environment is very accommodative when compared to a private sector environment where dog eats dog. In addition, the supporting structures (available or provided for growth) really help.

By contrast are responses that indicated that the professional environment is not favourable to women and does not take into cognisance the peculiarities associated with women and the enormity of the responsibility they carry in addition to the requirements for professional excellence – it’s truly a man’s world!

This environment is discriminatory as men cannot accept women in leadership, probably because most members are male. This may be because a high percentage of men are resistant to women attaining leadership positions and consequently women are relegated as not too high achievers.

On the other hand, such an environment may not be conducive professionally in terms of facilities and equipment and consequently the true potential of individuals is never truly tapped, due to perennial problems of lack of basic laboratory equipment and reagents leading to frustration in research.

“Talking about professional environment in terms of collaboration, I would say it is friendly and the networking is opened. However, talking in terms of facilities, I am always in trouble while thinking about my project or my research because of the lack of facilities” (P40/Cameroun/35-44).

“Collaborative/collective responsibility” (P48/Uganda/35-44)

“I am working/studying in a quite nice environment where I as a woman have value and voice when needed. However, there is still sometimes where a job is not assigned to you mainly because you are a woman. It is funny but there are always lots of gossiping around when a woman achieve something but I don't really care about it” (P47/Cameroun/25-35).

Additionally, the professional environment of STEM sometimes appears naturally tough, tedious, and not easily accessible, and there can be sexual assaults and so it requires courage and extra effort to breakthrough. This is why women are scarce in STEM because of their natural limitations.

4.6.3 Impact of organisational culture on women in leadership

Divided feelings and opinions were expressed by the participants in regards to the influence of organisational culture on leadership. The following themes emerged from the participants: rituals, routines, control systems and stories. One of the women responded by relating her experience in Ghana as follows: “The laws of Ghana promote the use of female on all boards and therefore being a scientist, I am overwhelmed by the call to serve on so many boards that

needs scientist. Too many offers that I cannot meet all of them facilitate -- the organisation provides mentoring courses" (P1/Ghana/55-64)

Furthermore, others were of the view that they prefer to be more flexible and not to have too much red tape and that the organisational culture actually facilitated their leadership because it believed in its philosophy. Added to this, the organisational culture encourages one to bring out the best in its staff. Sometimes the organisational structure treats everyone as a man, some positions cannot be occupied by women while some are meant for women because they are women. Others were of the view that it helps them a lot and their organisation culture facilitates leadership because it is a woman leader in charge with few men under her leadership.

On the other hand, some do not depend on the organisational culture since it does not facilitate or hinder their leadership and therefore they feel unstoppable no matter what structure is in operation. Furthermore, although male dominance may hinder leadership and sometimes opportunities are not equally shared, one still has to press forward not minding what happens.

To be specific, in a university system, things are quite organized and move in their normal order and once you do not see yourself as being a woman but as someone who has a responsibility to fulfil, nothing can serve as a hindrance. Also, one's capability and pedigree will always facilitate one's growth. For instance, academic credentials have a higher say in determining whether you could be a leader in the organisation or not.

One of the participants reported as follows: "My organisation do not hinder leadership, but support staff in leadership position and because of the culture of my colleagues at work, the framework of the organisational culture does not discriminate against women leaders. On the contrary, it encourages female participation in leadership roles. Most of the discrimination stems from individual perception" (P35/Sudan/55-64)

"Sometimes decision making is not easy because of bureaucratic procedures" (P48/Uganda/35-44)

"Academic credentials have a higher say in determining whether you could be a leader in the organisation or not. I have therefore been able to look out and create my own space of influence out of the organisation. In Kenya for instance there is affirmative action to ensure that in leadership positions there is equal opportunity for each gender. This has ensured that more women are now given leadership positions and has given

me opportunity to prove that I am capable to deliver on my mandate” (P26/Kenya/35-44).

“The organizational culture facilitates my integration in my institution and allows me to be more confident by being friendlier and understanding” (P40/Cameroun/35-44)

A South Africa participant said: “I was born and raised in Soweto where the community is mixed (all cultures included) and therefore that freedom of knowing that we are all human beings first before you are a Zulu, Xhosa or any tribe, helped to break barriers of culture and the fact that I speak most South African languages including Afrikaans is a strength in my leadership. In addition, the institution facilitates leadership in that from the top most bosses is a woman, and most of the Departments have woman leader or boss encouraging our growth as women leaders. It facilitates when the organisation is supportive and hinder when some unpalatable bottle necks are brought in play that may slow down the pace of work. Thus, the organisation believe so much that whatever a man can do, a woman can do much better. So that has given opportunity for women to be in key position in the system” (P27/South Africa/65-74).

Contrary to the above some extracts indicate;

“Male dominance hinders leadership. Sometimes they do not give me equal opportunities as men, but still I press forward not minding what happens. Sometimes they deny me some rights but I was hesitant and not discouraged. I keep moving forward. Men are preferred because of the culture of the people I work with” (P23/Nigeria/55-64).

4.7 Discussion of Core Findings

The core findings are discussed and reflected against literature.

4.7.1 Career path and the attained position

Recent research in the Information Technology (IT) sector (Kirton & Robertson, 2018) found that women’s career path was affected by institutional or organisational inequalities where some jobs are designated men’s jobs. In this study, one of the participants explained that the

inability of the female to read and understand mathematics was because her classmates were male and they actually bullied her. Researchers such as (Griffiths & Moore, 2010) ascribed that the dearth of women advancement in IT careers might be due to the failure of IT employers to address the issues endangering women's career appropriation. Actually, no response showed any influence of IT on women's career path but that achievement in career progression has been through scholarship, personal efforts and motivation.

Accordingly career paths and progress for women, particularly in academia, result from the level of individual productivity especially with regards to publication (Lerchenmueller & Sorenson, 2018), and inability to publish papers could lead to women dropping out of academia, and thus may affect the career pathways. This means a lot of hard work, tenacity, self-determination, personal effort, commitment and hard work on the part of women, which some of the participants pointed out were the result of their career attainment.

Furthermore, a Palestine study Erdreich, (2016) found that university studentship career pathways led to career progression after university education. This author also found that family structure is a major factor influencing career path on returning home after university education. Socio-cultural factors influencing women's career, includes family, pregnancy and marriage structure. This agrees with the narrations of some women participants where one had to defer her admissions twice to pursue Masters and Ph.D. programmes because of pregnancy. Others noted that combining career and family upkeep, which is more or less women's duty, was not an easy task.

The quest for self-discovery and independence is also noted (Erdreich, 2016) as another factor that shapes women's career paths. Erdreich mentioned that experiences and transformation from university education tend to separate educated women from non-educated ones. Those experiences thus motivate their career path. University education changed their ideologies, and the need to keep identifying with those ideologies, thus defining their career paths. These are in agreement with the results obtained in this study and may attest that their doctoral education has been a stepping stone for them as it distinguishes them from their colleagues.

Finally, research by Christensen *et al.*, (2014) found that interest in STEM by students resulted from their quest to work with people in meaningful ways, with the interest associated more with professionals in STEM than their peers. This means that the career path was sharpened by motivation from STEM professionals. This line of thought was captured by some participants.

As one participant stated that after presenting group work the professor called her 'a lecturer' and so she continued her masters after graduation until she finally became a lecturer in the same school.

4.7.2 Inspiration in the leadership journey

According to some of the participants, their spouses inspired them, which is in alignment with the findings from the research of (Ocampo *et al.*, 2018). They explained that since mid-career is a period with serious life and work demands such as raising children and other house hold responsibilities, therefore career success results from perceived social support such as spousal and workforce support as the career individuals are also embedded in social relations.

More so, research (Palumbo, 2016) emphasised the role information and guidance can play in encouraging employment of female graduates. Such roles include offering of trusted information to disabuse biases against women career employment. The findings of this research confirm the possibility of information biases in terms of employing women and even in giving them leadership posts, as expressed by one participant.

Ceci *et al.*, (2009) highlighted the low rate of women involvement in STEM was blamed on motivation. In dissecting what comprises motivation, they said it was the school and family. Some participants mentioned that fathers and husbands inspired their choice for STEM. Aeschlimann *et al.*, (2016) noted that though they attributed motivation to school and family, they ignored the design of instruction for STEM as part of the motivation. Such instructional motivation in STEM includes enlightenment about career opportunities, ensuring comprehensive teaching of Mathematics and sciences for students. The result of this research concurs with the statements of some of the participants that their Ph.D. supervisors inspired their leadership journey.

4.7.3 Definition of successful leadership in STEM

Appraisal of science development in Africa indicated several successful achievements in science building capacity. However, there are still instabilities in the foundations and graduates of science due to poverty (Irikefe *et al.*, 2011). In a bid to determine gender disparity in STEM, a recent study Vial *et al.*, (2016) explained that women usually have a tougher time in leadership than men. This was captured by the result of this research, as male ego,

insubordination and family responsibility make career and leadership for women really very tough (Vial *et al.*, 2016).

The result obtained in this research showed that leaders need to be outstanding in order to be successful. And to be outstanding such leaders should exhibit charisma and pragmatism (Griffith *et al.*, 2015) as also outlined by participants in this study. Women leaders should display many emotional tactics which can be utilised in influencing their followers, as the emotional constitution of each leader distinguishes her. The research of Çekmecelioğlu & Özbağ, (2016) confirms the assertions by the participants that successful leaders must intellectually influence their followers. This is because as they do so, they stimulate the followers to be creative. The participants noted that a true leader is an individual who influences the followers to perform given duties and take actions when necessary (Gumusluoglu & Ilsev, 2009).

4.7.4 Characteristics of effective women leaders in STEM

Information gathered testifies that effective leaders need to show empathy towards their subordinates. They need also to be honest to their subordinates and show integrity in their activities when dealing with different employees hence this will eliminate the suspicions of favouritism. These traits enable women to be great and effective leaders in their working environments. In addition, leaders need to listen and be dynamic and allow subordinates to express their ideas, hence giving an opportunity for generation of new ideas.

Emotional intelligence was captured by the participants to be such leadership virtues as being authentic, innovative and a builder among others. This is in accordance also with an earlier study by some researchers (Maree *et al.*, 2006). They described emotional intelligence as a set of abilities which are found to have direct effect on leadership ability. As participants mentioned, a leader has to be democratic and this is supported by recent research (Mayer *et al.*, 2017). An aspect of emotional intelligence is emotional quotient which they said comprises of the ability to manage stress, adaptability and general mood. For a leader to be democratic, she must be able to manage stress and adapt to the opinion of others even when contrary to hers.

Leaders who are transformational in character usually inspire people following them to align their interest to that of the organisation even in extreme events (Eberly & Fong, 2013) as equally demonstrated in the gathered information from this study. Hede, (2001) defined a leader as having the capacity to influence others to achieve a certain goal. This represents the

participants' attribution that a leader must command followership. Results from this research among the characteristics of a leader include ability to encourage subordinates to aspire to achieve higher, ability to listen to other peoples' suggestions and leading by example. This agrees with the work of Holmes, (2005) that suitable behaviour modelling and responsibilities distribution will help a mentee to develop and respond to career improvement. He also noted that mentoring which is gender relevant, should be remarkable in stylistic flexibility and wide verbal repertoire.

4.7.5 Challenges women faced in position as a leader in STEM

Resource distribution disparity incentivizes men and women differentially (Ronay *et al.*, 2018). Though the goal of the present study is not focussing on the differences in the gender of leadership, however it may be interesting to know that men differ from women in leadership.

The phenomenon called queen bee is a state in which women are leaders in organisations controlled by males and infuse themselves into the male world by distancing themselves from female juniors, thus encouraging gender inequality. Derks *et al.*, (2016) agreed with the participants' responses that some challenges women leaders face is non-cooperation from older women. Besides, it was reported that insubordination is more associated with women leadership than male (Vial *et al.*, 2016). Also as suggested in this study, women's leadership elicits less respect and so it is harder for them in leadership. Insubordination from junior colleagues worsens the leadership hassle for women in leadership and thus could possibly lead to anger and inappropriate responses to subordinates.

Obstacles encountered by women leaders in South Africa were noted as wrong perceptions about women's leadership, lack of support from women's groups, the distance in-between women leaders and followers and also gender mechanism that is dysfunctional (Gouws, 2008). Some of these were expressed by participants as hindrances in women leadership in STEM.

A female leader positive gender identity reduces identity conflict in women leadership, consequently helping in stress reduction and increases life satisfaction (Karelaia & Guillén, 2014). They also found that positive leader identity, although it increased women's willingness to lead, also increased identity conflict. Some participants listed some negative gender identity which made their career and leadership very hectic.

For example, black women are generally negatively evaluated for their organisational failure over black men or white women, and all are negatively evaluated over white men in organisational failure. In terms of organisational success, all categories are evaluated equally. The assertion is that for a black woman in leadership, there should never be failure (Rosette & Livingston, 2012). No participant mentioned any story about failure, but one mentioned that she sees challenges as hurdles to be crossed to achieve goals and so she has conditioned herself to handle challenges as they come.

With regards to challenges women face in leadership, Eagly and Heilman, (2016) noted that discrimination as a result of cultural orientations relegates women behavioural attributes, thus making this a serious challenge. This was also reported from this research. Some women also shared their experience of disrespect from subordinates and even those in higher offices because they are women. Also, Meister *et al.*, (2017) researched on how women navigate misinterpreted actions and found that with time and power, the women leaders become less salient.

4.7.6 Biases or stereotypes encountered in position as a leader

Women exposed to women's groups or colleges or female to female mentoring produced less automatic stereotype behaviour than those women who went to mixed schools or were mentored by males (Dasgupta & Asgari, 2004) and the same was proven from this research because some of the participants said they never experienced automatic stereotype behaviour because the institution they worked for had mostly female leaders and bosses. This is in agreement with the findings of Dasgupta and Asgari, (2004) that when women are exposed to female mentors or attend female colleges, they express less stereotypic behaviour especially if the women mentor portrays iron butterfly characteristics.

Some researchers ascribed the success of leadership to gender role in the society (Johnson *et al.*, 2008). This is because female leaders' success depends on ability to be sensitive, while males only require strength to achieve success. This confirms one participant's response that her inability to become the Dean of Faculty was because the male folk refused to vote for her on the reason that she would not have enough strength, while others attribute slowness to women.

Some participants pointed out that they were emancipated from cultural views of men concerning inability of women in leadership through leadership qualities they exhibited. Some

men believe that women are incapable of leadership. Leadership abilities, women can surmount these problems. Accordingly, it is necessary to have women in leadership to enhance prosperous and civil society (Hoyt & Murphy, 2016). They also stated that effects of stereotype threats on women depend on their ability to develop leadership qualities.

Stereotypes of emotion present two navigations women have to handle, with respect to what kind and how much emotion should be displayed (Brescoll, 2016). The researcher also promulgated that a significant barrier for women leaders ascending and succeeding in leadership is the gender stereotype of emotion. Stereotype of emotion could be bad where anger and pride are displayed as means of ascendancy but even insensitive women may also fail to fulfil their warmth role as women too. The participants noted some stereotype behaviours that could lead to anger or expression of negative emotion, which if not guided could result in leadership failure. Tiessen, (2008) found that it's not enough for women to get into leadership, but their continued sustenance in male dominated institutions is always a threat due to the gender unfriendly work environment among other threats. This agrees with the participants' submission that even being voted for are having one's contribution valued by men is a problem.

Findings from research of a 2007 survey on Gender Equality carried out by the South African Commission reported that more than 30% of people who participated responded to an opinion that the emotional traits in women cannot afford them to handle positions that are of high-level of leadership (Commission, 2007; Gouws, 2008). Usually a narrow-minded ideology would support women's capacities to perform well in leadership positions. Nonetheless, a lot of responses from the participants of this study said that women cannot cope with a job that is of high-level of leadership. This is erroneous because the participants in this are leaders in different fields and have shown a lot of competence.

4.7.7 Several transformational experiences that have changed women STEM leadership

Audenaert *et al.*, (2018) noted that challenges bring more satisfaction to an employee which agrees with the participants' submission. The same author also noted that expected contribution of employees in relation to the leader is a major factor of job satisfaction. On the part of the employee, when the employee's expected contribution aligns with the leader's expected outcome, there is job satisfaction.

Rus *et al.*, (2010) subscribed that accountability is a factor affecting self-serving in leadership, while it does not strongly affect low power leaders.

4.7.8 Values, goals and strategies manifested in women leadership role

It was observed that women in STEM leadership place a premium on including others by delegation, sharing responsibility and encouraging others to be part of the leadership team, maintaining good communication skills, setting goals and encouraging others to go along, listening to opinions from others and adjusting where necessary, respecting diversity and leading by example, discerning the motives of different individuals, being patient, and creating opportunities for young people to explore the world and share their research.

The women value truth and integrity of heart and purpose. These include financial integrity, accountability, and integrity in decision making which may sometimes involve making hard decisions that may not be favourable to colleagues. Integrity of heart is about thorough mentorship and good mentor-mentee relationship.

They have these to say:

“Members become empowered and potentials are released, innovations and inventions become created, the system and its environment become sensitised, the organisation becomes advanced and progressive and impact gains recognition from higher authorities”

“The desire to achieve desired goals both long term and short term, propels me to involve anyone who is likely to contribute in one way or the other, in the team. This strategy helps in the long run as the synergistic effect of the team brings about faster and more result-oriented achievements”.

“Being loyal to the organisation and accommodative as I lead people from various countries and different social backgrounds helps me to be the best that is possible. The staffs make me go an extra mile in making my assignment completed”

“Honesty, hard work, never procrastinates. Commitment, research, career and family. Driving research, fitting resource people into research. Through positive outcomes from my supervisees and change in their jobs and attitudes, having goals and strategizing and working towards the goal at the end”.

The women value going up the ladder, becoming a professor, taking up big leadership roles in the institution through focus, rendering selfless services which make followers feel at home and give maximum support.

4.7.9 What the professional environment is like to women in STEM leadership

Some participants mentioned that support from senior colleagues made the working environment habitable and friendly, while others said the environment is not favourable to women because it does not take cognisance of peculiarities of women including their enormous task at home (Audenaert *et al.*, 2018).

Amidst women in STEM (Szelényi *et al.*, 2013), interaction of women among diverse peers especially at the tertiary institutions facilitated enlargement of expectations of professional outcomes. These professional expected outcomes include anticipation to secure a noble job, accomplish a successful career and also a combination of a career that is professional and possessing a personal life that is balanced. Another study Stout *et al.*, (2011) agreed with this research finding that exposure of women to female STEM professionals promotes positive influence towards their identification with STEM. Women developed their self-concept better with female professionals.

Effects of a welcoming academic environment on science identification of women were earlier researched (Ramsey *et al.*, 2013). They came to know that in welcoming academic environments, students had more information about STEM women and were able to identify peer role models in STEM better than in traditional academic environments. Interventions and exposure are powerful tools in informing and retaining women in STEM.

The analysed experience of girls/women in different stages of their growing up and its effect on choice of STEM Dasgupta & Stout, (2014) concluded that in the recruitment, retaining and advancement of girls and women that are in STEM, an environment that is professional and conducive for learning and that fosters belonging is far more likely to be successful. This aligns with some of the participants that their working environment was part of their encouragement. Another study Gorman *et al.*, (2010) equally concurred to the above by saying that local and national STEM outreach programs strengthened the STEM workforce and education pipelines at many points.

The role of STEM in economic and social development (Burke & Mattis, 2007) was observed seriously and was given positive affirmation. Chronic stress as a result of discrimination, stereotypic behaviours and marriage/work interphase (Nelson & Quick, 1985) were earlier reported. It was observed that women who have to compete with a work setting that is dominated by men suffer chronic pressure. They Nelson & Quick, (1985) summarized that development of enduring mentor relationships that are supportive and functioning enhances her self-awareness and self-boldness. The woman who is professional can efficiently manage pressure and hence other women can learn from such a constructive role model/ideal. In addition, researchers King & Ferguson, (2001) emphasized the role of self-knowledge and mentoring as tools in communal building up of women. This is common to the findings in this study.

4.7.10 Leadership style of women in STEM leadership

Marchiondo *et al.*, (2015) described leadership as an interpersonal relational construct not just a formal top down construct as seen by academics and practitioners, thus making gender leadership perceptions affect leadership. This was also mentioned by the participants, that leadership is a relational thing which should showcase humility, firmness, outspokenness, and team work and inspire others, among other numerous features.

On the other hand, effect of feedback delivery on career development (Bear *et al.*, 2017) was found to be a negative factor affecting women's career development, a way to widen the gap between the leader and the subordinates. More so, the leader as the feedback delivery source may use it to victimize the feedback recipient. In our research, the participants discussed their own leadership style, in which they didn't mention any thing on feedback delivery.

A leader's self-awareness is an important tool to successful leadership (Taylor *et al.*, 2016) and leaders need to improve on this trait and find ways to improve their accuracy in predicting the positive impact they are having in their workplace. This is because it is important as a leadership capability tool and it helps boost their leadership outcome. These are attested by the finding of this research when the participants mentioned that, being aware that challenges are part of the system, one should not be destabilized when they come, which is part of self-awareness.

This study does not articulate with what one earlier study Patel & Buiting, (2013) found, that increasing numbers of women in organisational boards increases their diverse style of thinking,

thus assisting them to shape and affect the key gender behavioural pattern in their leadership style.

4.7.11 How organisational culture facilitates or hinders women in STEM leadership

Leaders with relationship oriented personalities affect their followers better in an organisation that is supportive (Phaneuf *et al.*, 2016). Leaders with determined attitude to support and cooperate are most likely to engage their followers better. This is in keeping with this study as it was mentioned by the participants that flexibility and not much red tape showed evidence of good leadership. This shows that they undertake relational leadership which is cooperative. Similarly, developing contextual, powerful and collective leadership dimensions is important for leadership when talking about race and ethnicity (Ospina & Foldy, 2009).

As (Vial *et al.*, 2016) recently also reported, females find it harder to elicit respect and admiration from subordinates and male colleagues. The participants also noted that male dominance hinders leadership and sometimes women don't have equal opportunities with men.

Ways in which academics should assist in supporting the retention of females after their university education were earlier proposed (Palumbo, 2016) and this is aligned with the findings of this research that men are preferentially treated with regards to employment. This will help in bridging this gap as Palumbo, (2016) proposed that leadership will be enhanced for women to grow into leadership in STEM or their chosen career. Women in the field of Agriculture in Southeast Asia appear to have an equal share of land, capital and other assets (Akter *et al.*, 2017), which is contrary to the conventional findings in some African nations. The participants noted that even jobs are unequally shared between genders.

Since economics and leadership are connected, these researchers suggested that economics should be integrated into leadership research (Zehnder *et al.*, 2017). The women leaders in their responses supported accountability as a tool in effective leadership. Accountability should also inculcate economies of money used during the process of leadership. Moreover, another study Parker, (1996) found that African-American and other women of race/color have less representative candidates in administration, which should serve as possible potential for experiences in leadership, and ought to be a motivation for leadership positions. In their review, differences in race and gender usually have influence on the strategies of leadership.

Establishments that have excellent worker relationships display substantially higher ranks of establishment value than ones whose workers show rapport that is poor (Lee & Kim, 2016). This agrees with the findings of this research that good relationship is key to good leadership.

4.7.12 Important aspects of being a woman in STEM leadership in higher education

Mentors are required for the continuity and development of research culture in Africa (Aidam & Sombié, 2016), where almost one out of four participants showed how research leadership is lacking. There will be an increase in research participation if there is investment in the improvement of research leaders in Africa as a possible and feasible long-term approach. According to Aidam & Sombié, (2016) the role of training and retraining in facilitating leadership performance is important for enhancing leadership.

The act in which a vision-driven revolution in followers is induced via a significant conversation between leaders and their workers is described as a transformational leadership (Bass, 1985). This has been linked to leader personality traits (Deinert *et al.*, 2015). Firstly, the obtained results indicated that there is direct connection between the Big 5 traits of personality and sub-dimensions of a leadership that is transformational and also to the whole measure and are not directly linked to the performance of leader. One of the leadership personality traits positively linked to transformational leadership was openness and this was also captured in this study.

Furthermore, as earlier reported Day *et al.*, (2014) a vibrant process comprising of various interactions that persevere over a period of time is a function of the development of leadership. This might be through the scrutiny of an array of elements which includes the following; personality, experience, skills, self-narratives and development, and social mechanisms. The development of leadership practice originates from a young or early age, and is partially impacted through the exhibiting of parents. Improvement and application of a diversity of expertise are involved which could be; creativity, intelligence and wisdom, and personality and relationships with others are the features responsible for shaping it.

4.8 Summary of Chapter

In this Chapter, the researcher presented the results as evidence quotes of participants in a logical form weaving them in a simple to read and digest format. The chapter coined the themes and discussed the findings in relation to the literature under each of the research questions as indicated by the analysis done.

Chapter 5 will conclude the study by providing a brief summary, contribution of the study, limitations of the study and recommendations from the research and managerial implications for African organisations in STEM.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

The conclusions arrived at in this study are presented in this chapter. In summary the data for this study were collected from the participants through phenomenology study that used open-ended self-administered questionnaires. Narrative research was the qualitative approach used: "Narrative is described as a text giving written or spoken account of an action of a particular event or sequential events which have chronological connection" (Czarniawska, 2004). This was adopted because it is the best yardstick that gives the lifetime experiences or stories of a particular life or a moderate number of lives of individuals in details. This study derived data from stories gathered from participants (also known as "field texts") about the individual behaviour of African women leaders in STEM. The data were analysed, by looking for codes, themes and patterns that emerged. These themes and patterns were discussed in the light of existing literature (Creswell, 2009). Qualitative research is best suited to the study of 'micro' phenomena (such as small group interaction) which gives helpful insights to discuss how individuals may navigate identity of asymmetries at work internally.

5.2. Attainment of Objectives

The four study objectives stated in Chapter 1 and listed below were all achieved as clearly stated in the previous chapter 4:

- 1) Explore the career path, and sources of inspiration of women in STEM towards attainment of leadership position
- 2) Investigate characteristics of successful and effective women leadership in STEM
- 3) Explore the common challenges, biases or stereotypes faced by women STEM leaders
- 4) Assess the organizational culture which facilitates or hinders women leadership style in STEM

In summary the following are indicative of findings related to the objectives mentioned above:

A common thread exists in the tone and life experiences of the African women leaders in STEM. The women all shared a passion for STEM. There are diverse organisations in STEM, however the majority of participants (96%) were from higher education institutions. Scholarship, supportive organisational structure, commitment, hard work, and tenacity were all experienced as enablers of their career paths and their attained positions. The level of education also contributed to achieving leadership positions. Senior professors, senior colleagues (male and female), husbands, PhD supervisors, and the personal self, stand out to be sources of inspiration for women in their STEM leadership journeys. Successful leadership in STEM is about a balance of career with family life, goal setting, problem solving, and openness to new ideas, embracing diversity, collaboration, STEM research expertise, and mentorship skills.

The study also found that African women leaders in STEM also still face enormous challenges of gender discrimination, family demands, insubordination, underrating their ability, conspiracy to put them down, lack of cooperation, cultural specific issues, and lower salaries. Many biases emanate from the view in some African societies that women should not issue instructions to men.

STEM leadership transformation experiences revolve around skills, boldness, determination, and being above standards. Among many other things, the values, goals and strategies women STEM leaders manifest include the desire to grow, self-actualisation, honesty, good listening skills, sharing responsibilities, staying focused, being a role model, driving state-of-the art research, striving for the truth, upholding integrity, maintaining financial integrity, accountability and hard work.

It is evident that women experience that they are less accepted than males in STEM leadership as the organisational culture still devalues women in leadership positions in a number of African countries. The role of a successful African women leader in STEM should be able to balance her career with her family and having a goal set for herself to pursue STEM as a career choice.

Additionally, the contribution of the study, the limitations, recommendations and managerial implications are referred to and a few suggestions for further research are made.

5.3. Contribution of the Study

This study showcases and demonstrates the strength of African women leadership in STEM. Their experience with very rich example provided insights in the disposition of African women's leadership within the context of STEM in Africa, which is often neglected. This study confirmed that gender disparity in STEM is real and that male counterparts have more opportunities for career advancement and promotions to leadership position.

5.4. Limitations of the Study

Some countries in Africa could not be accessed and possible participants were not prepared to voluntarily participate. Interviews could not be done with the sample group, because of the dispersed geographical locations on the continent of Africa. Doing proper interviews during the study would have produced a deeper knowledge of the perspective and responsive capabilities of the women as probing would have ensured deeper insights.

The study was conducted without input from international research institutions in Africa, which appoint women STEM leaders who could have provided additional data. It was a challenge to get people to participate most probably due to research fatigue and fear of being identified if they mentioned negative experiences as a result of the institution.

5.5. Recommendations and Managerial Implications

It is suggested that more research is done on leadership and socio-cultural barriers in order to help African women in STEM be rightfully prepare for leadership.

Managers and Organisations related to STEM in Africa should take cognisance of the peculiarities associated with women and the enormity of the responsibilities they carry with regards to equity in professional excellence. Making working hours flexible, especially for young mothers and single parents and providing support at work in the form of play schools can also assist.

There should always be a follow up on how well a leader is performing, and the organisation should not be too inflexible, as management does not equal managerialism.

Women should feel unstoppable no matter what organisational structure and culture is practiced. Communication and discussions on challenges preventing women to take on and practice their leadership role in STEM should be encouraged in STEM organisations.

5.6. Final Conclusion

The current study concludes that women in STEM have pains, the way up is crooked and stressful. Self-determination is a must and the support of partners, mentors, family member and such like cannot be underestimated in the leadership journey. Successful leadership is more than occupying a position, it is about solving community problems and mentoring upcoming scientists. In summary, the same challenges experienced by African women in STEM were found across the African countries sampled.

Annexure A: Questionnaire

The self-administered open-ended questionnaire has three sections:

- Section A - Declaration
- Section B - Demography
- Section C - Open-ended questions

Please complete all sections after you have provided your full consent.

A: Declaration

By participating in the study, you declare that you are fully informed of the purpose of the study and thereby give permission that:

The information given herein may be used for research purposes without identifying you as an individual.

The data obtained for this study, combined with other data on the topic, will be used to write academic articles and conference papers.

B: Demography

1. (a) Post or designation in organisation:
(b) Highest qualification?
(c) Years in leadership position?
(d) Citizenship?

2. In what country do you work?

3. What is your age?

- ☐ 18 to 24
- ☐ 25 to 34
- ☐ 35 to 44
- ☐ 45 to 54
- ☐ 55 to 64
- ☐ 65 to 74
- ☐ 75 or older

C: Open-ended questions

4. In what type of organisation do you work in STEM?

5 (a) As a woman in STEM, tell me about your career path and how you attained this position

(b) Who inspired you in your leadership journey?

<p>6 (a) How do you define successful leadership in STEM?</p> <p>(b) As a woman, what characteristics do you possess that make you an effective leader in STEM?</p>
<p>7. (a) As a woman, what challenges have you faced in your position as a leader in STEM?</p> <p>(b) What biases or stereotypes have you encountered in your position as a leader?</p>
<p>8. (a) As a woman, what are some experiences that have transformed or changed you as a leader?</p> <p>(b) How do your values, goals and strategies manifest in your leadership role?</p>

9. (a) As a woman in STEM, what is the professional environment like?

(b) How would you describe your leadership style?

10. (a) As a woman, how does the organisational culture facilitate or hinder your leadership?

(b) What is important to you in being a leader?

Thank you for your participation

Please email your filled questionnaire to

olubukola.babalola@nwu.ac.za

Annexure B: Data collection tool and Informed consent

INFORMATION SHEET AND INFORMED CONSENT FORM

Dear Madam,

I am Prof Olubukola Oluranti BABALOLA (Vice President, Org. for Women in Science for the Developing World). I am conducting a MBA study at the North-West University (NWU) Business School. The purpose of my research study is not only to explore and understand women leadership success and roles in Science, Technology, Engineering, and Mathematics (STEM) in Africa, but also to articulate and analyse the success factors and make suggestions in responding to it.

Your participation as a leader in STEM is of value and will anonymously be processed into the study report. My research is entitled “Women leadership success factors and roles in STEM within Africa”.

If you volunteer to participate in this study the questions will take approximately 20-30 minutes of your time.

NO RISK: The participant will make public observation without interaction or intervention and document their opinions.

The information provided by participants might benefit the North-West University, the Organisation for Women in Science in the Developing World, and all STEM stakeholders.

Payment benefits: There will be no payment for participating in this study as this is a voluntary exercise. You may also refuse to answer any questions you don't want to answer and still remain in the study.

Confidentiality will be maintained at all times. As no personal details will be collected from participants, there is no direct threat to participants. The information might also be inspected by the North-West University, Research and Ethics Committee. The studies will only be utilized by them in carrying out their obligations relating to MBA study.

If you have any questions or concern about the research, please feel free to contact my research supervisor Prof Yvonne Du Plessis of the North-West University - Tel: +27(0)183892021 or myself at Tel: +27(0)183892568.

Researcher's Address: Private Bag X2046, Mmabatho 2735, South Africa.

Thank you in advance for your contribution to this research study.

Yours sincerely,

Olubukola

INFORMED CONSENT FORM

In terms of the ethical requirements of the University, you are invited to complete this form as an indication of your permission to voluntarily participate in this study

I _____ hereby confirm that I have been fully informed about the purpose, procedures, and activities of the study. I will be given full opportunity to ask any questions and I understand that participants can withdraw from the study at any stage and time, without giving any reasons.

I therefore hereby freely **Give/Do not give** my consent to voluntarily take part in the study as outlined (**Delete the inapplicable**).

Signature: _____ **Date:** _____

Annexure C: Ethical Approval Letter



Private Bag X6001, Potchefstroom,
South Africa, 2520

Tel: +27(18) 299-1111/2222

Web: <http://www.nwu.ac.za>

Human Resource Research Ethics Committee

Tel: 018 269 2044

Email: Betchani.Tchereni@nwu.ac.za

25-Apr-2018

Per e-mail

Dear PROF YVONNE DU PLESSIS

APPROVAL OF ETHICS APPLICATION: NWU-HS-2018-0046

The following application has been reviewed by the Human Resource Research Ethics Committee (HRREC) on 18-Apr-2018.

Name of student: OO BABALOLA - 22392419.

Name of supervisor/promoter: PROF YVONNE DU PLESSIS.

Title of study: Women leadership success factors and roles in the Consultative Group on International Agricultural Research projects in Africa.

Application Risk Level: No risk (No contact with human participants).

This letter serves to inform you that your application has been approved from 18-Apr-2018 to 17-Apr-2021.

Special conditions of the approval (if applicable):

Yours Sincerely

A handwritten signature in black ink, appearing to be "B. Tchereni".

Prof B. Tchereni

Chairperson: Human Resource Research Ethics Committee (HRREC)

Annexure D: Turnitin Summary

Annexure E: Language Editor Certificate

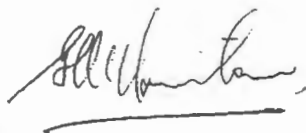
I hereby declare that I did the language editing re the dissertation by Dr. O.O. Babalola on

WOMEN LEADERSHIP SUCCESS AND ROLES IN SCIENCE, TECHNOLOGY, ENGINEERING
AND MATHEMATICS (STEM) IN AFRICA

DETAILS RE LANGUAGE PRACTITIONER:

1. NAME: Prof Gert Erasmus Mouton D.Soc.Sc.(SW) (UOFS)
2. IDENTITY NUMBER: 3803035024086
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6. TELEPHONE NUMBER: 0720681041

SIGNATURE:



Bloemfontein, 9 March 2019

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