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**Advancing women in science, technology, engineering and mathematics to  
leadership roles at a South African Research Institute**

**A dissertation submitted in partial fulfilment of the requirements for the degree  
of Master of Commerce/ in Leadership Studies**

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

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## DECLARATION

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## ABSTRACT

This study titled "Advancing women in science, technology, engineering and mathematics to leadership roles at a South African Research Institute" explores the factors influencing the under-representation of women in science, technology, engineering and mathematics (STEM) in leadership roles within this institution, the strategies they use to navigate these challenges, and their perceived role of leadership in their advancement discourse. Despite significant progress toward gender parity, there remains a noticeable disparity between men and women in leadership positions, particularly within STEM fields. This study focuses on one of the public research institutes in South Africa, where the number of women in STEM leadership roles is still low compared to that of men. Through a multi-theoretical approach, the research investigates the challenges and barriers women in STEM face in advancing their careers to leadership roles. Using a semi-structured interview guide, the study adopted an interpretative phenomenological approach to understand the experiences of these women. Data were collected from 12 participants based in the Gauteng region over two months. A reflexive thematic analysis method was used to identify broad patterns within the data. The findings suggest that women in STEM face various challenges in their quest for leadership roles, as STEM environments are still male-dominated with subtle masculine cultures. Meaningful progress has been made in transforming the organization, but the work-life imbalance, and stringent structure of the career ladder emerged as barriers to advancement. These findings highlight the need to review some organizational practices and foster inclusive leadership.

*Key terms:* leadership, women, STEM, empowerment, gender equality, diversity, challenges, strategies.

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# CHAPTER 1

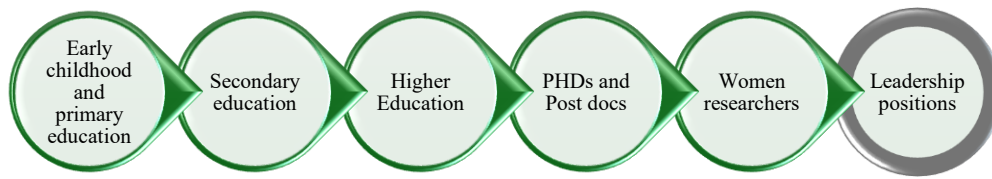
## INTRODUCTION TO THE STUDY

### 1.1 INTRODUCTION

Science, technology, engineering, and mathematics (STEM) are critical to countries' development, economic competitiveness, productivity, and social well-being (Freeman, Marginson & Tytler, 2019; Hammond, Rubiano Matulevich, Beegle & Kumaraswamy, 2020; Kayan-Fadlelmula, Sellami, Abdelkader & Umer, 2022). These fields produce technicians, researchers, and thinkers who contribute to advances in food security, education, transportation, nutrition, energy, infrastructure, communication, and health, among other areas (Hammond *et al.*, 2020). Sadly, countries do not fully exploit the potential of the entire population, including women and girls, as they continue to be under-represented in STEM fields, particularly in leadership positions (Botella, Rueda, López-Iñesta & Marzal, 2019). This chapter lays the foundation for the study. It begins by providing a contextual background on the underrepresentation of women in STEM leadership positions, providing a broader overview from global to national trends. This contextual background is then narrowed down to the specific research institute in South Africa, providing an overview of its workforce composition, career growth paths, and initiatives implemented to address the underrepresentation of women in these critical fields. It further presents the problem statement and the research aim and objectives guiding the study. A brief overview of the methodology employed by the study is then provided, including the study's contribution to industry and academia. These elements serve as a foundation for the chapters that follow.

### 1.2 BACKGROUND OF THE STUDY

The under-representation of women begins early in the lifecycle stages of their careers, grows with each successive seniority level, and becomes more profound in leadership positions (Bello, 2020; Bello & Estébanez, 2022; Botella *et al.*, 2019). This loss of women in STEM at various stages of their careers is called the leaky pipeline (Ysseldyk, Greenaway, Hassinger, Zutrauen, Lintz, Bhatia, Frye, Starckenburg & Tai, 2019). Figure 1.1 on page 2 visually depicts the career lifecycles of STEM women, highlighting the different phases they go through in advancing to senior roles.



**Figure 1.1: STEM women's career lifecycle stages**

Source: Adapted from Bello and Estébanez (2022)

The literature suggests that globally, women make up between 19.9% and 33.3% of professionals in headcount as a share of total researchers (Azcona, Bhatt, Brauchle, Fillo, Min, Page & Zhang, 2022; Bello, Blowers, Schneegans & Straza, 2021). The existing literature reveals that gender parity, characterized by women comprising 45% to 55% of researchers, is observed in only around 20% to 25% of nations (Thornton, 2019; UIS, 2023). However, many of these countries, approximately 127, still have representations of women in research, falling below half of the total researchers, and approximately 56 countries report women's representation at less than one third (UIS, 2023). African scientists form only a small fraction, approximately 2.4%, of the global researcher population, with only 31% of them being women compared to higher percentages in other regions such as Southeast Europe and the Caribbean (49%), Latin America and Central Asia (44%) and 37% in the Arab world (Azcona *et al.*, 2022; Ekine & Aremu, 2022; UNESCO, 2020).

Although certain nations have made progress in achieving gender parity, disparities persist across sectors (Bello *et al.*, 2021; Binda, Clayford, Kasongo, Kondlo, Mudavanhu, Mathekgga, Molotja, Mahlaela, Mavi & Mhlanga, 2023). Studies suggest that four out of ten countries have achieved gender parity in the government and academic sectors. However, the business sector continues to exhibit a notable gender imbalance, with men predominantly occupying positions that offer higher salaries. This pattern remains consistent even in countries where gender balance has been achieved across all sectors, since the proportion of women researchers in the business sector typically falls below 25% (Bello *et al.*, 2021). In educational settings, although women comprise a slightly higher proportion of graduates at the bachelor's and master's levels, with an average of 53% and 55%, respectively, the gap widens at the doctoral level (Bello, 2020). This gap continues in the global market and is particularly pronounced at higher levels of leadership, with women representing only 17.8% and 12.4% of Vice President and C-suite positions, respectively (Zahidi, 2023).

Sectors such as information and communication technologies, engineering, and manufacturing exhibit a particularly low representation of women in managerial and executive positions, with only 13-17% of managers and 3% of CEOs globally (Botella *et al.*, 2019; Catalyst, 2022). This discrepancy between educational attainment and representation in leadership positions is starkly evident, underscoring women's challenges in advancing to high-level roles (McCullough, 2019).

Developing countries have been experiencing notable growth in their researcher density, surpassing the global population increase between 2014 and 2018, with the researcher pool expanding by 13.7%, three times faster than the global population growth of 4.6%. China played a substantial role, contributing to 21.1% of international researchers in 2018, almost as much as the EU's share of 23.5%. Countries like Jordan, Mauritius, Iran, and Ethiopia are witnessing significant percentage changes in their researcher density (Lewis, Schneegans & Straza, 2021). In Latin America, there is a positive trend towards increasing the representation of women in STEM research. Several countries, including Argentina, Cuba, Guatemala, Panama, Paraguay, Trinidad and Tobago, and Uruguay, have achieved gender parity, while Venezuela has surpassed the parity threshold with 60% women researchers (Avolio & Chávez, 2023). In countries such as Mexico, there is a significant gender disparity in STEM, with women representing 33% of researchers and holding just 11% of engineering positions; however, female representation in top management is low at 14% in firms, and there is a considerable wage gap of 50% (Lappe, Torales-Sanchez, Fuentes & Caratozzolo, 2021).

Statistics for sub-Saharan Africa reveal disturbing inequalities, with an aggregate proportion of between 18 and 31% of women researchers compared to 49% in South-East Europe and the Caribbean, 44% in Latin America and Central Asia, and 37% in the Arab world (Azcona *et al.*, 2022; Ekine & Aremu, 2022; Huyer, 2015). The concentration of researchers in the SADC region differs significantly. Of all countries in the region, Eswatini has achieved gender parity among researchers, with women accounting for 47% of the total. However, South Africa is also close to achieving this with a 44% representation of women researchers (Binda *et al.*, 2023). The business sector in the region has limited researcher presence, with only three countries in the region, namely Eswatini, Namibia and South Africa, with over 10% of their researchers employed in the business enterprise sector (Kraemer-Mbula, Sheikheldin & Karimanzira, 2021). Newlin, Meki-Kombe, Kobusingye and Machingura (2022) contend that research funding in Africa is a serious challenge, with limited access for female scholars, who may also need more mentoring and role models. Their study implies that opportunities for knowledge creation are offered to men first, highlighting the need for gender equality in research.

South Africa has seen a notable upward trend in the proportion of women researchers, with the percentage steadily increasing from 41% in 2010 to 47% in 2021 (CeSTII, 2024; NACI, 2022). This percentage remained relatively stable in 2022, where the proportion of female researchers in headcount, excluding students, was 47% (CeSTII, 2024). Specifically focussing on the science council sector, the proportion of female researchers, measured in headcounts and full-time equivalents (FTEs), was consistently 46% from 2018/19 to 2020/21 (CeSTII, 2024). The Organisation for Economic Co-operation and Development (OECD), defines FTEs of R&D personnel as “the ratio of working hours actually spent on R&D during a specific reference period (usually a calendar year) divided by the total number of hours conventionally worked in the same period by an individual or by a group” (OECD, 2015:166). Only 17% of women in STEM are estimated to occupy leadership positions in South Africa (Mukhwana, Abuya, Matanda, Omumbo & Mabuka, 2020; Taylor, 2023).

Despite significant progress toward gender parity, there remains a noticeable disparity between men and women in leadership positions, particularly within STEM fields (Luthi, 2019; Messerli, Murniningtyas, Eloundou-Enyegue, Foli, Furman, Glassman, Hernández Licon, Kim, Lutz & Moatti, 2019; Zahidi, 2023). Globally, several initiatives and investments have been made to address the gender imbalance in STEM. The most extensive global policy framework for achieving gender equality, development, and peace objectives was agreed upon during the Fourth World Conference on Women in 1995 and is known as the Beijing Declaration and Platform for Action (UN Women, 2020). The accountability platform known as the “Global Platform for Gender Equality, in and through Education” was established in 2022 by various governments, industry leaders and stakeholders to promote gender equality through education, accountability, and action (UNESCO, 2024).

In Sub-Saharan Africa and some of its country states, steps have been taken to address the gender gap in STEM, such as the establishment of an organization named the Forum for African Women Educationalists (FAWE, 2019), a nongovernmental organization with the aim of advancing the education of women and girls in 1992 (FAWE, 2019). After the adoption of a Charter on Women in Science, Engineering and Technology by the SADC Secretariat in 2017, Eswatini was among the first countries to develop a constitution for its SADC Women in Science, Engineering, and Technology Chapter, aimed at promoting gender equality (Kraemer-Mbula *et al.*, 2021). Gambia has created a new ministry that focuses on higher education, research, science and technology and has improved the quality of education in agriculture, health and engineering. In addition, they removed primary and secondary school fees to ensure equal access to education for all genders (UNECA, 2020).

South Africa, among other actions, promulgated numerous policy instruments aimed at women empowerment, such as committing to the Convention on the Elimination of All Forms of Discrimination Against Women of 1979, implementing multiple policy frameworks such as the National Development Plan Vision 2030 and others to ensure women advance to positions with decision-making powers (Hofisi & Lukamba, 2024). The country also established a movement called Taungana, an initiative that offers rural high school girls the opportunity to explore STEM fields (UNECA, 2020). Diverse initiatives, spearheaded by both governmental institutions and non-state sector collaborators, have been implemented to improve the participation of women in STEM fields to address their under-representation such as scholarships, internships, the development of technological skills and, focused support platforms in technology (UN, 2019).

Despite efforts to promote gender diversity in STEM, women face various barriers, such as social norms, discrimination, and biases that hinder their advancement to leadership roles (Hammond *et al.*, 2020; Mukhwana *et al.*, 2020). Gender parity in STEM professions is critical to achieve the 2030 Sustainable Development Goals agenda (Moon, Oh & Ji, 2024). This qualitative study explores ways to advance women in STEM to leadership positions. According to Ekine and Aremu (2022), since women comprise nearly half of the global population, embracing diversity and gender inclusion in STEM is essential to stimulate creativity, innovation, and productivity. This study is conducted in this context.

### **1.3 CONTEXT OF THE STUDY**

The research was conducted in one of the public research institutes in South Africa. To protect the identity of this institute and comply with its confidentiality requirements, it is referred to herein as the South African Research Institute.

Public research institutes (PRI) have existed in South Africa since the nineteenth century as part of the National System of Innovation (Kruss, 2020). DST (2019:viii) defines PRIs as “a heterogeneous group of research organizations with varying degrees of governmental influence on their research activities and funding”. According to Athreye and Wunsch-Vincent (2021), PRIs were initially established as commercialization vehicles that take scientific research from universities and tailor it to meet societal and industry needs. In emerging markets, PRIs and universities mainly connected the home country and global knowledge exchange, where they absorbed knowledge from advanced economies. However, its role has evolved due to new opportunities and societal demands, making these institutions more diversified and complex, and thus the fundamental expansion of science councils (Kruss, 2019). Sector-specific science

councils are professional bodies with experts in engineering and science who support government entities (DST, 2019).

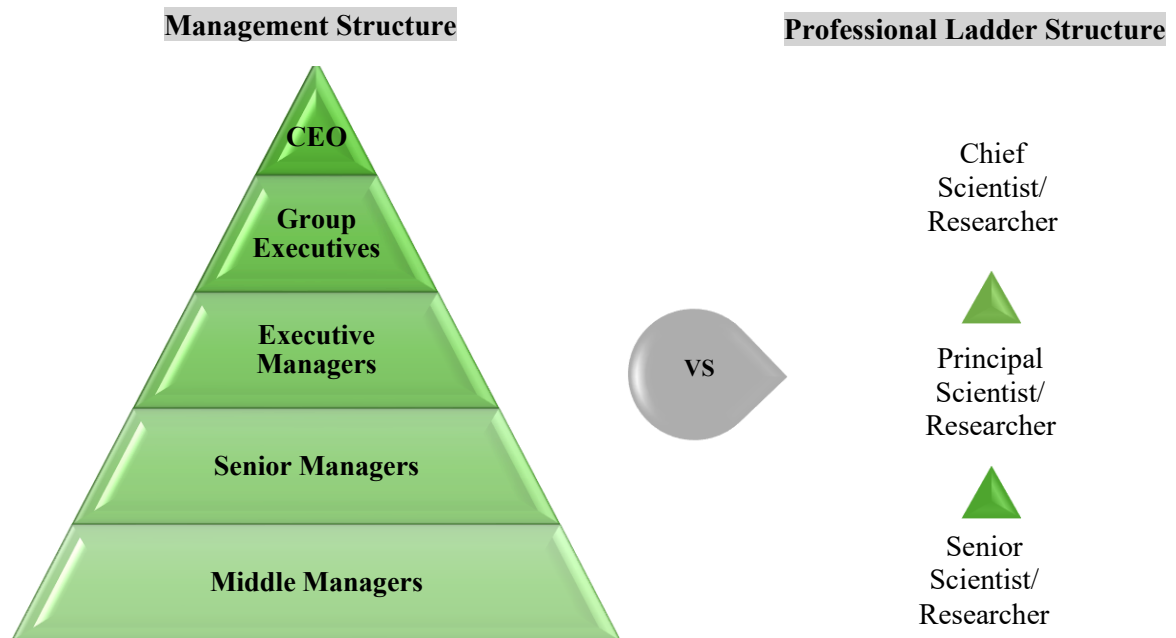
South Africa has 11 science councils (DSI, 2024). These organizations are considered trustworthy and impartial, leading technological advancements, and have a deep understanding of the user's application domain, cultural issues, and terminology (DST, 2019). Protected by the Intellectual Property Rights from Publicly Financed Research and Development Act, Act No. 51 of 2008, science councils and universities are deemed essential entities to the growth trajectory of South Africa and are now required to 'balance multiple mandates' (Mustapha & Ralphs, 2022). These institutions serve a generic threefold mandate, i.e. (a) to connect the country to the global knowledge system by contributing to science, (b) to promote inclusive economic growth by contributing to the innovation, technology, and competitiveness of informal and formal privately owned enterprises, (c) to promote sustainable development and help the government improve the quality of life of its nation through innovation (Kruss, 2020; Kruss, Haupt, Tele & Ranchod, 2016).

In line with the broader mandate of science councils, the South African Research Institute focuses on multidisciplinary issues aligned with national priorities. This organization brings together diverse experts to tackle complex national priority issues grounded in scientific and industrial fields to support a capable state. Its structure is strategically aligned with key sectors in South Africa and comprises three units. The organization employed more than 1600 STEM personnel in 2023/24, of which 625 were female. The percentage of STEM women in leadership or managerial roles was 19% in the same period (SARI, 2024).

One of the strategic objectives of this organization is the transformation of human resources. This organization has implemented several pipeline development programmes through its human resources team, from scholarships and bursary programmes to leadership, internships, and work-integrated learning programmes. These programmes are meant to attract and retain critical skills. In addition, leadership development programmes were also introduced to strengthen leadership capability at all levels of management (SARI, 2024).

Leadership career advancement opportunities for STEM professionals have two streams. One is through upward mobility, and the other is through a structured career ladder process. The upward mobility hierarchy comprises five levels of management, thus providing individuals with growth opportunities. There is a targeted recruitment and selection process aligned with the organization's employment equity targets. The career ladder process enables scientists to be promoted to higher levels based on the technical experience and skills gained. This process

focuses more on industry-related leadership than on organizational leadership. It offers individuals a natural path based on competence, skills, and knowledge to progress from emerging scientists to established scientists (SARI, n.d.; SARI, 2022b). Advancement of STEM employees to leadership roles can take either or both forms as depicted in Figure 1.2.



**Figure 1.2: Management vs professional career ladder structure**  
 Source: Adapted from SARI (n.d.); SARI (2022b)

Additionally, the Employment Equity and Skills Development Committee and the Consultative Forum were established to address historical inequalities in race, gender, and skill development, promoting inclusive participation in economic life. Recruitment plans are based on the existing employment equity plans. The organization also established a women’s support group to address the different challenges women face in this organization. The support group has four focus areas. The first focus area relates to outreach programs. These programmes seek to introduce girls of a young age to STEM fields. The second focus area is to offer professional and developmental support to women in STEM through training and other skills development programmes to ensure that there are capable women who can take on leadership roles. Another focus area of this support group is on providing mentorship opportunities for women. These opportunities are for mentors and mentees to get more women already in key positions to take up mentor roles and assist aspiring mentees. Lastly, the social support structure is another focus area for this support group.

#### **1.4 MOTIVATION FOR THE STUDY**

Given the importance of science in spurring innovation and engineering in developing infrastructure, STEM occupations frequently serve as the cornerstone of a country's economy (Schmader, 2023). Despite the significant contributions of women scientists to Africa's development and transformation, particularly in South Africa, they remain significantly under-represented in higher education and STEM sector leadership positions (Mukhwana *et al.*, 2020; Taylor, 2023). A dearth of varied viewpoints has significant consequences in STEM professions, since they are intimately linked to our comprehension of the natural world and our creation of the physical one (Schmader, 2023).

The literature on gender and STEM careers, as well as women and leadership, is extensive (Beaudry, Prozesky, St-Pierre & Mirnezami, 2023; Bello & Estébanez, 2022; Botella *et al.*, 2019). However, there is a notable scarcity of research focusing on women's leadership in STEM careers (Dutta, 2018). Despite extensive research on the challenges faced by women in STEM careers globally, including leadership, little attention has been paid to the perceptions of women in STEM employed by South African research institutes regarding barriers to advancing to leadership roles (Babalola, du Plessis & Babalola, 2023; Sachs, Lafortune, Kroll, Fuller & Woelm, 2022; Schmitt & Wilkesmann, 2020). According to Lashari (2023), there is an opportunity for future research to explore possible interventions to facilitate the journey for young women aspiring to leadership roles. This study sought to illuminate the specific challenges experienced by women in STEM in their quest to advance to leadership roles and factors that promote their advancement within the South African Research Institute. Understanding these experiences makes it possible to develop strategies to promote gender equality and support their progression to leadership roles. The motivation of this study is to contribute to the advancement of women in STEM leadership roles and the promotion of gender equality in the highest echelons of the organization.

#### **1.5 PROBLEM STATEMENT**

Despite efforts to increase the number of women in STEM fields, the world is not on schedule to achieve gender equality by 2030 (Mukhwana *et al.*, 2020). STEM women rarely advance to leadership positions, with their representation declining from entry-level to high-level leadership positions (Azcona *et al.*, 2022; Mukhwana *et al.*, 2020; UNESCO, 2023). This situation is mirrored in South Africa, where the percentage of women in STEM has progressed, but achieving gender parity in STEM leadership remains a pressing concern (Unterhalter, Howell, Longlands, Malloy, Nascimento & Sigamoney, 2024). Women in the professional, scientific, and technical sectors represented 35% of top management and 43.6% in senior

management positions (CEE, 2023). The South African target for this sector is 43.5% of women in top managerial positions and 49.5% in senior management positions, according to the draft Employment Equity Regulations 2023 (DEL, 2023).

Although efforts are being made to identify challenges that limit women's participation, including policy reviews in STEM fields, there remains a significant time frame to close gender gaps (Azcona *et al.*, 2022; Van Staden, Ahmed, Getachew, Gledhill, Kanjere, Khuluse-Makhanya & Das, 2019). The existence of gender disparity in corporate leadership roles hinders progress, as qualified and skilled women are underutilized (Martínez-Martínez, Molina-López, Mateos de Cabo, Gabaldón, González-Pérez & Izquierdo, 2021). These findings collectively highlight a wide gender gap in leadership roles, especially within STEM fields, indicating a critical area for further research and intervention (Chanda & Ngulube, 2024; Parmaxi, Christou, Fernández Valdés, Puente Hevia, Perifanou, Economides, Mazaj & Manchenko, 2024).

## **1.6 AIM & OBJECTIVES**

The study aimed to investigate and understand the challenges and strategies related to advancing women in STEM to leadership roles within the South African Research Institute.

The objectives of this study were:

- To identify the specific challenges facing women in STEM within the South African Research Institute as they endeavour to advance into leadership roles.
- Investigate the various strategies used by women in STEM to navigate obstacles and progress in their careers within the South African Research Institute.
- Explore the perceived role of leadership in the advancement of STEM women into STEM leadership positions within the South African Research Institute.
- To recommend strategies and interventions that the South African Research Institute can implement to promote the advancement of women to leadership roles in STEM fields.

## **1.7 RESEARCH QUESTIONS**

The study sought to answer the following questions:

- What are the challenges that hinder the career advancement of women in STEM to leadership roles within the South African Research Institute?
- What strategies do women in STEM use to advance their careers and overcome challenges within the South African Research Institute?
- What is the perceived role of leadership in advancing women to STEM leadership roles within the South African Research Institute?

- What strategies and interventions can South African Research Institute implement to promote the advancement of women leaders in STEM fields?

## **1.8 RESEARCH METHODOLOGY**

This qualitative study used an interpretative phenomenological approach to explore the experiences of women in STEM at the South African Research Institute and the challenges they face in advancing their careers to leadership roles. The sampling methods used for this study was purposive sampling method, which is considered appropriate for the study due to the nature of the work that the study participants do and, the need to identify participants who will provide rich information for the study. The sample population consisted of two homogeneous groups, namely women already in leadership roles and those in the pipeline within a single institution. Each group consisted of 6 respondents. The study utilized a semi-structured interview guide for data collection and a reflexive thematic analysis technique to analyze the collected data.

## **1.9 SIGNIFICANCE OF THE STUDY**

The findings of this study may contribute to both academia and industry. According to Sougou, Ndiaye, Nabil, Folayan, Sarr, Mbaye and Martínez-Pérez (2022), there has been significant progress toward gender equality; however, it is not universal around the globe, particularly in the STEM faculties, and the inequalities in expressions by context are also less frequently explored. These variations in expression must be recognized to build context-specific responses to inequities encountered in various contexts and settings.

In academia, this study can contribute to the existing body of literature on the advancement of women to leadership positions in STEM fields within South African research institutes. By analyzing the experiences and perspectives of women in STEM, the study can provide a deeper understanding of the barriers they face and perceived enablers of women's advancement to leadership positions. This knowledge can inform future programmes and initiatives to promote gender equity and diversity in STEM leadership roles.

In industry, the importance of this research lies in the potential benefits that can be derived from having more diverse leadership teams in STEM fields. Research has shown that diversity in leadership can lead to better decision making, innovation, and overall organizational performance (Ekine & Aremu, 2022; Makarem & Wang, 2020). By exploring the barriers that hinder the advancement of women in STEM to leadership positions in South African research institutes, this study can help identify opportunities for increasing gender diversity and promoting women's advancement into leadership roles. The findings of this study can inform

the development of targeted interventions and strategies to support the recruitment, retention, and advancement of women in STEM fields in industry.

In general, this research is important for gender equity and diversity in STEM leadership roles, not only in the research organization but also in South Africa and beyond. The participation of women in social, educational and organizational movements that advocate for transformation and representation in STEM is crucial for the future of leadership in this sector. As the importance of inclusion, equity, and justice gains prominence in organizational policies and discussions, research on women's leadership in STEM becomes increasingly valuable (Lappe *et al.*, 2021).

## **1.10 CHAPTER OVERVIEW**

Chapter 2 delves into theoretical frameworks advocating for gender diversity and leadership, examines global and South African-specific statistics on women in STEM, explores legal frameworks supporting gender equality, identifies challenges hindering women's advancement in STEM leadership, and discusses strategies to overcome these obstacles.

Chapter 3 outlines the methodological approach adopted by this qualitative study to explore the experiences of women in STEM fields in advancing their careers to leadership roles. It starts with the justification for the use of a qualitative method for this study, then the research design, the sampling method and the inclusion and exclusion criteria applied in the study. It goes further to explain the data collection methods employed and the analysis techniques used. Ethical considerations regarding gatekeeper approval to conduct research, informed consent, and confidentiality are also addressed in this chapter.

Chapter 4 deals with research findings, analysis of the findings, and the sub conclusions made in this regard. The key themes of the study are identified and their implications in relation to the research questions and objectives are analyzed.

Chapter 5 summarizes research findings and conclusions, provides recommendations for industry on possible strategies to advance women in STEM to leadership roles, and suggests possible future research opportunities related to the research findings.

## **1.11 CONCLUSION**

The role of STEM in any country cannot be overstated. This is particularly important in developing countries such as South Africa. Science councils are critical to the development of

the country. However, their lack of gender diversity, specifically in crucial leadership roles, is a concern (Mukhwana *et al.*, 2020). As organizations that help the government solve many of the social issues that require scientific input, their composition must represent the demographics of the country. The diversity in these organizations will enable them to carry out their mandates and enrich the lives of South Africans.

This chapter laid the foundation for understanding gender imbalance in STEM fields within the context of this study. The problem statement was also discussed to highlight the current challenges in South Africa and the research context. Although the limitations of this study are acknowledged, research questions were asked to direct the inquiry. Similarly, the study objectives were also outlined, aligning with the broader goal of understanding the challenges women in STEM face in their quest to advance to leadership roles and exploring strategies that can be used to assist these women. Furthermore, the significance of the study was discussed, highlighting its potential relevance for application in academia and industry. Finally, an overview of the structure of the subsequent chapters was provided as a roadmap for this dissertation. Building on this foundation, Chapter 2 reviews the existing literature and theoretical foundation relating to the subject under examination.

## **CHAPTER 2: LITERATURE REVIEW**

### **2.1 INTRODUCTION**

This chapter provides a broad overview of the barriers women in STEM face in their quest to advance to leadership roles, resulting in their under-representation in these positions, and the role of the organizational leadership team in advancing these women. The under-representation of women in leadership roles has been ascribed to a multitude of complicated and multifaceted factors (Lashari, 2023; Samuelson, Levine, Barth, Wessel & Grand, 2019). Therefore, the study adopts a multi-theoretical framework rooted in social psychology and organizational behaviour to identify these factors. Specifically, two theories of social psychology are discussed: the theories of social role and role congruence. The organizational practices that hinder the advancement of women in STEM to leadership roles will be examined through the lens of gendered organization and institutional theories. Leadership theories are also discussed to understand the dynamics within leadership practices and their intersection with gender. The barriers women face in attaining leadership roles are also discussed. The chapter further delves into the legal framework to promote women's advancement and inclusion in positions of influence and power. Some of the strategies women use to climb the career ladder will also be discussed, including the role of the organizational leadership team in helping these women.

### **2.2 IMPORTANCE OF DIVERSITY IN STEM LEADERSHIP**

The achievement of gender diversity in STEM leadership is important for various reasons. Gender equity in leadership is a matter of justice. Women are denied the power to make a positive influence in the world when they are excluded from top leadership positions, and this adds directly to overall gender pay inequalities as leadership positions tend to be the best paid within organizations (Hill, Miller, Benson & Handley, 2016). The presence of ongoing gender disparities in the scientific workforce results in the clustering of female scientists in lower-level positions, which not only limits diverse perspectives and obstructs the progression of women but also underscores the importance of employing a gender lens to acknowledge their input and development requirements (Tiedeu, Para-Mallam & Nyambi, 2019). Diversity in leadership teams is important for the empowerment, inspiration and representation of minority groups, in addition to enhancing the capacity for thoughtful decision making and the creation of a healthy working environment (Davis, 2024).

The projected worsening of the skill shortage in STEM fields over the next decade highlights the importance of gender diversity to address this issue (Truluck, 2023). Attracting and retaining women in these traditionally male-dominated occupations will be critical to meeting

the growing demand for a STEM workforce (Makarem & Wang, 2020). A diverse team can generate more relevant and nuanced research questions, leading to research that is beneficial to a wider population.

Barkhuizen, Masakane and van der Sluis (2022) argue that promoting women leaders challenges stereotypes, enhances organizational performance, and empowers individuals by improving self-perceptions and boosting self-confidence in male-dominated environments. Furthermore, the implementation of successful diversity management establishes a workplace that is inclusive and equitable for all employees, thereby enhancing the organization's workforce as an asset and increasing its competitiveness in labour markets and happy workforce (Galsanjigmed & Sekiguchi, 2023; Martins, 2020). It also improves the organization's credibility with stakeholders and providers of resources while fostering organizational creativity and innovation (Martins, 2020). Lack of diversity in decision-making spaces can result in inadequate governance and ethical failures, which can result in goods and services that fail to meet the requirements of women, sometimes with tragic results (Kim & Meister, 2023). Furthermore, a hostile work environment can be created for other women, inadvertently perpetuating masculine cultures through policies and practices that do not accommodate women (Chanda & Ngulube, 2024).

In general, diversity can help address systemic barriers, achieve better outcomes by promoting inclusivity and understanding in different fields, and promote gender parity in leadership roles (Chanda & Ngulube, 2024; Shannon, Jansen, Williams, Cáceres, Motta, Odhiambo, Eleveld & Mannell, 2019). This will in turn increase the ability of a country to achieve its full potential, improve its competitiveness in the global landscape, and ensure economic sustainability (Makarem & Wang, 2020).

### **2.3 THEORETICAL FRAMEWORK**

Gender inequalities in organizations are multifaceted and intricate matters influenced by numerous factors; as such, they have attracted the attention of researchers from various perspectives ranging from management, economics, sociology, and psychology (Hanek & Garcia, 2022; Srivastava & Nalawade, 2023). Similarly, leadership is a multifaceted construct and often contextual (Abdellatif, Penha-Vasconcelos, Lewis-Strickland, Silva, Tan & Spadorcia, 2023). This study adopts a multi-theory approach rooted in social psychology and organizational theories. This approach aligns with literature findings, indicating that multi-theoretical methods provide deeper insights into complex business phenomena, addressing limitations of existing management theories (Mills & Bettis, 2015; Tsang, 2022). Additionally, two or more theories may offer a more comprehensive explanation when their complementary

aspects are considered, as theories often focus on specific facets of a phenomenon (Price, Jhangiani & Chiang, 2015; Tsang, 2022). A similar approach was adopted in a study by Hayes (2023) to explore how women perceive the support organizations provide for female candidates seeking leadership roles in STEM fields. Likewise, Issa and Zaid (2021) used a multi-theoretical approach in their study to explore the impact of board gender diversity on corporate environmental performance.

Research on gender diversity in leadership scholarship has focused primarily on gender as a variable (Abdellatif *et al.*, 2023). Although sex is a biological trait and gender is a social construct, psychological differences between men and women are frequently referred to as "gender differences" to highlight the importance of social psychological processes, which reinforce biological variations in sex as the causes of these discrepancies (Hanek & Garcia, 2022). Social psychology is "the scientific study of how people's thoughts, feelings, and behaviours are influenced by the real or imagined presence of other people" (Aronson, Wilson, Akert & Sommers, 2021:25). As humanity arranges and conceptualizes the social world based on the powerful social construct of gender, social psychological theories are commonly used in the study of gender disparities in organizations to explore gender gaps and challenges faced by women in workplaces (Hanek & Garcia, 2022; Hoyt & Simon, 2024). Using a gender lens in discussions about organizational theory is beneficial because it helps to understand how relational dynamics function within organizations and how they shape or remodel the social, psychological, and cultural aspects that influence the organization (Rodriguez & Guenther, 2022).

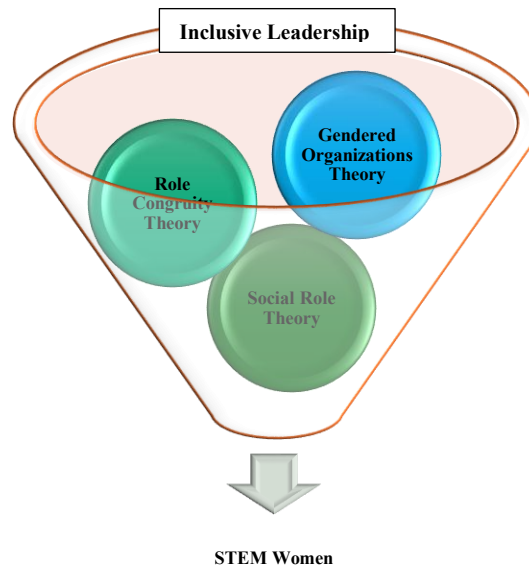
To improve the understanding of gender stratification dynamics in leadership and develop more effective interventions, it is important to recognize the breadth, complexity, and dynamic nature of the social systems within which leadership development and organizational entry occur (Samuelson *et al.*, 2019). This understanding is crucial, given research findings by Taparua and Lenka (2022), which highlights how social and cultural stereotypes hinder women's confidence and ambition for leadership roles, while organizational barriers, like biased corporate policies and the "think manager think male" stereotype, compound these challenges, leading to personal struggles for women in leadership positions. Social psychology theories also examine why women conform to workplace norms established by assuming that work should take precedence over other aspects of life, leading to inequitable arrangements and rules (Clark-Saboda & Lemke, 2023).

As social entities, organizations possess several defining characteristics, including goal orientation, intentional structure, and coordinated activity systems, and interconnectedness with

the external environment (Daft, 2021). Additionally, they adopt various practices, such as marginalization based on gender, ethnicity, and class, that represent the unequal power relations prevalent in society (Amis, Munir, Lawrence, Hirsch & McGahan, 2018). Traditionally, organizations are believed to have a gender-based environment, restricting leadership concepts to one gender, which is undesirable (Galsanjigmed & Sekiguchi, 2023). Leadership is particularly critical in developing effective organizations and ensuring the inclusivity and performance of organizational members (Cherian, Gaikar & Raj P, 2020). The impact of patriarchal institutions on concerns of fairness and access in the workplace and other domains of life has been noted by scholars, with very few exceptions across the globe (Dahlvig & Longman, 2020). Social ideologies and status beliefs that justify social inequities based on sex and other characteristics generally impede progress toward gender equality (Eagly & Wood, 2016).

Organizational theory investigates the behaviour of complex organizations, including formal structures, internal processes, external constraints, and the reciprocal influence between members and the organization (Tompkins, 2023). Its concern is on how the organizational structures inspire the organization's members to achieve the objectives laid out by top leadership and how the external environment impacts the organization (Ferdous, 2016). This is particularly relevant when exploring organizational behaviour's impact on the career aspirations of women in STEM and their advancement to leadership roles. Evidence from the literature suggests that organizational practices do shape women's career paths negatively or positively (Hart, 2016). Organizational theory is, therefore, not defined by a single theory or cohesive body of information; rather, it is a vast and multidisciplinary field of study (Tompkins, 2023).

The foundational framework of this study is multifaceted. It encompasses theories of social psychology, such as social role and role congruity theories, along with organizational theories like Acker's gendered organization theory and inclusive leadership theory. This framework is depicted visually in Figure 2.1 on page 17.



**Figure 2.1: Theoretical framework**

Source: Own diagram (2024)

The social psychological theories examined in this study encompass the theories of social role and role congruence. Social role theory is regarded highly relevant in elucidating the presence of gender stereotypes in organizations (Tabassum & Nayak, 2021). Eagly and Wood (2011) developed the theory, suggesting that gender differences and behavioural similarities stem from societal stereotypes and evolved gender-specific traits. Role congruity theory, which scholars have applied in an array of organizational settings, builds on these foundations to explore the expectations, behaviours, and norms associated with specific social positions, while social role theory delves into the influence of societal expectations and stereotypes on individuals' roles and behaviours (del Carmen Triana, Song, Um & Huang, 2023).

Organizational theories examined in the study include gendered organizations and leadership theories. Gendered organization theory examines how gender interacts with various aspects of social, political, economic and technological realms, influencing organizational dynamics and inequalities (Rodriguez & Guenther, 2022). Leadership theories seek to explain why women are under-represented in leadership positions and which leadership styles are most effective in addressing this matter.

### **2.3.1. Social psychology theories**

#### **2.3.1.1. Social role theory**

The concept of a social role suggests that society expects men and women to fulfil specific social roles. These expectations include descriptive roles, defined by the traits and behaviours

that each gender exhibits, and prescriptive roles, which men and women should inhabit (Weiner & Burton, 2016). The beliefs about gender roles, also known as stereotypes, develop when people observe the conduct of men and women and ultimately assume that the two genders possess matching tendencies (Eagly & Wood, 2016). Therefore, roles that require specific characteristics and behaviours are often assigned to different individuals (Rudman & Glick, 2021). Societies engage in intensive socialization to develop personality traits and abilities that allow role performance to prepare men and women for their typical responsibilities at home and in the workplace (Eagly & Wood, 2016). It is therefore essential to examine the socialization that takes place to prepare women for leadership positions when examining their presence in these roles (Jones & Pal, 2022).

In organizational settings, individuals develop behavioural patterns consistent with the norms of their organization, resulting in behavioural variances among its members (Rudman & Glick, 2021). Therefore, women's self-conceptions are based on the cultural meanings associated with their gender (Eagly & Wood, 2016). These cultural preconceptions shape gender-based behavioural distinctions and the resulting social roles, which are engrained in people from an early age (Jones & Pal, 2022). Men are more agentic, while women are more communal (Eagly & Wood, 2016). In general, agency refers to traits that characterize a predisposition toward assertiveness, control, and confidence, while communion mainly refers to qualities connected to cooperation and the well-being of others (Schock, Gruber, Scherndl & Ortner, 2019). Social role theory posits that when men and women conform to their designated social roles, they tend to be separated based on their gender, reinforcing established gender stereotypes (Tabassum & Nayak, 2021). This theory assumes that people generally reward conformance to gender roles through acceptance and sustained engagement while penalizing nonconformance with disrupting social interaction and imposition of sanctions (Eagly & Wood, 2016). This is also evident in assessing women's leadership potential (Jones & Pal, 2022). Considering that leadership is defined primarily in culturally male ways and denigrates women, gender matters in leadership (Eagly & Sczesny, 2019). According to the correspondent's inference, the literature suggests that leadership roles are more like the male gender in content, as they are perceived to be agentic and incongruent with the female gender due to the perception of them being more communal (Eagly & Wood, 2016; Eagly & Sczesny, 2019). Consequently, discrimination against women in leadership positions may arise because they are perceived to lack the agentic qualities necessary for effective leadership (Eagly & Sczesny, 2019). Additionally, literature suggests that even in situations where women's qualifications are equal to those of males, they are frequently viewed as less capable and qualified than their male counterparts, hindering their ability to rise to leadership positions, and thus a factor in their under-representation in senior leadership roles (Chikwe, Eneh & Akpuokwe, 2024). Thus,

women must demonstrate their leadership abilities rather than being presumed to have potential, which aligns with the stereotype that poor agency women hold (Eagly & Sczesny, 2019). Social role theory led to the emergence of role congruity theory (del Carmen Triana *et al.*, 2023; Eagly & Karau, 2002).

### **2.3.1.2. Role congruity theory**

Role congruity theory goes beyond social role theory to consider the congruency between gender and other roles, particularly leadership (Eagly & Karau, 2002). According to role congruity theory, social roles and gender roles are interrelated, they can be aligned, mismatched, or adopted concurrently (Ferguson, 2018). The theory also identifies important variables and mechanisms that affect congruity perceptions and their implications for bias and discriminatory actions (Eagly & Karau, 2002). This theory is particularly relevant to women occupying leadership roles (Ferguson, 2018). According to the role congruity theory, success in leadership is associated with congruent agentic traits, while communal traits are incongruent with effective leadership traits (Koburtay, Jawad & Radi, 2019; Tremmel & Wahl, 2023). If there is alignment in the roles that a person demonstrates, they will be positively evaluated and considered authentic (Ferguson, 2018). Consequently, bias can develop when there is a perceived discrepancy between expectations of success in a social role and stereotypes about a particular social group (del Carmen Triana *et al.*, 2023). As indicated in the previous section, agentic behaviours are associated with males, thus the idealized leader behaviour, while communal behaviours are associated with women. Role congruity theory argues that there are two types of predispositions faced by women in leadership roles, one relating to the low probability of them being considered for appointment into leadership roles and, secondly, the unfavourable evaluation of their performance in leadership roles (Eagly & Karau, 2002; Kark, Barthel & Buengeler, 2023). This is evidenced by the study conducted by Hopkins, O'Neil, Bilimoria and Broadfoot (2021), which revealed the existence of bias in evaluating women's leadership potential and in their performance evaluations in the role.

## **2.3.2. Organizational theories**

### **2.3.2.1. Gendered organizations theory**

In 1990, Joan Acker introduced the concept of gendered organizations as spaces where men and women experience varying advantages and disadvantages, exploitation, control, actions, and emotions, as well as the shaping of meanings and identities (Clark-Saboda & Lemke, 2023). Researchers use gendered organization theory to identify and address hidden gender discrimination and inequality within organizations (Clark-Saboda & Lemke, 2023). According to Acker (1990) a comprehensive theory of gender and organizations is vital due to its role in

understanding and addressing gender segregation, income disparities, cultural influences, individual gender identity, and promoting feminist goals in large-scale organizations.

Acker initially presented five processes that create and perpetuate gendered organizations, the first being the division of tasks (Zippel, 2019). Gender stereotyping finds its roots in the historical gender division of tasks, where men have traditionally controlled the means of production and distribution within a patriarchal cultural, social, and economic framework (Tabassum & Nayak, 2021). This division has led to biased and fixed beliefs about individuals' roles, abilities, and characteristics based on their gender, perpetuating stereotypes that can influence societal expectations and behaviour (Carli, Alawa, Lee, Zhao & Kim, 2016). Symbols are the second process identified by Acker (Zippel, 2019). Cultural symbols, ideology, beliefs, visuals, attire, language, and representations play an important role in expressing and strengthening gender divisions (Clark-Saboda & Lemke, 2023). The preference for masculinity in organizational contexts is deeply ingrained in societal, cultural, and professional norms, perpetuated through unreflective repetition within organizational cultures, which, in turn, often reinforce gender symbolism associated with positions and job types (Holgersson & Romani, 2020). These symbols can encapsulate the notion of hegemonic masculinity, which entails depictions of an alluring, authoritative, emotionally detached and powerful leader (Clark-Saboda & Lemke, 2023). The third process is to reinforce gendered interactions (Zippel, 2019). This relates to the interactions between people of various genders - men and men, women and women, and women and men - and the actual enactment or expression of gender in real work settings, consciously or unconsciously (Acker, 1990; Bates, 2022). These interactions cover a range of behaviours that can show authority and servitude and ultimately shape gendered social structures, including organizations (Acker, 1990). The fourth process relates to the internalization of these gender norms and, finally, the construction of seemingly gender-neutral organizational logic with underlying gendered structures (Zippel, 2019). The logic consists of gender-biased beliefs and actions that form the organization's foundation in a framework established during the organizing processes, which, in turn, contribute to its gender-specific characteristics (Bates, 2022).

These gendering processes reinforce an implicit masculine norm that attributes higher status to masculinity in society and organizations, making it difficult to challenge and leading to an unchanged gender hierarchy (Holgersson & Romani, 2020).

### **2.3.2.2. Leadership theory**

The topic of leadership has been the subject of many published research studies spanning several decades (Harrison, 2018). Despite this huge collection of research, leadership remains

an elusive idea (Benmira & Agboola, 2021; Hunt & Fedynich, 2019). Many philosophers, thinkers, scholars, and leaders have defined leadership differently in the literature (Malik & Azmat, 2019). The concept of leadership is a multifaceted and complex issue that is defined differently by different scholars (Manning & Robertson, 2022). As a multifaceted concept, Manning and Robertson (2022) argue that it is impossible to develop a single definition of leadership that encapsulates the intrinsic nature of leadership. The scholars, therefore, use concepts coined as the 6Ps of leadership to define it: person, power, position, process, perception, and performance. Leadership as a person implies that some people have leadership capabilities or are seen to have these capabilities. As a result, any attempt to understand this concept involves understanding the characteristics of these people. Leadership as power implies that leaders have a certain level of power to influence others. Leadership as a position implies that a leader is appointed to a leadership position within the organization. Leadership as a process implies a sequence of purposeful activities in the execution of leadership duties that require individual interactions. Leadership as performance implies that leaders are expected to deliver on their mandates. Lastly, leadership as a perception implies that societal values and beliefs shape the duties or expectations of a leader.

The most popular definitions of leadership include inspiring others to attain a goal and directing organizational change (Reed, Klutts & Mattingly, 2019). Leadership is also defined as “a process in which an individual influences a group of individuals to achieve a common goal (Iszatt-White, Saunders, Botha, Ladzani, Rudansky-Kloppers & Strydom, 2018;n.p; Northouse, 2022:59).

Daft (2022:4) defines leadership as “an influence relationship between leaders and followers who intend real changes and results that reflect their shared goals”. The scholar identified six key elements to this definition: (a) influence process between leader and followers; (b) there are followers where people willingly follow the leader and the leader is also willing to follow where required; (c) the followers intentionally desire change; (d) there is change that occurs leading to (e) a shared purpose of which (f) each person took a personal responsibility towards its achievement.

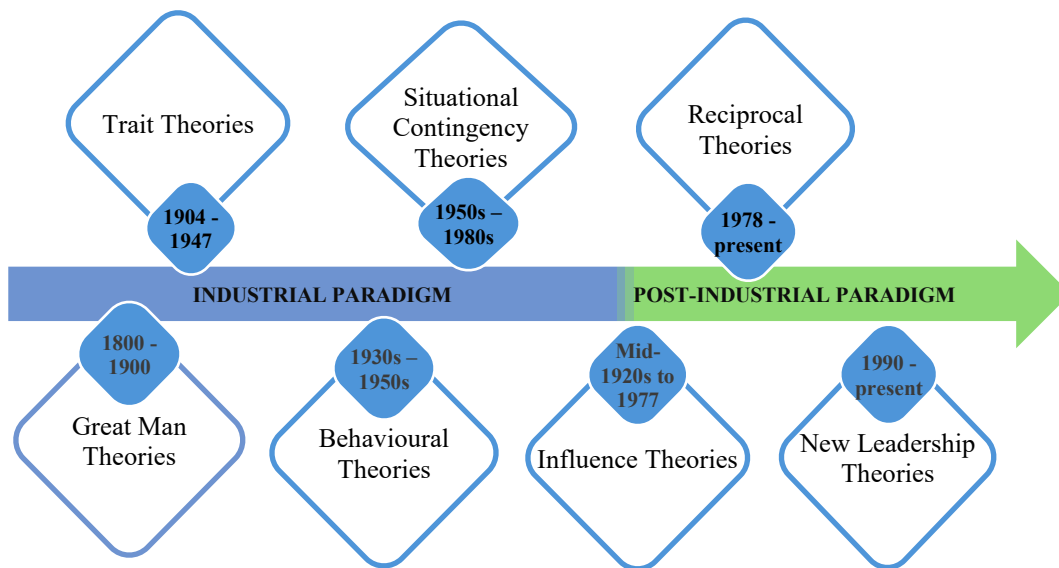
Lussier and Achua (2022:10) define leadership as “the influencing process between leaders and followers to achieve organizational objectives through change.” This definition comprises five elements of leadership, namely, (a) the leader-follower relationship as a shared responsibility, (b) the influence process involved in getting followers to support and execute ideas, (c) the change management process involved in getting followers to change certain things to achieve

specific objectives, (d) organizational objectives set by the leader, and (e) people management as leaders lead and achieve objectives through people.

A common theme across the above definitions of leadership is that it is an influence process. There must be followers for the leadership to take effect. In addition, all individuals pursue a common goal that will bring about change. Therefore, the single definition of leadership adopted in this study is ‘leadership is an influence relationship between leaders and followers to bring about change that leads to the achievement of organizational objectives.’

### 2.3.2.2.1. Evolution of leadership theories

Leadership theories evolved over time, with the first theories emerging in the 1840s, from the Great Man theory, the research on leadership styles and what makes effective leaders continues (Wei, Brown & Horns, 2022). However, there has been much debate on a unified approach or even a consensus on the characteristics of good leadership (Hunt & Fedynich, 2019). Examining leadership theory evolution offers context and perspective to understand its complexity (Benmira & Agboola, 2021). The philosophies around leaders and leadership have changed and grown with each era of this historical journey (Hunt & Fedynich, 2019). Figure 2.2 is a diagrammatic representation of the evolution of these theories over time.



**Figure 2.2: Evolution of leadership theories**

Source: Adapted from Benmira and Agboola (2021); Daft (2022); Northouse (2022)

Table 2.1 on page 23 provides a concise summary of each theory.

**Table 2.1: Leadership theories**

<b>Approach</b>	<b>Period</b>	<b>Influencers</b>	<b>Major assumptions</b>
The Great Man Approach	Mid-1800s to early 1900s	Thomas Carlyle	The theory argues that leaders are born with unique characteristics that make them leaders, such as influence and power, and not created or developed, concerning leaders such as Napoleon Bonaparte, Julius Ceasar, and Abraham Lincoln (Benmira & Agboola, 2021; Daft, 2022; Rosenshield, 2020).
Trait Approaches	1904 to 1947	Gordin Allport	Influenced by Gordon Allport, the theory suggests that some individuals possess personal attributes or traits that make them fit for leadership roles (Uys & Webber-Youngman, 2021). This theory aims to determine the characteristics that make a person a leader to predict their behaviour and find ways of training others to possess similar characteristics (Daft, 2022).
Behavioural Approaches	Late 1930s to early 1950s	Kurt Lewin, Robert Blake and Jane Mouton and others	Theorists argue that leaders are not born but made through the development of effective leadership skills (Benmira & Agboola, 2021). This approach focuses on two leadership behavioural categories, namely task and relationship behaviours, and how leaders engage in or combine both to affect followers (Northouse, 2022). The democratic style which involves delegation of power and authority, participative decision making, and

			feedback mechanisms between the leader and their followers is considered the most effective (Zeeraak, 2023)
Situational/ Contingency Approaches	1940s to 1960s	Fred E. Fiedler, Paul Hersey, and Ken Blanchard, among others.	The principle of this theory is that leaders should adapt their leadership styles based on the situation at hand (Khan, Bhat & Hussanie, 2017; Northouse, 2022). These theories include Fiedler's contingency, situational leadership, and decision making.
Influence Approaches	Mid-1920s to 1977	James M. Burns, Robert House, and Max Weber	The principle of this group of theories is that leadership is a process of social exchange or influence between leaders and followers (Dugan, 2024). Some of the theories under this category include path-goal, transformational leadership, charismatic leadership.
Reciprocal Approaches	1978 to the present	George Graen, Jams M. Burns	This theory assumes that leadership is a shared and interactive process between leaders and participants with a common goal. Followership is emphasized to achieve social change (Dugan, 2024). Some of the theories under this category include the leader-member exchange theory, transactional leadership, servant leadership, and
New Leadership Approaches	1990 to the present		Leadership is an influential relationship process within an evolving and complex system (Benmira & Agboola, 2021). Theories in this category include, but are not limited to, chaos

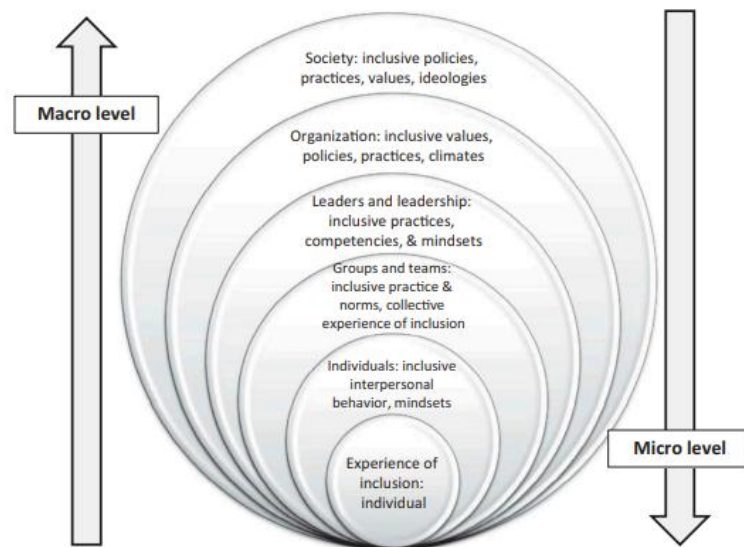
			leadership, authentic leadership, adaptive leadership, inclusive leadership, strategic leadership for social change, and others.
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**2.3.2.2.2. Inclusive leadership**

Due to the realization that traditional theories needed to address the complex nature of leadership in its entirety, new leadership theories emerged (Benmira & Agboola, 2021). A crucial aspect of 21<sup>st</sup> century leadership is the capacity to be inclusive, as well as to create and maintain an inclusive culture in communities, organizations, and workplaces (Ferdman, Prime & Riggio, 2020). Inclusive leadership theory is one of the new theories believed to address the under-representation of women in leadership roles, particularly in male-dominated environments such as STEM.

When an organization adopts an inclusive approach, it clearly indicates that it values people of all backgrounds (Davis, 2024). In today and tomorrow's businesses and communities, successful and effective leadership demands a deep understanding of and proficiency in generating and igniting opportunities to capitalize on diversity in all its forms and augment these capacities in oneself and others (Ferdman *et al.*, 2020).

According to Ferdman *et al.* (2020), inclusion is a complex, multifaceted, and multilayered process and construct manifested from micro- to macrolevel and thus developed at several systemic levels. The scholar describes it as “an interacting set of structures, values, norms, group and organizational climates, and individual and collective behaviours, all connected with inclusion experiences in a mutually reinforcing and dynamic system” (Ferdman, 2014:16). The concept of inclusion at work refers to how leaders, groups, organizations, and their members enable everyone to have a sense of belongingness and connectedness by allowing them to provide input, participate, and contribute without losing their individuality or having to give up essential facets of who they are (Ferdman, 2014). Ferdman (2014), therefore, proposed a multilevel systemic framework that illustrates the construct depicted by Figure 2.3 on page 26. In terms of this model, people who experience inclusion demonstrate this through their behaviour and thinking. In group settings, there is a collective practice of inclusion, and leaders play an essential role in ensuring that organizational practice, policies, and climates are inclusive. This then filters through to societies the individuals are part of. On the contrary, inclusion can start from a macro-level and cascade down to the micro- or individual level.



**Figure 2.3: Systems of inclusion: a multi-level analytical framework**

Source: Ferdman, Prime and Riggio (2020:9)

As discussed earlier in this chapter, the benefits of inclusion and diversity in STEM fields vary. Therefore, STEM organizations must diversify their teams, especially in leadership roles, to ensure innovation and success. Inclusive leadership has been identified in the literature as an enabler to the advancement of women to leadership positions, particularly in male-dominated industries such as STEM environments (Meng & Neill, 2021; Randel, Galvin, Shore, Ehrhart, Chung, Dean & Kedharnath, 2018). According to Randel *et al.* (2018), inclusive leadership is more appropriate in matters relating to gender and diversity, as it fosters a sense of belonging and values diversity like other leadership philosophies fail to do. Their arguments are based on comparisons made with other new leadership theories, such as transformational, empowerment, servant, leader-member exchange, and authentic leadership styles, which do not adequately address the uniqueness of individuals by accepting them as they are and valuing their unique contributions to the workplace.

### 2.3.3. Summary

The under-representation of women in STEM leadership roles is a multifaceted and complex issue that cannot be explained using a single theory. Therefore, the theoretical lens provided in this section of the literature review is critical in understanding the complex nature of leadership and how societal norms and expectations contribute to the under-representation of women in leadership roles within STEM fields in organizations. The social psychological theories examined illuminated the social stereotypes and biases that contribute to this problem. As members of organizations are also members of society, these biases are further established in

organizational settings through different organizational processes and are evident in leadership roles for women already occupying these roles and the potential pipeline. The following section investigates the challenges women face in advancing to leadership roles at the organizational level and, ultimately, at the individual level.

## **2.4 OBSTACLES TO WOMEN'S ADVANCEMENT IN STEM**

Although corporations have started to promote the recruitment of women in senior management positions to achieve gender equality and enhance organizational performance, women face slower progression up the leadership hierarchy compared to their male counterparts (Schmitt & Wilkesmann, 2020). Multiple obstacles have been identified in the literature, both at the structural and individual levels, that contribute to the limited presence of women in senior management roles (Schmitt & Wilkesmann, 2020). These barriers that affect the leadership journey of women are called 'leadership labyrinths' (Northouse, 2022). According to Eagly and Carli (2018), the women's journey to leadership is a difficult path full of bends and curves, however, achievable. Understanding the systemic barriers that hinder diversity in organizational leadership is a crucial initial step toward cultivating inclusive leadership cultures (Russell & Metcalf, 2019). Several metaphors have been used in the literature to explain the barriers that prevent women from reaching leadership due to stereotyping and bias (Galsanjigmed & Sekiguchi, 2023). Three broad categories at which these barriers occur have been identified in the literature at the individual, organizational, and sociocultural levels (Zhu, Cooke, Chen & Sun, 2022).

### **2.4.1. Sociocultural factors**

Societal norms and bias contribute largely to the lack of women's advancement to leadership roles. Stereotypical views, tokenism, gender inequities, and situations in leadership positions are societal barriers that prevent women from advancing further in their careers (İnal-Cavlan & Ertan, 2023). Due to ingrained biases and stereotypes, women in leadership positions are often viewed as incapable of succeeding in these roles compared to their male counterparts, resulting in their marginalization and lack of self-confidence (Chanda & Ngulube, 2024).

The prevalence of unconscious gender bias, dual dilemmas, and in-group preference contributes to the challenges faced by women in STEM and, thus, their underrepresentation in leadership roles (Barkhuizen *et al.*, 2022; Mantler, 2020). Female research leaders face discrimination, resistance, and exclusion from crucial decision-making processes by their colleagues (Babalola, du Plessis & Babalola, 2021). Moreover, these women often encounter opposition and envy from senior colleagues. They must navigate the complexities of dealing with insubordination from older male subordinates, making their journey in leadership particularly arduous (Babalola

*et al.*, 2021). Gender biases and stereotypes are rooted in societal beliefs and expectations regarding gender roles. These phenomena find support in social role theory, which posits that societal perceptions of gender roles influence the organization of men and women in society based on gender stereotypes (Alqahtani, 2019). Gender role expectations are particularly pervasive in fields such as STEM where men hold most positions and contribute to the limited career growth opportunities available to women (Barkhuizen *et al.*, 2022; Dicke, Safavian & Eccles, 2019).

#### **2.4.2. Organizational factors**

Organizations contribute to gender stereotypes in many ways, from recruitment and promotion practices to organizational culture (Tabassum & Nayak, 2021).

##### **2.4.2.1. *Bias in recruitment and selection***

According to Alawi & Mubarak (2019), there is employment bias in STEM fields where women are less favoured, though they possess similar qualifications to their male counterparts. Scholars argue that imperceptible obstacles impede women's upward mobility to leadership positions inside an organization, known as glass ceilings (Galsanjigmed & Sekiguchi, 2023; Timmer & Woo, 2023). This obstacle is frequently caused by biases and gender preconceptions that prevent women from being recognized as competent leaders (Srivastava & Nalawade, 2023; Wiedman, 2020). Not only is a barrier implied by the metaphor, but it also highlights a person's incapacity to manage a senior role and, thus, their inability to progress to the next level (Lucia & Padgett, 2021).

##### **2.4.2.2. *Think manager-think male mentality***

Additionally, people evaluate current and future leaders based on implicit leadership theories, which are common views on what it takes to be a leader (Hoyt & Simon, 2024). The 'think manager-think male', a metaphor describing the perceived dissonance between traits usually associated with leaders and women, creates masculine standards for career advancement (Kulich, Gartzia, Komaraju & Aelenei, 2021; Rink, Stoker, Ryan, Steffens & Nederveen Pieterse, 2019). This notion exacerbates gender disparity in organizations by concentrating on male managers (Galsanjigmed & Sekiguchi, 2023). Consequently, women in authority often face the expectation of conforming to masculine leadership styles to validate their competence (Alqahtani, 2019; Hoyt & Simon, 2024).

##### **2.4.2.3. *Think crisis-think female mentality***

Gender bias regarding women's leadership capabilities may not always result in the preconception of their incompetence in a leadership role (Mashele & Alagidede, 2023). On the

contrary, to 'think manager-think male', there is a phenomenon called 'think crisis-think female'. This notion assumes that females are better suited to handle crises than males (Galsanjigmed & Sekiguchi, 2023). If and when women manage to achieve leadership positions, these roles can be more risky than those occupied by their male counterparts (Timmer & Woo, 2023). The literature suggests that in difficult times, women tend to be preferred candidates for leadership positions due to the preconceived notions that they are more sensitive, genuine, and caring and thus viewed as fit for these positions (Mashele & Alagidede, 2023).

#### **2.4.2.4. *Glass cliff***

Ryan and Haslam introduced a phenomenon known as a glass cliff in 2005, who argued that women are more likely to be assigned to leadership positions during difficult times when there is a greater chance of failure (Diehl & Dzubinski, 2024; Srivastava & Nalawade, 2023). It deals with how women who have already broken through the glass ceiling are assigned to riskier situations and roles than males, face gender inequities, and are held accountable for unfavourable outcomes that were already established before their appointment (Angélica, 2022; Srivastava & Nalawade, 2023). These women are set up to fail from the beginning, perpetuating the notion that women are unsuitable for leadership positions (Szilak, 2023). According to Obenauer and Langer (2019) the possibility of receiving similar leadership opportunities in the future may be reduced by such exposure, which may also result in unfavourable performance reviews, employment termination, and reputational harm. If women are to hold leadership positions, they will need to put in a great deal of effort to demonstrate their abilities or give in to the pressure of these challenges (Coetzee & Moosa, 2020).

#### **2.4.2.5. *Queen bee syndrome***

The queen bee phenomenon is another prevalent barrier that amplifies discrimination against women in organizational settings (İnal-Cavlan & Ertan, 2023). This phenomenon was initially introduced in 1974 by Staines, Tavis, and Jayaratne to describe certain behaviours caused by organizational inequities in which women in leadership roles intentionally obstruct junior women's possibilities for upward mobility (da Rocha Grangeiro, Gomes Neto, Silva & Esnard, 2024). This phenomenon suggests that women in leadership roles within male-dominated environments tend to distance themselves from other women and treat their male subordinates more favourably than female subordinates (Kremer, Villamor & Ormiston, 2019; Suharnomo & Permatasari, 2019). Baykal, Soyalp and Yeşil (2020) believe that this type of behaviour is caused by (a) the stereotypically negative characteristics associated with women, such as emotionality and meticulousness, and (b) their reaction to discriminatory organizational practices and, thus, social identity threat. Suharnomo and Permatasari (2019) argue that this

kind of behaviour negatively impacts victims, as they can feel intimidated and stressed out, leading to an uncomfortable and uncondusive work environment and operational disruptions.

#### **2.4.2.6. Double bind**

As women are socially perceived to be more nurturing and caring than agentic, a woman who asserts herself and assumes a leadership role could be seen as cold and less desirable than a woman who conforms to traditional gender attributes (Galsanjigmed & Sekiguchi, 2023; Tremmel & Wahl, 2023). This creates a paradoxical 'double bind' situation due to perceived incongruence of the role when women behave contrary to their social role (Hopkins *et al.*, 2021). Thus, they are criticized for not being feminine enough and condemned for lacking leadership qualities if they adopt a highly feminine approach (Alqahtani, 2019; Hoyt & Simon, 2024). Based on subjective leadership qualities associated with men, women find themselves in situations where they face subtle discriminatory practices and limited leadership opportunities (Casad, Franks, Garasky, Kittleman, Roesler, Hall & Petzel, 2021; Galsanjigmed & Sekiguchi, 2023; Rink *et al.*, 2019). This bias is particularly pronounced in STEM fields, where masculine traits are prioritized (Casad *et al.*, 2021). The literature suggests that women who show only one set of behaviour, that is, agentic or communal, are viewed as less effective leaders than those who portray a balance of both (Chikwe *et al.*, 2024).

#### **2.4.2.7. Lack of fit and backlash effect**

As masculine traits are preferred in STEM fields and leadership roles, women are expected to display these qualities to be viewed as influential leaders (Galsanjigmed & Sekiguchi, 2023). However, as argued by the social role theory, women are expected to behave in certain ways by society, while the role congruity theory posits that when women in leadership roles behave in ways that contradict their preconceived social role, then a role incongruence occurs, therefore leading to lack of fit and ultimately a possible backlash effect (Froehlich, Tsukamoto, Morinaga, Sakata, Uchida, Keller, Stürmer, Martiny & Trommsdorff, 2022). Additionally, achieving a balance between agentic and communal traits can be a challenge, and regardless of how these women behave, they may still receive criticism or backleash (Chikwe *et al.*, 2024). The study conducted by Chakraborty and Serra (2024) confirmed that women's appetite for leadership roles is affected by threats of backlash.

#### **2.4.2.8. Sticky floors and gender pay gaps**

The term "sticky floors" denotes invisible barriers preventing women from upward career mobility to executive roles and being compensated equally as their male counterparts in the same roles (Puspitasari & Putry, 2023). This phenomenon suggests that women are held back and stuck in the same low-paying jobs for a long time, with minimal chances of career

progression and advancement (Shabsough, Semerci & Ergeneli, 2021). The gender wage gap is a widely recognized and debated ethical issue in scientific fields, where women consistently earn less than men for comparable work and qualification (Samaniego, Lindner, Kazmi, Dirr, Kong, Jeff-Eke & Spitzmueller, 2023; Van Staden *et al.*, 2019). Despite some decrease over time, the gap persists and is more prominent in higher-level positions (Samaniego *et al.*, 2023; Wiedman, 2020). Two main theories attempt to explain this disparity: one attributes it to the higher likelihood of women taking leave for family responsibilities, leading to the perception of lower productivity and justifying lower pay, while the other points to cultural stereotypes and preferences that favour men, particularly in STEM occupations, resulting in higher wages for male employees (Van Staden *et al.*, 2019). Samaniego *et al.* (2023) found that the correlation between gender and pay was more favourable toward men, exacerbating the gender pay gap.

#### **2.4.2.9. *Traditional academic career model***

Individual productivity, particularly publication, is the key driver for women's advancement in STEM (Babalola *et al.*, 2023). The traditional academic career model, which emphasizes continuous publications and regular promotions, perpetuates the perception that women with discontinuous careers are less productive compared to male colleagues, resulting in systematic disadvantages for women (Beaudry *et al.*, 2023). Publishing is one of the most fundamental and crucial activities in science (Ghiasi, 2021). Scientific publication has evolved into a task and a goal to obtain credentials, jobs, or promotions in the age of the publish or perish mentality (Cuschieri, 2022). Three connected factors can be used to explain this: (a) Publications are the primary means by which new knowledge is disseminated because they are officially recognized as scientific or scholarly; (b) scientific reward systems are built around publications, which give researchers credit and reputation; and (c) publications serve as an official declaration of peer approval, defining the procedures by which scientific performance is evaluated (Ghiasi, 2021). In most cases, the publication rate for males is higher than for females (Kwiek & Roszka, 2022). Several factors have been attributed to the low publication rate of female researchers, such as family commitments, low confidence levels, capacity and commitment and skills to conduct and publish studies (Beaudry *et al.*, 2023; Sougou *et al.*, 2022). In some cases, the Matilda effect exists where women are not acknowledged for their contributions as much as their male counterparts (Ross, Glennon, Murciano-Goroff, Berkes, Weinberg & Lane, 2022).

#### **2.4.2.10. *Limited research funding***

Although there has been a rise in the proportion of female researchers obtaining grants and awards, they still fall behind their male counterparts (Safdar, Naveed, Chaudhary, Saboor, Zeshan & Khosa, 2021). Due to the critical role that research funding has in the advancement to senior roles within academic and research professions, inequalities in funding also play a part

in the insufficient retention and career advancement of marginalized groups, such as women (Jebsen, Nicoll Baines, Oliver & Jayasinghe, 2022).

#### **2.4.2.11. Bias in evaluations**

The literature suggests that systematically there is an under-representation of women in peer-reviewed publications, both as first and last authors, compared to the ratio of women in STEM fields (Llorens, Tzovara, Bellier, Bhaya-Grossman, Bidet-Caulet, Chang, Cross, Dominguez-Faus, Flinker & Fonken, 2021). Peer review is a process by which manuscripts are evaluated by peers of the author, who are scientists or physicians who belong to the same area or sub-area of specialization or research (Peh, 2022). Additionally, reliance on traditional citation practices as an evaluation metric undervalues research conducted by women, as men tend to receive more citation than females (Llorens *et al.*, 2021). Therefore, some of the productivity gap may reflect a difference in the amount of credit given to women for their contributions to science rather than a difference in the amount of work they do (Ross *et al.*, 2022).

The incongruity between expectations and reality, as suggested by the Role Congruity Theory, leads to unfavourable performance evaluations, biases in information processing, and perpetuates discriminatory behaviours (del Carmen Triana *et al.*, 2023; Heilman & Caleo, 2018). Women researchers, possessing traits such as goal orientation and analytical skills, may struggle to conform to gender norms, facing social consequences like negative evaluations and exclusion, as the perceptions of assessors often do not align with the requirements for effective job performance, resulting in reduced appeal for leadership roles among women and higher attrition rates (Casad *et al.*, 2021; Mukarram, Saeed, Hammoudeh & Raziq, 2018; Samaniego *et al.*, 2023).

#### **2.4.2.12. Masculine cultures**

At the structural level, organizational culture, influenced by leadership styles and social norms, particularly masculine cultures, contributes to the under-representation of women in senior positions (Barkhuizen *et al.*, 2022). A culture characterized by masculinization encompasses implicit and explicit beliefs, practices, behaviours, policies, and procedures that promote the superiority of men's interests, including their abilities and skills over those of women (Baird, 2018). This results in dysfunctional workplace climates characterized by toxic leadership and gender inequality (Barkhuizen *et al.*, 2022). These cultures result in social identity threats and imposter syndrome (Van Veelen, Derks & Endedijk, 2019). The persistence of gender stereotypes poses challenges for women who aspire to work in traditionally masculine fields because they assume that certain actions and qualities are exclusive to men (Heilman & Caleo, 2018).

#### **2.4.2.13. *Microaggressions in STEM***

Microaggressions, prevalent in STEM fields, constitute subtle, yet enduring discriminatory acts that perpetuate identity-based privilege (Makarem & Metcalfe, 2023). Gender microaggressions are described as “brief (hence ‘micro’) and regularly experienced verbal, behavioural, or environmental indignities that—often unintentionally—communicate hostile, derogatory, or negative slights toward women” (Kim & Meister, 2023:516). According to Russell and Metcalf (2019), gender and racial inequalities persist in leadership roles within STEM fields, as organizations perpetuate a lack of diversity through biased cultures and microaggressions that hinder women's progress and prevent institutions from fully leveraging the existing untapped leadership potential they possess. Women in STEM often face various forms of microaggression, including devaluation of their competence and physical presence through a microinsult (Kim & Meister, 2023). Microinsults, which belittle individuals based on marginalized identities, can manifest institutionally as gender pay disparities or heavier workloads for women in STEM (Makarem & Metcalfe, 2023). Additionally, microinvalidations, which undermine women's experiences of gender bias, are prevalent (Kim & Meister, 2023).

These microaggressions can be underestimated by individuals not subjected to negative stereotypes, leading to a lack of awareness about their harmful impact (Sekaquaptewa, 2019). They perpetuate the societal notion of male superiority, reinforce traditional gender stereotypes in the workplace, and contribute to violence against women through objectification and sexualization (Makarem & Metcalfe, 2023). In male-dominated STEM fields, where women's leadership is often questioned, these microaggressions threaten women's identity as leaders, exacerbating feelings of exclusion and lack of fit in such environments (Kim & Meister, 2023).

#### **2.4.3. Individual factors**

Numerous factors hinder the advancement of women in STEM fields, including leadership roles (Andersen, 2023). The ramifications of gender biases and stereotypes extend beyond the advancement of women's research careers and impact their lives (Van Veelen & Derks, 2022). Some of these factors will be discussed next.

##### **2.4.3.1. *Self-limitations, lack of self-confidence and efficacy***

Limitations imposed on oneself by physical, emotional, psychological, mental, and social factors that result in low self-esteem and self-doubt are known as self-limitations (Longe & Ouahada, 2019). Self-limiting beliefs about career choices and internalization of stereotypes

undermine women's sense of purpose and social fit and perpetuate gender biases within organizations (Galsanjigmed & Sekiguchi, 2023; Schmader, 2023). A highly significant positive self-evaluation and one of the most frequently researched personal predictors of goal-directed behaviour is self-efficacy (Rigotti, Korek & Otto, 2020). Occupational self-efficacy in the workplace is the belief in one's own competence and ability to carry out and execute actions important to their line of work, as well as the assessment of the implications of successful completion of the task (Hartman & Barber, 2020).

Research has shown that self-efficacy is related to selecting more difficult assignments, persevering through difficulties, and eventually achieving results (Rigotti *et al.*, 2020). Due to self-limiting beliefs, women's self-assessments and effectiveness can be negatively affected, leading to a lack of confidence in their ability to succeed (Cundiff, 2018). Women with low occupational self-efficacy or negative self-belief are less inclined to take chances; they do not want to be visible at work and present a negative image of themselves. This causes them to abstain from taking on leadership responsibilities and negatively affects their leadership aspirations (Hartman & Barber, 2020). Self-efficacy affects task performance through self-regulation and goal setting during performance (Sandrone, 2022). Fear of negative evaluation and its associated repercussions force these women to conform to specific appearances and behaviours dictated by expectations of social role (Amon, 2017).

Moreover, women can feel incongruent with the traditional "superhero" archetype of success, characterized by traits such as self-confidence, self-centredness, and competitiveness, creating a cognitive dissonance that poses a significant barrier to their advancement and professional development (Van Veelen & Derks, 2022). Women, therefore, end up taking jobs that are more people-centred, office, and data-driven than leadership roles (Batara, Ngo, See & Erasga, 2018).

#### **2.4.3.2. *Imposter syndrome***

Female scientists commonly experience the 'imposter syndrome' (Van Staden *et al.*, 2019). This phenomenon affects accomplished individuals who doubt their abilities and attribute their success to external factors such as luck, fraud, or deception (Chakraverty, 2022; Freedman, Green, Kussman, Drusano & Moore, 2023). It was introduced by Clance and Imes in 1978, who argue that it has three distinct characteristics, namely (a) the belief that others amplify one's skills and abilities, (b) the fear of exposure as a phoney, and (c) constantly giving credit to external factors when success is achieved (Mann, 2019). Consequently, women often attribute their successes to external factors rather than their capabilities (Chakraverty, 2022; Szilak, 2023). Such a self-deprecating mindset can adversely affect physical and mental health, self-

presentation, confidence in one's abilities, and integration and success within academic settings (Chakraverty, 2022; Freedman *et al.*, 2023).

#### **2.4.3.3. Social identity or stereotype threat**

The literature suggests that the poor performance of women and their low participation in STEM fields are largely caused by the threat of social identity (Hall, Schmader, Aday, Inness & Croft, 2018). Social identity threat is conjured when people experience fear of stigmatization, ill-treatment, or being undervalued due to their membership in a certain group (Tabassum & Nayak, 2021; Van Veelen *et al.*, 2019). Social identity threats can harm well-being, general cognitive abilities, self-control, decision-making skills, self-worth, and sense of belonging (Van Staden *et al.*, 2019). In a STEM field where men predominate, women's experiences of social identity threat have a detrimental impact on how they view their careers, especially on job engagement and confidence (Van Veelen *et al.*, 2019).

#### **2.4.3.4. Workload and lack of work-life balance**

Due to the need for women in male-dominated industries such as STEM to prove themselves, they find themselves in situations where they need to overcompensate and overwork to get the recognition they deserve (Mazlan, Asri, Chamhuri & Al-Hadi, 2023). Women in leadership jobs must balance many roles, home obligations, and work obligations, which causes them an enormous amount of stress and conflicting demands on their time (Dzingwa & Terblanche, 2024). The findings of the study conducted by Batara *et al.* (2018) confirmed that women in managerial positions experience frustrations and stress due to their multiple responsibilities at work. This results in them lacking personal and family time. Balancing work and personal obligations is crucial for women in leadership positions, particularly when leading in male-dominated fields like STEM (Brue, 2019).

The progression and success of women in scientific careers heavily depend on influential factors such as cultural environments, economic limitations, and socio-institutional arrangements regarding women with children in the workforce, including emotional and practical family support (Bello & Estébanez, 2022). The conflict arising from the struggle to achieve work-life balance significantly impacts their career trajectories (Main, Wang & Tan, 2022). This is particularly notable among female scientists who leave their STEM professions after giving birth for other jobs that offer them the required flexibility to create a work-life balance (Cech & Blair-Loy, 2019). Juggling work commitments with caregiving duties poses substantial challenges, particularly for scientists who are single parents (Hansen, 2020). Additionally, Nanyiti and Sseruyange (2022) have established a correlation between higher fertility rates and decreased participation of women in STEM fields, further emphasizing the

interconnected nature of family dynamics and women's engagement in scientific pursuits. Women who encounter greater levels of work-life conflict are more prone to perceive their workplaces as unsupportive (Coetzee & Moosa, 2020).

#### ***2.4.3.5. Lack of social capital***

The gender gaps observed in STEM faculty can also be attributed to women's comparatively lower social capital, which refers to their limited access to influential social networks and interpersonal connections that provide advantages such as material resources, networks, and other benefits crucial for progressing in their careers (Casad *et al.*, 2021). Establishing a strong research reputation is essential for securing research funding effectively (Jebsen *et al.*, 2022). Lack of social capital can also arise from other factors such as limited decision-making powers, low salaries, fewer opportunities, and lack of laboratory facilities (Casad *et al.*, 2021).

#### ***2.4.3.6. Lack of role models and mentorship opportunities***

Women require role models in leadership positions that they can look up to (Batara *et al.*, 2018). Most women in STEM careers lack role models and mentors. Research suggests that women are inspired by female role models, especially in fields like STEM where women are under-represented (Robles, Martínez, Prieto, Catinsani & Salgado, 2021). Witnessing successful women in these fields motivates other women to pursue career advancement, contributing to greater gender diversity in traditionally male-dominated industries (Robles *et al.*, 2021). Exclusive requirements, cultural challenges, and geographical barriers restrict their access to traditional networking avenues, contributing to their under-representation (Boccuzzi & Uniacke, 2021). Additionally, it can be challenging for female employees to actively seek mentors if organizations do not have formalized mentorship programmes available (Garner & Van Staden, 2022).

#### **2.4.4. Summary**

In summary, the challenges women face in STEM are numerous and multifaceted. These range from the societal stereotype issues which then filter into organizational settings, making it difficult for women to advance to positions of power. When they manage to break through the glass ceiling, they still face challenges that make their career journey very difficult. Unfortunately, the ramifications of these challenges go beyond the career journey of these women and affect their psychological and emotional well-being. This combination of barriers at different levels hinders women's career advancement and growth opportunities in STEM, perpetuates inequality (both on the organizational and social levels), and creates a hostile environment for women in leadership roles or those with aspirations to leadership.

## 2.5 LEGAL FRAMEWORKS FOR GENDER EQUALITY

In pursuit of gender equality and inclusive representation in STEM fields, South Africa has recognized the importance of empowering women to leadership positions (DST, 2019). The South African government is observing several international treaties. It is a signatory to the Convention of the International Labour Organisation Convention (100, 111, 156), which requires the elimination of discriminatory practices as far as employment opportunities, remuneration, and equal treatment are concerned, as well as the 1979 Convention of the United Nations on the Elimination of All Forms of Discrimination Against Women (CGE, 2023). Furthermore, South Africa has established several legislative frameworks that serve as a foundation to promote gender equality and combat discrimination within South African society, particularly in women's empowerment in various sectors, including STEM (South Africa, 2019). The South African government has shown its commitment to addressing gender inequalities since 1994 with the dawn of democracy. According to Section 9 of the Constitution of South Africa 1996 (as amended), "everyone is equal before the law and has the right to equal protection and benefit of the law" (South Africa, 1996). This right laid the foundation for subsequent legislation on workplace equality and women's empowerment. In 1995, South Africa committed itself to implementing the Beijing Platform for Action, which seeks to empower women and eliminate any form of gender inequality (CGE, 2023).

The Employment Equity Act 55 of 1998 is a framework of legislation with the purpose of promoting workplace equity by eliminating unfair discrimination and ensuring equal opportunities and fair treatment in employment. Additionally, it aims to implement affirmative action measures to address disadvantages experienced by designated groups, ensuring their equitable representation across all occupational categories and levels in the workforce (South Africa, 1998). Section 20 of the Employment Equity Act calls on the corporate sector to guarantee adequate representation of women at all job levels, with a particular emphasis on managerial positions (Marimbe, 2023). To encourage responsibility and transparency in advancing equity, the Act requires employers to submit an annual Employment Equity Report (Maria & Collins, 2017). In April 2023, the Presidency of South Africa signed the Employment Equity Amendment Act 4 of 2022 into law, amending the existing Employment Equity Act 55 of 1998, whereby the Minister of Employment and Labour has been granted the power to establish numerical targets for particular economic sectors, resulting in businesses within those sectors being required to adhere to specific equity goals and transformation objectives (Deventer, 2023).

In 2000, the Promotion of Equality and Prevention of Unfair Discrimination Act (PEPUDA) 4 of 2000 was passed, which is a prominent piece of legislation promoting equality in leadership,

education, and the labour market by ensuring fair treatment between genders. It prioritizes promoting gender equality and establishes enforcement mechanisms like equality courts and alternative forums to uphold and safeguard equality principles (Shopola, Malapane & Nokele, 2023).

The South African National Assembly approved the Women Empowerment and Gender Equality Bill 50 of 2013 in March 2014. Still, due to significant concerns, the legislation was referred to parliament for additional consultation during the review process (Coe, Wiley & Bekker, 2019). This legislation is designed to effect Section 9 of the Constitution of the Republic of South Africa, 1996, by focusing on women's empowerment and gender equality. It establishes a legal framework to align all laws and their implementation to promote women's empowerment and increase women's representation in decision-making positions and structures (South Africa, 2013).

The 2019 White Paper on Science, Technology and Innovation by the Department of Science and Innovation emphasizes the importance of increasing women's participation in the scientific workforce. It proposes the creation of a Women in Science Desk within the DSI to address and promote gender equality in science and technology (DST, 2019; Mouton, van Lill, Prozesky & Redelinghuys, 2022).

In summary, South Africa has made significant strides in promoting gender equality and empowering women in STEM. This is evident through the country's formal agreements with other countries, various developed legislative frameworks, and policy initiatives undertaken.

## **2.6 THE ROLE OF ORGANIZATIONAL LEADERSHIP IN ADVANCING WOMEN IN STEM**

The role of leadership in organizations has transformed over the years from a classic sense that included basic managerial duties and influence on leading organizations in an era of change and innovation (Kozioł-Nadolna, 2020). The vision, strategies, organizational structure, and culture of an organization are influenced by its senior leaders, who hold positions of power at the highest level within the organization (Martins, 2020). The leader is crucial in providing direction and guidance to individuals. Through their actions, leaders can persuade their followers to adopt desired behaviours and identities in pursuit of organizational goals (Molla & Shawlin, 2023).

Considering the women in STEM's challenges in advancing their careers to leadership roles, it is critical to comprehend the role leaders play in creating inclusive work environments in such organizations. Leaders are strategically positioned to foster diverse and inclusive workplaces through their behaviours, values, and principles which influence their follower base (Santos, Luna, Reyes, Traylor, Lacerenza & Salas, 2022). Leaders develop and implement strategic plans that reflect the company's philosophy on inclusion and diversity (Rahman, 2019). This involves developing a clear and comprehensive strategy that promotes and embraces diversity and inclusion within the organization (Rahman, 2019; Van Buskirk, 2020). Inclusion encompasses the purposeful and continuous effort to guarantee that individuals from diverse backgrounds, possessing various identities, can actively engage in every facet of an organization's operations, which encompasses holding leadership roles and participating in decision-making procedures (Tan, 2019). An essential element of the strategy regarding equality and advancing women to leadership positions entails the purposeful recruitment of traditionally under-represented individuals in science, particularly women (Swartz, Palermo, Masur & Aberg, 2019).

In addition to crafting a strategy that supports diversity and inclusion, the responsibility of a leader is to ensure that the strategy is effectively communicated and implemented throughout the company, fostering an inclusive and diverse work environment (Rahman, 2019). It involves active support of its implementation by ensuring that the necessary resources are provided, there is an equitable distribution of work, innovation is promoted, and realistic targets are set for achieving the goals (Balcerzyk, 2021). To have a sense of inclusion, individuals need to feel a sense of belonging within a group where their unique identities are valued and they are treated as insiders, while also being able to learn from and utilize the differences among team members.

The role of leaders also involves providing an organizational culture and climate that are inclusive, equitable, and diverse, which is crucial to creating an environment where women feel welcomed, accepted, secure, supported, accomplished, and valued (Coe *et al.*, 2019; Santos *et al.*, 2022; Zhao, 2020). As employees expect leaders to provide the context within which they should function, leader behaviour and adoption of the desired values are critical to providing an environment of trust (Feyes, 2018). This behaviour of leaders and managers sets the psychological climate in organizations and determines the toxicity or health of their organizations (Gilbert, Carr-Ruffino, Ivancevich & Konopaske, 2012). Psychological safety refers to the behaviours, ownership, and efficacy of a leader in promoting inclusivity (Venter, Plessis & Stander, 2024). Organizational leaders have a role to play in creating a supportive work environment for women. This includes identifying relevant competencies for their growth, establishing clear equality policies, and helping these women overcome masculine tendencies

(Ketchiwou & van der Walt, 2023). It also involves eliminating barriers to pervasive masculine cultures, disintegrating systemic barriers, and establishing an atmosphere where everyone is treated with respect and fairness, ensuring equal opportunities for engagement and progress that contribute to organizational success (Chanda & Ngulube, 2024; Panicker, Agrawal & Khandelwal, 2018).

## **2.7 LEADERSHIP ADVANCEMENT STRATEGIES**

### **2.6.1. Individual strategies**

Despite the barriers women face in STEM fields, some can navigate their way to leadership roles by using personal strategies. Creating the necessary informal connections and networks is vital for women to advance themselves and navigate the challenges they face with respect to leadership and access opportunities (Chikwe *et al.*, 2024). Sponsors and mentors are crucial to women's career progression as an advancement tool to assist them in gaining the relevant competencies and assignments for critical projects that will benefit their career aspirations (Cosentino, Weese & Wells, 2021). Attending networking events, collaborating with colleagues, and membership in professional organizations can help these women by providing support networks and serving as opportunities for career growth (Chikwe *et al.*, 2024). Furthermore, these networks can increase and strengthen the social capital of women in STEM by increasing access to knowledge, resources, and sponsorship (Cantrell Robinson, 2017).

Women who excel in their careers are self-motivated and focus on achieving their goals (Burke & Simmons, 2020). Working hard and being self-motivated assists women in STEM to build resilience against gender-insensitive workplaces and navigating some of the challenges such as time management, family responsibilities, and ensuring work-life balance (Fathima, Awor, Yen, Gnanaselvam & Zakham, 2020). Badura, Grijalva, Galvin, Owens and Joseph (2020) contend that the motivation propelling a person to lead is a fundamental element of the leadership process. The scholars base their arguments on the fact that those with intrinsic motivation are driven to succeed in leadership roles and will persist and persevere in their leadership efforts.

Regarding career goals and advancement, women prefer a multifaceted strategy focusing on achieving role competency and preparing for career success. In the context of leadership, this means that women will wait to fulfil leadership positions until they feel they can pursue them. Thus, self-efficacy is vital for women to pursue leadership roles (Hartman & Barber, 2020). Awareness and recognition of the existence of gender bias in organizations is also essential for

women to recognize when it happens and find ways to navigate such situations and discourage further prejudice and discrimination (Cheers, 2017).

Establishing trust in scientists is essential. Ensuring that colleagues, clients, and stakeholders know that women in STEM are qualified, capable, and competent to do their jobs is vital to establishing credibility and trust (Burke & Simmons, 2020). Participating and presenting at scientific conferences allows women in STEM to receive peer recognition, including networking and career growth opportunities (Fathima *et al.*, 2020). Having ally support that can vouch for women's competence and capabilities in their work can help establish credibility and trust, and it can help these women regain their confidence in their technical ability (Kim & Meister, 2023).

When workplace norms and expectations are incongruent with women's authentic selves, the logical response could be to create a façade. However, this can negatively impact individual productivity and well-being (Johnson, 2024). Women can adopt non-masculine and effective leadership styles (Galsanjigmed & Sekiguchi, 2023). Authenticity is vital in such situations to effectively navigate stereotypes and biases that negatively affect women's leadership abilities and effectiveness in these roles. They can remain true to themselves by not compromising their beliefs and values, embracing their identity, and demonstrating self-confidence in their abilities (Chikwe *et al.*, 2024).

Emotional intelligence advocates argue that leaders' high emotional intelligence behaviour demonstrates effective leadership that results in efficiencies and positively impacts the success of individuals (Duan, Asif, Nik Hasnaa Nik & Wan Normeza Wan, 2023). Emotional intelligence is the ability to comprehend one's and others' feelings, motivate oneself, and effectively manage emotions in oneself and relationships (Duan *et al.*, 2023). Emotional intelligence can be gained through the practice of self-control/ management, self-awareness, social skills, and empathy according to Coleman's Competency Model (Chikwe *et al.*, 2024; Shabani, Citaku, Ramadani, Mano, Barach, Waldrop, Zillioux & Hayat Khan, 2021). Self-awareness is a trait that helps people to be emotionally alert and understand why those emotions exist (Shabani *et al.*, 2021). Self-management is the ability to manage one's emotions practically (Lubbadeh, 2020). Social skill refers to a person's ability to build networks and manage relationships, while empathy refers to a person's ability to manage (Karasneh & Al-Momani, 2020).

To ensure work-life balance, women must identify priorities at work and in their private lives. This will enable them to focus on issues with the highest impact. Setting boundaries between

work and family life, including taking time to care for yourself, is also essential to ensure mental and physical well-being (Bilger, 2024).

### **2.6.2. Organizational strategies**

Organizational culture is critical to the advancement of women to leadership roles. Masculine cultures hinder the advancement of women to leadership roles, while inclusive and supportive cultures create an empowering environment that provides women with the opportunity to excel and thrive (Chanda & Ngulube, 2024). Women already in STEM leadership positions should ideally utilize their positions to influence inclusive policies to assist those in the pipeline (Mukhwana *et al.*, 2020). Increasing the number of women in leadership positions leads to an increase in female leaders in an organization and challenges masculine cultures and gender bias (Galsanjigmed & Sekiguchi, 2023).

An inclusive organizational culture can reduce stereotype threat experiences (Hall, Schmader, Cyr & Bergsieker, 2023). Hall *et al.* (2023) propose three ways to develop and support inclusive cultures. The first one involves adopting a top-down approach in which the organization communicates cultural information to the workers through various communication tools available in that organization. This can be achieved using highly valued and credible individuals who will communicate cultural messages and persuade employees to embrace diversity and inclusion. The second approach is the adoption of community transmission of information where there is a communication and transmission of information between workers. This can be achieved through the identification of influential people amongst workers as communication vehicles to get other workers to embrace inclusion. Other methods could be through social learning by observing the behaviour of others. The last approach is grassroots transmission where there is communication from the workers to the organization. The scholars further propose the use of public platforms to recognize individuals who model inclusive behaviours and address any violations of the organization's inclusive norms and expectations.

Demonstration of the organizational commitment to diversity through early-stage talent recruitment practices is essential to ensure there is a sufficient pool of leadership pipeline (Sin-Ning, Stephanie & Isaac, 2019; Susilowati, Hidayat, Wardani & Purwanti, 2022; Zhu & Wang, 2023). The first step is to continuously evaluate organizational recruitment and retention policies, including pay equity (Swartz *et al.*, 2019). A diverse recruitment strategy can attract the desired pool of candidates (Casad *et al.*, 2021).

To ensure more equitable evaluation, which has implications for future career progression and possibly under-representation of women at senior levels in STEM fields, it is necessary to

address biases and deeply held stereotypes about women in STEM. These stereotypes can negatively impact how women in STEM are evaluated due to their lack of alignment with stereotypes about being scientists (McKinnon & O'Connell, 2020). To eradicate gender bias cultures in treating women and their leadership competency evaluations, awareness and education initiatives that help organizational members identify their own biases are recommended (Llorens *et al.*, 2021). Ideally, the recruitment panel should also be trained on diversity and equality in recruitment processes (Casad *et al.*, 2021). Specifically, training that emphasizes the qualities men and women have in common rather than how they differ will probably be more successful (Caleo & Heilman, 2019).

Furthermore, reviewing the peer review process for publications is essential to ensure that female researchers are fairly evaluated and credited for their work. This can be done in various ways, including but not limited to double-blind reviews where the authors' name is not disclosed to the review panel, adoption of an open peer review process where the authors, editors, and reviewers' names are made public, or hybrid peer review method where there is an open platform for discussions to take place regarding the publications between the scientists and the reviewers while maintaining the anonymity of the authors (Llorens *et al.*, 2021).

Conducting employee onboarding programmes that include leadership development and organizational values, policies, and processes is also beneficial in advancing women to leadership roles (Kirchner & Akdere, 2019). Organizations should consider investing in leadership development programmes that provide networking, mentorship, skill building, and career advancement opportunities for women in leadership positions to enable them to reach their full potential and overcome barriers (Chikwe *et al.*, 2024). Kirchner and Akdere (2019) suggest that leadership-related experiential learning exercises should be built into these programmes, so recruits will have to evaluate their competencies against the required leadership competencies at the end of the exercises and identify opportunities for self-development. Providing personal development opportunities to address competency gaps will help these women advance their careers to leadership roles. This includes addressing accountability, optimism, and confidence (Ketchiwou & van der Walt, 2023). Assisting these women with career management support, from helping them with career mapping and planning to assigning them to projects and programmes that positively contribute to their career growth and refine their leadership capabilities will be helpful (Ketchiwou & van der Walt, 2023).

Giving these women stretch assignments and the necessary support in the form of internal coaches or support staff will contribute positively to their career advancement and ensure that they succeed in these assignments (Burke & Simmons, 2020). Providing developmental

opportunities to learn and experience leadership will boost their self-esteem and combat internalized gender norms (Galsanjigmed & Sekiguchi, 2023). Women will also feel that their skills and abilities are valued and that their specific needs as women are met when given the opportunity to advance by taking on leadership responsibilities and further growth opportunities (Coetzee & Moosa, 2020). It is also beneficial to invest in line managers by training them on inclusion and how to assign challenging tasks to their team members equitably (Burke & Simmons, 2020). Organizations can also help these women identify leadership styles that align with their strengths to ensure they can thrive and be authentic in their approach (Galsanjigmed & Sekiguchi, 2023). Additionally, it will be beneficial to provide support in the form of internal coaches who can guide these women through challenging situations and act as their sounding board when important decisions need to be made (Burke & Simmons, 2020). Fostering an environment where women are acknowledged and respected as authentic leaders helps dismantle gender stereotypes and self-limiting beliefs (Galsanjigmed & Sekiguchi, 2023). Leadership training should be enhanced with role modelling, networking, sponsorships, and mentoring, as critical enablers of women's leadership and career advancement (McGinty, 2024).

Mentorship and role modelling play a crucial role in the success of women in STEM fields by combating negative stereotypes and fostering a sense of identity and belongingness (Freedman *et al.*, 2023). Mentoring is an informal or formal initiative organizations provide to mentees to support their professional and personal development (RuizCantisani, Lara-Prieto, García-García, Ortiz, Flores & Romero-Robles, 2021). Mentoring programmes are considered helpful attraction and retention tools to bridge the gender inequality gap in STEM (Saffie-Robertson, 2020). Historically, mentoring was done in person, encouraging a trusting environment between mentor and mentee (RuizCantisani *et al.*, 2021). Ideally, mentors should come from the same identity groups as mentees who share similar experiences to make mentoring programmes succeed (Sin-Ning *et al.*, 2019). However, the social capital of women may also develop quickly if a prominent male person shows interest in their professional careers (Eagly & Carli, 2018). In such cases where the organization opts to have male mentors for women in STEM, it is essential to ensure that such programmes are supported with practical diversity and inclusion guidelines, clear procedures, and appropriate levels of support and training for mentors (Burke & Simmons, 2020). The mentor-mentee relationship fosters a community built on trust, growth, and networking, enabling the development of skills, knowledge, and personal and professional growth (RuizCantisani *et al.*, 2021). Mentoring programmes have a positive impact on female mentors as they create the perception that they are role models to other women and provide them with the opportunity to acquire both technical and soft skills in the process (Torres-Ramos, Fajardo-Robledo, Pérez-Carrillo, Castillo-Cruz, Retamoza-Vega, Rodríguez-Betancourt & Neri-Cortés, 2021). Rewarding mentors with financial incentives, time, and recognition will

ensure that willing mentors are available for these women (Burke & Simmons, 2020; Diehl & Dzubinski, 2023).

However, mentoring on its own is insufficient to help women advance to leadership roles (Ayyala, Skarupski, Bodurtha, González-Fernández, Ishii, Fivush & Levine, 2019). STEM organizations should prioritize the development of professional environments that facilitate women's retention and optimal performance at senior levels (Moss-Racusin, Pietri, van der Toorn & Ashburn-Nardo, 2021). In addition to mentoring, sponsorship is a recommended strategy to increase the number of women in leadership positions for organizations battling women's under-representation in these roles (Hayman, 2020). Sponsorship is defined as “active support by someone appropriately placed in the organization who has significant influence on decision-making processes or structures and who is advocating for, protecting, and fighting for the career advancement of an individual” (Fourst-Cummings & Dinolfo, 2011 as cited in Ayyala *et al.*, 2019:94). It is a valuable element of mentoring that seeks to expedite the mentee's or protégé's exposure to significant professional circles and career advancement opportunities through the mentor's influence (Randel, Galvin, Gibson & Batts, 2021). Proficient mentors are highly experienced and professionally connected talent scouts with access to networks that offer unwavering assistance while elevating protégés (Ayyala *et al.*, 2019). The sponsor, in addition to offering advice, actively assists the protégé in advancing in their careers by ensuring that they are considered for challenging projects and promotions and protects them from negative scrutiny (Melvin & Leblanc, 2020). Accessing and exerting influence within professional networks is a prerequisite for a sponsor's efficacy (Ayyala *et al.*, 2019). The protégés also access the sponsor's networks through a sponsorship opportunity. Creating networking opportunities for women in STEM is essential to reduce feelings of isolation, alienation, and tokenism associated with performing leadership roles in STEM as a minority group (Sin-Ning *et al.*, 2019). Hosting events that showcase successful women in STEM and creating platforms where both men and women in STEM can share their knowledge and learn from each other can also be helpful (Burke & Simmons, 2020).

In addition to the availability of career-advancing networks, effective work-life balance is essential (Brue, 2019). Organizations can support work-life balance by adopting strategies that make workplaces more accommodating for women. This includes developing policies that protect women's rights on the job, supporting their reproductive health needs, and considering their family needs when deciding on transfers or other business needs (Mukhwana *et al.*, 2020). According to Garner and Van Staden (2022), acknowledging the parental responsibilities of women and supporting work-life balance result in higher levels of engagement and productivity. Implementing flexible working options, such as flexible schedules,

telecommuting options, and remote work opportunities, helps women advance their careers without compromising their personal lives (Chanda & Ngulube, 2024). Organizations can also consider the development of objective productivity metrics in which highly productive women with a demanding home life are rewarded for their work efficiency (Eagly & Carli, 2018).

## **2.8 CONCLUSION**

In conclusion, advancing female researchers to leadership positions in STEM fields is a critical endeavour that requires addressing the challenges they face and leveraging the role of organizational leadership. The theoretical framework examined in the literature review, which includes social role, role congruity, gendered organizations, and inclusive leadership theories, seeks to illuminate the reasons for the under-representation of women in leadership roles, in addition to the most effective leadership style required to address gender disparity in STEM and ensure an inclusive and welcoming environment for women.

Social role theory highlights the challenges social norms and expectations bring. These stereotypes are ingrained in people and ultimately play out in organizational settings. Role congruity highlights the challenges that women face when their preconceived gender roles are not aligned with the behaviour required from leaders, according to the social role expectations, resulting in a lack of fit and other issues.

Gendered organizations theory seeks to explain how societal stereotypes affect organizations and are established in normal operations through policies, structures, processes, behaviours, and cultures that discriminate against women. When combined with social role and role congruity theories, this suggests that organizations sustain the marginalization and discrimination of women by embracing traditional gender norms through their structural and cultural makeup, maltreating them, and punishing them when their social roles contradict their professional roles.

Inclusive leadership, on the other hand, challenges traditional gender practices and stereotypes as posited by the theories of social role and role congruity by ensuring that marginalized groups, specifically women, are accommodated, empowered, treated fairly, and valued. It also seeks to break down the traditional structures and cultures created by gendered organizations that undermine women's advancement in organizations, especially those that are male dominated, such as STEM. The combination of these theories, therefore, provides a rich context for the study, highlighting critical issues that lead to the under-representation of women in STEM leadership roles.

It is evident from the literature review that women in STEM face many challenges in their career journey. These stem from social structures to which these women belong, as evidenced by the theories of social role and congruity of roles and gendered organizations. The barriers then filter through to organizational structures and manifest themselves in many ways as organizations operate as subsystems of a bigger system, therefore, resulting in gendered organizations. They then infiltrate the individual level, become internalized, and affect the individual personally.

This study identified several barriers, including metaphors used to explain the under-representation of women in leadership roles. All these barriers illuminate the complex and multi-layered issues that women must deal with to advance themselves. These barriers affect women adversely and sometimes lead women to lose interest in leadership roles. It is clear from the literature review that societal expectations and stereotypes contribute largely to the phenomenon. Structural or organizational barriers include, among others, biased organizational cultures, gender inequality practices, and limited career growth opportunities. At the individual level, a lack of self-confidence and esteem caused by gender biases and negative experiences of these women in the workplace and within society are some of the barriers that affect their leadership aspirations. These barriers perpetuate gender disparities in organizations and society at large, contribute to the gender pay gap and low economic empowerment of women, and hinder their full potential in leadership.

There is sufficient justification for including women in STEM leadership and having a diverse leadership team. Achieving gender diversity in STEM leadership is essential for justice, economic sustainability, and better outcomes in research and innovation. Various laws have also been passed to address gender inclusion and economic empowerment of women. At the international level, treaties were signed and South Africa committed itself to implementing the treaty agreements. At the local level, laws were passed to address this matter, and several other initiatives were carried out. Despite progress in promoting gender equality in leadership, women still face slower progression and numerous challenges in reaching senior positions.

Leadership has been defined in many ways in the literature and from the various definitions the study investigated, it is evident that no singular definition of the construct aligns with the views of other researchers. The evolution history of leadership theories provides a broad overview of how the construct started and evolved. It also highlights the dynamic nature of this construct. Based on the synthesis of the definitions considered for this study, a definition adopted here is that leadership is an influence relationship between leaders and followers that leads to change

that leads to achieving organizational objectives. In this study, a leadership role is any role that fits the adopted definition.

Therefore, organizational leadership plays a crucial role in advancing women in STEM. This involves developing comprehensive strategies that promote diversity and inclusion. Leaders should implement recruitment practices that attract and retain women, eliminate barriers, and establish a respectful and fair work environment. Effective communication and implementation of diversity and inclusion strategies are essential to foster an inclusive and diverse organizational culture. Mentoring programmes and flexible working options can also support women's career development and work-life balance. Addressing the challenges of women researchers in STEM requires collective efforts from leaders, organizations, and society. The literature review also investigated some of the strategies women in STEM can use to advance their careers, as they are also responsible for their own development and advancement.

By dismantling barriers, providing equal opportunities, and promoting inclusive leadership cultures, a conducive environment can be created where women in STEM can thrive, contribute their unique perspectives, and achieve leadership positions that will benefit the field of STEM. The following chapter looks at the research methodology adopted by this study to answer the research questions and achieve its intended objectives.

## **CHAPTER 3**

### **METHODOLOGICAL APPROACH**

#### **3.1 INTRODUCTION**

This chapter outlines the methodological approach adopted by the study to explore the challenges women in STEM fields face in their quest to advance to leadership positions. It outlines the research design and approach used to investigate the factors that hinder and enable these women's progression to leadership roles within the South African Research Institute. The chapter further discusses the target population for the study, the sampling method adopted to select eligible participants, and the eligibility criteria and justification for inclusion or exclusion of participants. Following this, the study's data collection and analysis methods are discussed. Attention is also given to issues of trustworthiness, ethical considerations, and assumptions and limitations of the study.

#### **3.2 RESEARCH PARADIGM AND APPROACH**

This study adopted a qualitative phenomenological approach to explore the challenges women face in STEM in advancing to leadership positions. This study addresses the challenges women in STEM experience in advancing their careers to leadership roles, leading to their under-representation within the South African Research Institute. As stated in Chapter 1 of this study, the literature on gender, STEM careers, women, and leadership is extensive. However, there has been limited focus on the perceptions and experiences of women in STEM across research institutes in South Africa regarding the barriers they face in advancing to leadership roles. The primary phenomenon of this study is therefore the challenges that women in STEM face at the South African Research Institute in their quest for leadership roles and their perception of the role of organizational leadership in women's advancement discourse. This applies to those already in leadership roles and those aspiring to leadership, including the leadership pipeline. Chapter 2 of this study highlighted several challenges women in STEM face in advancing to leadership roles, but these challenges were not explored within the context of research institutes in South Africa.

In the social sciences, qualitative approaches have gained acceptance, as researchers recognize that many studied phenomena are complex and require in-depth introspection and incisive analysis (Smith & Nizza, 2022). Qualitative research is a naturalistic inquiry that does not use numerical data to explain or control phenomena. Instead, it seeks to investigate and understand situations based on how individuals experience them (Aspers & Corte, 2019; Nassaji, 2020). The perceptions and experiences of participants, as well as how they make meaning of their lives, are therefore the subject of qualitative research (Creswell & Creswell, 2023;

Liamputtong, 2020). The benefit of qualitative approaches is that they offer an in-depth comprehension of research issues, delving into the viewpoints and settings of the research target population (Hennink, Hutter & Bailey, 2020). Using a qualitative approach, researchers can develop and apply their subjectivity and interpersonal skills to their exploratory research methods (Alase, 2017). The use of this method aligns well with the purpose of this study: to investigate and understand the challenges and strategies for advancing women to STEM leadership roles within the South African Research Institute.

The methodological approach most often applied in qualitative research is phenomenology (Liamputtong, 2020). Phenomenology is defined as “the study of the meaning of lived-through experiences — phenomena, as they appear, reveal, and show themselves, and as they give themselves in our consciousness before they have even been named, conceptualized, abstracted, and/or theorized” (Van Manen, 2023:39). Phenomenological research is a method of inquiry rooted in psychology and philosophy that involves the description of the lived experiences of participants about a phenomenon through interviews (Creswell & Creswell, 2023). Phenomenology, as a qualitative research approach, focuses on examining first-hand experiences within individuals' environments, with its core aspect revolving around the examination of lived experiences through conscious awareness and reflective introspection (Neubauer, Witkop & Varpio, 2019; Smith & Nizza, 2022). Two essential components regarding consciousness emerge from this concentration, being that it is intentional and non-sensory. Intentional means that its primary focus is on an object that could be immanent to the conscious process or transcendent to it, real or not, and possibly absent. The second aspect that awareness is fundamentally non-sensorial must be recognized (Giorgi, Giorgi & Morley, 2017).

Phenomenology is deeply rooted in philosophy and borrows extensively from Edmund Husserl's writings, including Heidegger, Merleau-Ponty and Sartre (Creswell & Poth, 2018). Different phenomenological approaches exist in the literature, each following a specific philosophical underpinning (Neubauer *et al.*, 2019; Vagle, 2018). This study will highlight two common types of phenomenological approaches used in qualitative studies: interpretive or hermeneutic phenomenology and descriptive or transcendental phenomenology (Alhazmi & Kaufmann, 2022; Neubauer *et al.*, 2019). Descriptive phenomenology, which derives its theoretical foundation from Husserl's earlier works, focuses on psychological or transcendental subjectivity or awareness as an area of investigation (Larsen & Adu, 2022). Husserl posits that phenomenology is fundamentally concerned with lived experiences of intentional events, objects, things, or entities as they present themselves in human awareness (Van Manen, 2023). Husserl uses the technical word ‘intentionality’ to denote the interconnectivity between the object of attention and the associated cognitive processes (Smith, Flowers & Larkin, 2022).

Husserl further advocates for epoché and bracketing, meaning the exclusion of any bias, judgment, or assumptions when analyzing the experiences and focusing purely on the experience itself and using phenomenological reduction to uncover the essence of the lived experience (Larsen & Adu, 2022).

Giorgi built on Husserl's philosophy and highlighted the importance of analyzing others' descriptions, adopting a phenomenological reductionist mindset (bracketing) and looking for homogeneous psychological meaning (Vagle, 2018). The transcendental perspective implies that meanings of such experiences are constituted by elements external to the apperception horizon and objects themselves, residing instead in how objects are processed in the mind by consciousness or perception (Larsen & Adu, 2022).

Interpretive phenomenology, also known as hermeneutic phenomenology, is rooted in the philosophy of Martin Heidegger (Neubauer *et al.*, 2019). It highlights the experiences and unique perspectives of the participants within a specific setting (Ramsook, 2018). This methodology enables researchers to examine how culture, traditions, and experiences influence everyday behaviours (Oerther, 2021). Unlike Husserl's philosophy, Heidegger's perspective focuses on the phenomenology of being known as 'Dasein' by examining human actions and interactions with objects, illuminating the significance or meaning of their existence (Larsen & Adu, 2022; Van Manen, 2023). Heidegger adopted an ontological approach in which he was interested in being and temporality, whereas Husserl adopted an epistemological approach interested in knowing (Neubauer *et al.*, 2019). Heidegger stressed the importance of considering phenomenology as an interpretive process and believed that understanding the meaning of experience requires seeing past its outward manifestation and accounting to discover its inner significance (Smith & Nizza, 2022). Since interpretative phenomenological analysis believes that people are sense-making beings, the accounts that participants give will show how they are trying to interpret what happened to them (Smith *et al.*, 2022). For Heidegger, a person cannot leave their lifeworld or witness an event without thinking back to prior knowledge (Neubauer *et al.*, 2019). This inquiry explores the meaning of being through the ontological explanation of experiencing and the scope of time (Larsen & Adu, 2022). The foundation of hermeneutic phenomenology is interpretation: the use of one's own lifeworld to make sense of events and occurrences (Neubauer *et al.*, 2019). It is based on two key ideas: Heidegger's theory that the individual is constantly and irrevocably a worldly "person-in-context" and the phenomenological notion of intersubjectivity (Smith *et al.*, 2022). In hermeneutic phenomenology, the investigator's prior experiences, subjective point of view, and expertise serve as invaluable guidelines for the investigation, acknowledging that the researcher cannot escape his or her lifeworld, much like the research participants (Neubauer *et al.*, 2019).

The selected phenomenological method for this study is the interpretative or hermeneutic approach. It was deemed appropriate as the study aims to understand the challenges women in STEM face within the South African Research Institute in advancing to leadership positions and their perceptions of the role of leadership in women's advancement discourse. The goal of the interpretative phenomenological analysis is to engage with the reflections of people as they begin to consider the importance of what is happening when they are involved in 'an experience' of a significant event in their lives (Smith *et al.*, 2022). The lifeworld concept in this study plays a key role. As stated in Chapter 2 of this study, leadership is a multicomplex and multifaceted issue; the same applies to women's challenges in advancing to leadership roles. By exploring the lived experiences and personal narratives of these women about how they make sense of their world, the study can uncover how the intersection of societal, institutional, and personal factors affects their career aspirations and leadership journeys. The approach focuses on the participants' perspectives, enabling a deep dive into the challenges they experience in their career path. Common themes or challenges can be identified through structured interviews, guiding the study recommendations. The method also acknowledges the role of the researcher's life view on the phenomenon, thus allowing for the interrogation of theory to gain deeper insights into the matter to inform practical strategies that the South African Research Institute and women in STEM can use to ensure inclusive leadership. Similar studies investigating the challenges women face in advancing their careers to leadership roles adopted a phenomenological research approach and demonstrated its efficacy in providing a deeper understanding of the phenomenon under study (Barkhuizen *et al.*, 2022; Dlamini, Mncube, Mkhasibe & Kutame, 2024; Harley, 2022).

### **3.3 SAMPLING**

The selection of participants, subjects, or respondents for a study is known as sampling (Islam & Aldaihani, 2022). To gain a deeper understanding of a phenomenon, researchers often select individuals from a broader community who have a connection to the phenomenon being studied (Haenssger, 2019).

#### **3.3.1. Sampling method**

A sample is a smaller data set selected from a larger population (Wegner, 2020). A population is "a group of individuals, objects, items or entities with common characteristics or attributes" (Etikan & Babtope, 2019:50). To generate accurate and reliable estimates of the population from which it was taken, a sample must be representative of its intended audience (Wegner, 2020). Sampling was done using the nonprobability sampling method. Non-probability sampling is the name given to any sampling technique in which sample participants are not

randomly chosen (Wegner, 2020). Non-probability sampling relies on the researcher's determination, allowing the interviewer to control the sample selection, which is faster, more convenient, and cost-effective than probability sampling methods (Wiid & Diggins, 2021). This sampling technique is generally suitable for studies that seek to establish an initial understanding of the phenomena (Mweshi & Sakyi, 2020).

Purposive sampling, a form of non-probability sampling method, was used for this study. Purposive sampling according to Palinkas, Horwitz, Green, Wisdom, Duan and Hoagwood (2015) is a qualitative research approach for identifying and selecting cases with much information to make the most of limited resources. The aim was to focus on individuals who fit the specified profile and can contribute to the research agenda (Etikan, Musa & Alkassim, 2016). A form of purposive sampling that was employed is homogeneous sampling. To ensure that the study is relevant and meaningful to respondents, interpretative phenomenological analysis researchers work to create a purposeful and relatively homogeneous sample (Noon, 2018). Purposive homogenous sampling was deemed suitable for this study, given the emphasis on the study population. This allowed the researcher to gather information about a particular set of people who have encountered a certain phenomenon (Noon, 2018). Homogeneous sampling is adopted when the study population shares similar characteristics and the phenomenon under study applies to that group (Douglas, 2022). Purposive sampling is the most used non-probability sampling method, in which participants are selected based on their knowledge inclination and experience (Etikan & Babtope, 2019). Similar studies have also used this method (Davis & Maldonado, 2015). Its advantage is that it provides the researcher with a wide range of non-probability sampling methods to choose from; however, it is subject to the researcher's bias and can make justification for its use difficult (Sharma, 2017).

Additionally, convenience sampling was used for this study due to the difficulty of finding willing participants and obtaining diary entries for interviews. Convenience sampling, although less desirable, is frequently used to select respondents based on their convenience and availability (Creswell & Creswell, 2023). This technique proves very helpful in exploratory research, where concepts and perceptions hold higher value than the objectivity of science (Wiid & Diggins, 2021). Since the study population consisted of individuals engaged in various projects, the convenience sampling was appropriate based on the willingness and availability of the target participants.

### **3.3.2. Sample size**

The sample size refers to the number of respondents chosen from the population to represent the entire study population (Wiid & Diggins, 2021). The optimal sample size to accurately

represent a population depends on the level of homogeneity or diversity within the population; the more similar the population members are, the smaller the sample size needed, and the more diverse the population, the larger the sample size required (Adams & McGuire, 2022). The sample size of a phenomenological study traditionally ranges from 2 to 25. The homogeneity of the sample pool should be represented and reflected in the selection of the participants (Alase, 2017). As the study employed an interpretative phenomenological analysis method, this allowed the researcher to find an adequately homogeneous sample conducted on small sample sizes (Smith *et al.*, 2022).

The principle of saturation is widely used to evaluate the sufficiency of purposive samples in qualitative research (Hennink & Kaiser, 2022). Saturation is the stage where the gathering of additional data does not produce further insight or information relevant to the research questions (Guest, Namey & Chen, 2020; Lowe, Norris, Farris & Babbage, 2018). Data saturation is the conceptual benchmark for estimating and evaluating sample sizes in qualitative research (Guest *et al.*, 2020). The information richness of the chosen cases and the observational or analytical ability of the researcher have more to do with the validity, significance and insights obtained by qualitative inquiry than the sample size (Tolley, Ulin, Mack, Robinson & Succop, 2016).

According to Guest *et al.*(2020), 6 to 7 interviews are necessary to reach 80% saturation on average, indicating that further data collection only contributes to new insights. However, at the higher end of the threshold (95th percentile), a larger sample size of 11 to- 12 interviews may be needed to achieve greater saturation. Based on Guest *et al.*(2020) arguments, the sample size for each group was 6 to 7 participants to ensure 80% saturation. Therefore, the base size for this study was 6 participants per group with a total sample size of 12 to 14 participants. Base size refers to the minimum number of interviews that should be conducted to identify new or unique themes within the group and determine data saturation (Guest *et al.*, 2020). The benchmark for the new information threshold was 0%. The plan was to conclude the interviews once saturation was reached. However, had new information still available after the sixth interview, a run-length of 3 was going to be used. A set of subsequent events or interviews is referred to as a run, while a run length refers to the number of interviews that are conducted to determine the presence of new themes (Guest *et al.*, 2020). This meant that 3 more participants were going to be interviewed to identify new themes.

### **3.4 TARGET POPULATION**

The target population for this study was women professionals in STEM fields within the South African Research Institute, particularly those involved in research work. This included those already in leadership roles and those aspiring to leadership roles. The participants were at

different stages of their career. An eligibility criterion or inclusion and exclusion list guided the recruitment of participants for this study. The inclusion and exclusion criteria list for participant selection plays a crucial role in determining the feasibility and quality of data in a study, as overly narrow or broad criteria can result in inadequate or ambiguous information (Hornberger & Rangu, 2020).

### 3.4.1. Eligibility criteria

To be eligible for participation in the study, the participants were required to meet the following criteria:

Group A - STEM professionals:

- Must identify as female.
- Hold a candidate or researcher position within STEM fields.
- Possess over 12 months of experience within the organization in STEM fields.
- Possess at least a master's degree in a STEM field.
- Willing to share insights and experiences related to their STEM career journey during the interview process.

Group B - STEM leaders:

- Identify as a female
- Hold a leadership position (e.g., middle manager, senior manager, senior researcher, principal researcher, or chief researcher) within a STEM field.
- Have at least 12 months of experience in their current role.
- A doctoral degree in a STEM field or equivalent professional experience.
- Be willing to reflect and share insights regarding their journey to leadership, challenges faced, and strategies employed to advance women in STEM roles.

The eligibility criterion for the two groups was guided by the job profiles of the prospective participants and their natural upward mobility or career path.

- **Requirement for participants in specific positions:** The requirement for STEM professionals who are part of the leadership pipeline was guided by the fact that they are future leaders, and understanding the challenges they face in advancing to leadership roles will assist in finding ways to mitigate those barriers to ensure equity and diversity in leadership teams. The requirement for those in leadership positions is guided by their first-hand experience of the barriers and challenges associated with advancing or operating in those roles as females within the STEM fields. The assumption is that they have employed some strategies to overcome these barriers, and those insights are

valuable to those still aspiring to leadership roles. By including both groups, the study sought to gain a balanced perspective on these challenges and identify any systemic gaps that must be addressed to ensure equity and inclusion in leadership teams.

- **Requirement for 12 months of experience in the role:** The requirement for a specific degree per group was guided by the job requirements of their current position. To ensure that participants could contribute meaningfully to the study objectives, a minimum of 12 months of experience in the current role was considered per group. Having 12 months of experience in a role gives potential participants reasonable experience, understanding, or exposure to challenges related to the advancement of their careers to leadership roles. This also aligns with the annual career ladder application process, by targeting individuals with a year of experience, the study ensures that people familiar with its requirements participate and provide meaningful information.
- **Requirement for a specific qualification:** The requirement for a master's degree for pipeline employees and a doctoral degree or appropriate experience was driven by the job requirements for senior or leadership positions. The job requirements for a managerial role, chief researcher, and principal researcher require candidates to have a doctorate degree.
- **Requirement for willingness to participate:** As participation in research studies is voluntary, it was critical that participants were willing to participate and share their experiences. This ensured that rich data, offering the lived experiences of these women, was gathered to meet the study objectives.

#### **3.4.2. Recruitment of participants**

Potential participants were identified through consultation with various members of the management team, particularly operations managers and senior managers, to obtain the names of possible participants who met the eligibility criteria. Existing networks were also used to identify and refer potential candidates willing to participate in the study. The study aimed to enrol between 12 and 14 participants and increase the numbers by a duration of 3 if new themes emerged after the last interview. Participants were recruited from different units, ethnicities, and cultures within the organization. Twenty suggested names were received with 8 participants already occupying leadership roles, and 12 identified as part of the potential leadership pipeline

Potential participants were contacted by phone to determine their willingness to participate. After the telephone discussion, an official invitation to participate was sent to those who expressed interest in participating. The informed consent form, gatekeeper's approval, and ethical clearance letter were attached to the invite with a brief description of the documents.

While it was difficult to contact some of the individuals telephonically and through email, 15 responded positively. Two participants did not honour their interview appointments; follow-up communication was sent to determine their availability without any response. Therefore, they were deemed to have lost interest in participating in the study. Thirteen participants were interviewed, 12 of them met the eligibility criteria.

During the recruitment phase, the participants were informed about the nature of the study and ethical considerations applied, such as the voluntary nature of the study for academic purposes, their right to withdraw without justification, the commitment to protecting their identity and that of the organization, and the confidentiality of the discussions. The informed consent form that was attached to the email invitation also reiterated these issues. Interview sessions were scheduled based on the availability of participants and their preference for virtual or physical meetings. No new themes emerged after the 10<sup>th</sup> interview. The last three interviews were shorter than the others, lasting only 30 minutes, while others took about an hour to complete. Due to the lack of new themes emerging even after completing the 12<sup>th</sup> interview, it was determined that additional interviews would unlikely provide new insights and data saturation has been reached.

### 3.4.3. Participant profile

The demographic information of the participants for this study is presented in Table 3.1 below.

*Table 3.1: Participants' demographic information*

#	Participant Pseudonym	Date of interview	Age Group	Highest Qualification	Current Position	Years of Experience in Current Position	Previous Roles
1	Amethyst	18/10/2024	46-55	PhD	Senior manager	2 years	Senior researcher and middle manager
2	Coraline	31/10/2024	46-55	PhD Candidate	Senior manager	4 years	Registered architect, researcher, middle manager

3	Crystal	14/11/2024	46-55	PhD	Senior researcher	3 years	Candidate researcher, researcher
4	Emerald	12/12/2024	46-55	PhD candidate	Senior researcher Acting position as a middle manager	9,5 years 3 years	Specialist, researcher, senior researcher
5	Gemma	10/12/2024	46-55	PhD	Principal researcher	8 years	Post-doctorate studentship, senior researcher
6	Jade	14/10/2024	46-55	PhD	Middle manager	8 years	Researcher, senior researcher, principal researcher
7	Opal	30/10/2024	46-55	PhD	Middle manager	7,5 years	Engineer
8	Rosequartz	23/10/2024	36-45	PhD	Principal researcher	3 years	Senior researcher
9	Ruby	02/12/2024	46-55	PhD	Senior researcher	5.5. years	Post-doctorate studentship, researcher
10	Sapphire	07/11/2024	36-45	Masters candidate	Senior researcher	5 years	Consultant
11	Topaz	22/11/2024	36-45	MEng	Systems Engineer	8 years	Systems engineer in another company
12	Aventine	13/11/2024	36-45	PhD	Senior researcher	7 years	Vacation student, researcher

13	Pearl	03/12/2024	36-45	MSc	Technician	12 years	Technician
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#### 3.4.4. Participant inclusion and exclusion decisions

After the recruitment of potential participants, formal invites were sent to those who expressed interest in participating in this study and were subsequently interviewed. However, during interviews, it was established that five participants did not fully meet the eligibility criteria requirements. Certain decisions had to be made about these participants who were eager to participate in the study. Below is an outline of the decisions taken regarding their inclusion and exclusion, along with the justifications for those decisions.

**Decision 1:** Senior researchers were excluded from the leadership group and placed in the leadership pipeline group due to the lack of participation of junior researchers. As these positions are not yet at the leadership level, the decision to place them under the leadership pipeline is justified.

**Decision 2:** Exclusion of participant 'Pearl' who was employed as a technician for 12 years with a master's degree from the STEM leadership pipeline group. Although Pearl met the qualifications requirement in terms of having a master's degree, her current role, which supports researchers, is more technical in nature, and she is not required to produce research articles or attract research funding as those who are actively involved in research work. Although this role is valuable to ensure credible research by the organization, it does not meet the requirements of being employed in a research role and is misaligned with the research objectives.

**Decision 3:** Inclusion of the participant 'Sapphire', who was employed as a senior researcher for 5 years with an honour's degree in the STEM leadership pipeline group. While Sapphire has an honours degree, she works as a senior researcher for a period of 5 years and is currently pursuing her master's degree to align her qualifications with job requirements. Although she did not have completed her master's degree, she was employed in the role before the qualification requirement was revised, and her active pursuit of the degree to ensure she meets all requirements is a commitment to her intention to meet educational requirements. Her experience exceeds the minimum requirement of one year and is thus deemed suitable or eligible to participate.

**Decision 4:** Inclusion of participant 'Coraline' employed as a senior manager for 4 years with a master's degree, awaiting Ph.D. conferment after submitting thesis or examination in the STEM leadership group. Coraline has been employed as a senior manager for 4 years now. She

previously occupied a middle management role for a period of 10 years in the research space before her promotion to a senior managerial role. She has a master's degree and just submitted her PhD. thesis for examination to meet the qualification requirements for her role. This demonstrates her commitment to fully meeting the job requirements, and she has practically completed her studies. With her extensive experience in this space, she is considered eligible for participation in the study.

**Decision 5:** Inclusion of participant 'Topaz', who was employed as a systems engineer for 8 years in the leadership pipeline group. While Topaz is employed as a systems engineer, she reports to a middle manager within the research space. Her line of work also requires her to conduct research activities and produce publications. Although her title does not specifically state 'researcher', its duties align with those of the researchers, and thus, it is deemed eligible to participate in this study.

The above decisions were made carefully to ensure that willing participants who can provide the rich information required by the study can participate.

### **3.5 DATA COLLECTION METHOD**

Data collection in qualitative research is defined as “the selection and production of linguistic (or visual) material for analyzing and understanding phenomena, social fields, subjective and collective experiences, and the related meaning-making processes” (Flick, 2018:7). There are two main categories of data collection, namely primary and secondary data collection methods (Taherdoost, 2021). Primary data are first-hand information collected by the researcher while secondary data refer to the information already available and produced by others (Ajayi, 2017).

This study utilized both primary and secondary data. Primary data were collected using a semi-structured interview guide. The use of one-to-one semi-structured guide is a common method used to collect data from interpretative phenomenological studies (Smith *et al.*, 2022). Guest, Namey and Mitchell (2013) argue that the ability to delve into replies or observations as needed to acquire more extensive descriptions and explanations of events, behaviours, and beliefs is the most significant advantage of this method. According to Creswell and Creswell (2023), the interview technique is proper when participants cannot be watched directly. Participants can also contribute historical information while the researcher controls the investigation path.

An interview guide was developed as a primary data collection method, which is provided in Appendix B of this study. The purpose of the interview guide was to ensure that all participants were asked the same questions to provide meaningful information for the study. This guide

contained three main research questions related to the objectives of the study. Each main question consisted of 3 to 4 sub-questions. Furthermore, demographic and eligibility criteria questions were included at the beginning of the guide to determine the eligibility of participants to participate in this study according to predefined eligibility criteria. It also included a question that required participants to share their career journey as women in STEM at the South African Research Institute. This question was designed to better understand the participants and served to provide context to the actual research questions. The interview guide questions were not rigidly adhered to. For questions where the participant provided more information than required, which was part of another question, that question was omitted, as responses were already obtained to ensure compliance with time limits and for the participants not to feel like they were constantly repeating themselves. In some cases, the participants answered a question and provided examples of what they would like to see happen; these inputs were captured in the section that deals with recommendations. Questions were rephrased as necessary during the actual interview process to ensure participants provided relevant answers.

As stated in Chapter 3, a total of 13 participants were interviewed. Twelve interviews were conducted virtually via Microsoft Teams for ease of recording and convenience, as some individuals work remotely. Only one participant requested that they not be recorded and that the meeting be held in person. This request was honoured. The sessions lasted between 30 and 60 minutes, depending on the intensity of the discussions. The participants' consent to record the discussion was obtained upfront. Access to the recording was limited to the individual interviewed and the researcher to protect their identity. The recordings were manually transcribed in preparation for the data analysis phase as some of the automatically transcribed information was not accurate due to speech recognition, language and accent model limitations.

Secondary data was collected through a literature review of published sources that align with the study topic and a review of company documents. Publications included online journals, books, and various government and institutional reports. Google Scholar, Google website, Microsoft Edge and UKZN library were used as the main search engines for the publications/reports. Words that match the specific phenomenon under study were used to identify suitable literature for the study. The information obtained in the journals was cross-checked to validate the information. Government and institutional reports provided valuable statistical data necessary to contextualize the study.

### **3.6 DATA ANALYSIS METHOD**

During research, data analysis is a continuous activity. It involves analyzing participant data, and researchers often use generic and design-specific analytic approaches (Creswell &

Creswell, 2023). In interpretative phenomenological studies, interpretations are limited by the investigator's data analytic ability, as well as the respondents' ability to explain their experiences (Noon, 2018). Smith *et al.* (2022) argue that there is no definitive right or wrong approach to performing an interpretative phenomenological analysis. A suitable and effective technique to attempt to understand a collection of events, ideas, or actions throughout a data set is thematic analysis (Kiger & Varpio, 2020).

Although the study aimed to understand women's lived experiences in STEM in advancing their careers to leadership roles, it also sought to identify patterns and broader themes across the experiences of the participants to ensure practical recommendations that will benefit most women in STEM within the organization. Thematic analysis is not tied to any preexisting theoretical framework, unlike IPA or grounded theory; as a result, it can be utilized within various theoretical frameworks and accomplish various tasks within them (Braun & Clarke, 2006). Therefore, this study adopted the Braun and Clarke six-step reflexive thematic analysis (RTA) method. The RTA method is used in various research designs and is flexible in terms of data set composition and size, for example, from comparatively homogeneous to heterogeneous data sets (Braun & Clarke, 2022). According to Braun and Clarke (2022), reflexivity requires the researcher to critically investigate how their experiences, social position, and prior knowledge contribute and influence the research process and possible insights into qualitative data.

Researchers are required to address some theoretical assumptions when conducting RTA studies (Byrne, 2022). These considerations are addressed below and the decisions taken in this study.

- **Essentialist vs. constructivist epistemologies**

The essentialist approach views language as a straightforward reflection of experience, whereas a constructivist perspective sees language as both shaping and being shaped by social processes, producing and reproducing meaning and experience (Byrne, 2022). This study adopts a constructivist approach where the experiences of women in STEM within the South African Research Institute are seen as an outcome of the intersection of organizational, cultural, personal, and social factors.

- **Experiential vs. critical orientation**

Experiential techniques seek to document participants' experiences and viewpoints by basing research on participant narratives rather than researcher classifications, critical orientation, on the other hand, question what conventional psychology and experiential approaches share, that is, the notion that language is only useful for describing feelings and emotions (Clarke & Braun, 2014). This study adopts an experiential orientation to

understand the lived experiences of women in STEM in the South African Research Institute.

- **Inductive vs. deductive analysis**

With an inductive approach, the data set serves as the foundation for exploring meaning, while a deductive approach relies on theoretical concepts for coding and interpreting data sets (Braun & Clarke, 2022). The study adopts inductive analysis when identifying emerging themes. The themes are identified from the data as they emerge, without any preconception of what they should entail. These are based on the nuanced experiences of women in STEM in this specific organization.

- **Semantic vs. latent coding**

Semantic coding focuses on the obvious or explicit meaning of data as narrated by the participants, while latent coding is more focused on the conceptual or implicit meaning of data (Braun & Clarke, 2022). This study mainly adopted semantic coding to ensure that the codes represent the real experiences of the participants.

This method entails a six-step process as proposed by (Braun & Clarke, 2022) as described below:

### **Step 1: Familiarizing yourself with the data set**

This step entails immersing oneself in the dataset, reading and re-reading the information, and taking notes of any insights or analytical ideas the researcher might have about the dataset (Braun & Clarke, 2022).

### **Step 2: Coding**

This step involves going through the data set analytically to identify data related to the research question and systematically coding the information by capturing single meanings (Braun & Clarke, 2022). When coding, an inductive, deductive, or combination of both approaches can be used (Byrne, 2022; Dawadi, 2020). Inductive analysis involves developing codes or themes independently from any other framework, while deductive analysis involves developing codes or themes based on the researcher's pre-existing knowledge derived from the literature review (Dawadi, 2020). Using both methods ensures that the depth of the analysis is maximized (Dawadi, 2020).

### **Step 3: Generating initial themes**

This step entails the identification of broad themes from the coded dataset. These themes are grouped together based on their relation to the research questions. Once the themes are

developed, the coded data that aligns with each candidate theme is collated (Braun & Clarke, 2022).

#### **Step 4: Developing and reviewing themes**

This step entails checking if there is a fit between the full data set, coded extracts, and the provisional candidate themes (Braun & Clarke, 2022).

#### **Step 5: Refine, define, and name themes**

This step entails ensuring the clear demarcation of each theme, built around a solid fundamental principle or idea. The researcher needs to ask themselves questions in terms of understanding what the themes narrate and how that fits into the holistic narrative about the data (Braun & Clarke, 2022).

#### **Step 6: Writing up**

This step entails formal writing of the findings and usually starts from step 3 (Braun & Clarke, 2022).

### **3.7 DATA STORAGE AND PROTECTION METHODS**

This section details the protocols and methods used to ensure data storage and protection of data collected throughout the study to ensure confidentiality and security of the organization and the information of its participants. Measures taken to maintain the confidentiality, ethical standards, and integrity of the research included:

#### **3.7.1. Data storage**

Alase (2017) recommends that a robust and secure storage system be included in the IPA study to manage and preserve research data. Data collected throughout this study are stored in the student's OneDrive cloud, deemed a secure system, and submitted with the dissertation for the university to store on the research platform. This includes the deidentified transcripts. The university's IT department protects the OneDrive storage. The signed informed consent forms are stored on the student's laptop with password protection.

#### **3.7.2. Data access control**

All the devices that contain the research data are password protected. The full data set is only accessible by the student and the study supervisor through the application of user access restrictions by the student on OneDrive.

### **3.7.3. Case study organization identity protection**

Given the requirement of the gatekeeper to keep the organization and participants' names confidential and the sensitive nature of the study, it was essential to implement appropriate measures to ensure compliance with this requirement. To protect the identity of the organization, the pseudonym 'South African Research Institute' was used throughout the study when it was necessary to identify the organization; this was also included in the transcripts. Any direct references to the actual location of the organization, the real name, the actual job titles, and departments or proprietary information were replaced with generic terms or similar names to prevent any risk of association and identification. The organizational material used, including reports, was redacted before being included and referenced in the study. Instead of verbatim producing the information from these documents, it was summarized.

### **3.7.4. Participants' identity protection**

To ensure the protection and anonymity of the study participants, each participant was given a name inspired by crystal stones. Information about the interview dates was excluded from the transcripts to mitigate the risk of association between the transcripts and the informed consent forms. When participants were invited to participate in the study, they were verbally informed about the need to complete the informed consent form. The informed consent form contained all the necessary information pertaining to the title of the study, its objective, how the participant's information will be protected, and the rights of the participants to withdraw should they wish to do so without consequences. Participants were also assured that their identity would be protected and that a pseudonym would be used to identify them in the study. Informed consent forms were kept separate from the dissertation to ensure anonymity. Although the signed informed consent forms were submitted by participants via email, the emails were deleted from the inbox and from the organizational archives folder and stored on a personal computer in a password-protected folder for reference should they be required.

### **3.7.5. Retention and disposal of data**

Data retention and disposal is critical in any research study to ensure that the collected data is retained according to university requirements and disposed of ethically. The ethical clearance letter states that the data from this study must be retained in the department for 5 years. Alase (2017) further recommends that audio, video or any recorded data be deleted for the safety and protection of participants after they have been transcribed. Interviews were conducted through Microsoft Teams, and recordings of individuals who agreed to be recorded were deleted from the platform and OneDrive storage after transcription to protect the identity of the participants.

### 3.8 ASSUMPTIONS

The following assumptions were made regarding the study:

- The pool of eligible women in STEM willing to participate in the study will be adequate.
- Potential respondents will avail themselves as per the scheduled dates and times.
- Respondents will freely engage and provide information during interviews that accurately reflects their experiences at the South African Research Institute without bias or fear of negative consequences for their participation in the study.
- The risk of participants withdrawing from the study during interviews is low.
- The information obtained from the participants will add value to the study objectives.
- Insights gained from the analysis of the findings and recommendations for practical implementation will benefit the South African Research Institute in its endeavours to attract and retain women in STEM.
- Ethical principles and guidelines that govern research with human participants will be followed throughout the study process, ensuring the protection of participants' rights, confidentiality, and well-being.

### 3.9 LIMITATIONS

This study posed several limitations as follows:

- One of the conditions of the gatekeeper's approval was that the identity of the organization and its subjects must always remain confidential. This meant that appropriate measures had to be taken to meet this requirement. Measures taken include the use of a pseudonym to identify the participants and the organization in the text and references. The URL of the organization had to be withheld in the reference list for confidentiality.
- Due to the nature of this study being an interpretative phenomenological study with a nonprobability purposive sampling method, the research findings cannot be generalized to other environments, as they are limited to one research institute in South Africa for the specified target group. According to Noon (2018), when using interpretative phenomenological analysis, the aim should be to grasp the views and understandings of a specific group within their environment rather than what happens in every situation. The research questions, therefore, sought to understand the participant's experiences in the case study organization, although some made references to previous employment to provide context to their journey and experiences as females in the STEM field.
- As the study employed a non-probability sampling method, the odds or probability with which the chosen sample represented the population is unknown because non-probabilistic samples do not rely on probability theory. However, it does mean that the results cannot be statistically extrapolated to a broader population or given confidence intervals. Fortunately,

these measurements are neither intended nor expected from this qualitative study (Guest *et al.*, 2013).

- This study was particularly focused on women in STEM currently employed in research activities; as a result, it excludes other women in STEM such as technicians or any other function that are not directly doing actual research work but part of the support structures. The study does not necessarily address issues from other professions or contexts where gender equity is a concern.
- The findings of the study are limited by the experiences of the women interviewed; therefore, the findings may lack broader applicability.
- A small number of women expressed interest in participating in the study, which could be attributed to the sensitive nature of the research topic and the timing of the interviews, which coincided with numerous organizational process cycles and deadlines.
- If participants felt unsafe to disclose some information, considering that the interviews were recorded, although consent was sought prior to recording, or if they had a sense that their anonymity could be compromised or did not fully comprehend the purpose of the study, they may have intentionally provided limited information, and this may potentially compromise the study findings. However, this was not picked up during the interviews, particularly for participants who agreed to be recorded, although it cannot be ruled out as a possibility.
- Creswell and Creswell (2023) contend that the use of interviews as a data collection method has some limitations:
  - Indirect information is provided through the perspectives of the respondents.
  - The presence of a researcher may influence the responses.
  - Not everyone is as articulate or perceptive as the next. This was noted during the interviews and may have limited the ability of some participants to fully narrate their experiences.

### **3.10 TRUSTWORTHINESS**

According to Kyngäs, Kääriäinen and Elo (2020), Lincoln and Guba first discussed the concept of rigour in qualitative research, which is based on the fundamental measure concept of trustworthiness. Their concept of trustworthiness covers credibility, confirmability, transferability, authenticity, and dependability.

- Credibility, as defined by Kyngäs *et al.* (2020), refers to whether the research findings offer a credible conceptual interpretation of the initial data. It aims to determine the extent to which the research findings align with reality, a judgment that is subjective and dependent on individual assessment, as noted by (Stahl & King, 2020). Employing

purposive sampling for this research ensured that the credibility of research findings was maintained by the deliberate selection of participants based on a specific criterion that contributed positively to the reliability and validity of the research findings.

- Confirmability refers to the degree to which the study conclusions are validated by the data obtained (Kyngäs *et al.*, 2020). As data were collected through structured interviews, some recorded recordings were readily available for transcription. The recordings were listened to several times to ensure that the transcripts reflected the words of the participants. The justification for the inclusion and exclusion of some participants who did not fully meet the eligibility criteria was clearly stated.
- Transferability refers to the extent to which research findings can be applied to different fields and situations (Kyngäs *et al.*, 2020). To ensure transferability, the eligibility criteria for the participants, including the sampling methodology used, were explicitly stated so that other researchers from similar institutions could determine whether the findings of this study are transferable to their specific situations.
- Authenticity refers to how accurately and faithfully researchers depict a variety of realities in their research report by including numerous citations that establish the relationship between results and data (Kyngäs *et al.*, 2020). At least two citations with the exact words of the participants were included in the thematic analysis in response to a specific question.
- Dependability refers to data consistency over time and under various settings (Korstjens & Moser, 2018). A standard structured interview guide was used for all interviews; this ensured that all participants were asked the same questions. No changes were made to the original approved research design.

### **3.11 ETHICAL CONSIDERATIONS**

The following ethical considerations were applied to this study:

- Gatekeepers' approval – Before any research can be conducted in the organization, a gatekeeper approval is required. Gatekeeper approval to conduct this research at the identified institute was received. The process of obtaining approval required the submission of a request to the organization's Research Study Committee, which reviewed the application before final approval. To uphold ethical standards, the organization granting permission for this research requires that its name and the identities of its employees always remain confidential. Therefore, no identifying details, including the organization's name, employee names, or specific job titles, will appear in this dissertation. This measure ensures anonymity and protects the privacy of all involved

parties. All research activities were conducted according to the approved protocol and in accordance with the set requirements.

- Ethical clearance – The University approved the ethical clearance before data collection could proceed, refer to Annexure D.
- Informed consent – Before participation in the study, all identified participants were advised to sign and submit informed consent. The informed consent template is attached as Annexure A. Participants were informed about the purpose of the study, voluntary participation, the freedom to withdraw at any time without penalty, and the right to respect confidentiality and anonymity. This was reiterated at the beginning of each interview session, and participants were asked to ask any questions they may have for clarity before the session started. Only one of the 13 participants expressed discomfort with the possible leakage of the discussion. The participant was assured of the confidential nature of the talks and their participation.
- Recording of the sessions – before recording the interview sessions, the participants were asked for their consent to do so. Only one participant declined the request to record. As a result, notes of their responses were taken during the interview session.
- For decades, applied sociologists, anthropologists, and other social scientists have been obligated to disseminate information to study participants and make findings public (Tolley *et al.*, 2016). The participants were assured that their identity and the organization would be kept confidential. The findings and recommendations will be communicated to the Human Resources team without disclosing the names of the participants.

### **3.12 CONCLUSION**

In conclusion, this interpretative phenomenological study employed a qualitative nonprobability research method. Using purposive sampling techniques to identify and recruit participants ensured that only information-rich data would be collected to identify the challenges women in STEM face in this institution. A clear eligibility criterion was established, allowing the researcher to look for potential participants who met the criterion. The recruitment strategy employed helped to ensure that participants who met the eligibility criteria were recruited for this study. Data collection was done through semi-structured interviews, providing both the researcher and the participants with an in-depth discussion of the subject matter.

Using thematic data analysis techniques was beneficial in understanding these challenges and how the organization can assist these women in advancing to leadership roles. Limitations posed by this methodology included the non-generalization of findings to other situations, the

possibility of participants withholding some information, especially if they thought their anonymity might be compromised, and the suboptimal timing of the interviews for data collection. Measures that will be taken to ensure the trustworthiness and credibility of the information include selecting participants who can provide rich information, recording the interview sessions, and member checking, among others. Using a phased thematic data analysis method will help to ensure that unique themes are identified and that data saturation is established. This study has also addressed ethical considerations to ensure that the study is conducted ethically.

# CHAPTER 4

## ANALYSIS OF FINDINGS

### 4.1 INTRODUCTION

This chapter presents the data collected from structured interviews with women in STEM within the South African Research Institute. It further highlights the main findings of this research study.

The study sought to answer the following four questions:

- What are the challenges that hinder the career advancement of women in STEM to leadership roles within the South African Research Institute?
- What strategies do women in STEM use to advance their careers and overcome challenges within the South African Research Institute?
- What is the perceived role of leadership in advancing women to STEM leadership roles within the South African Research Institute?
- What strategies and interventions can the South African Research Institute implement to promote the advancement of women leaders in STEM fields?

The research interview guide was developed in such a way that it covers all these main research questions. This chapter describes the data analysis and presents the study findings.

### 4.2 DATA ANALYSIS

As indicated in the previous chapter, the data analysis method employed in this study is the reflexive thematic analysis of Braun and Clarke (2006).

#### 4.2.1. Overview of the participants

The participants represented a mixed racial profile, that is, White, Indian and African. The analysis of the participants' demographic information is presented in Table 4.1.

**Table 4.1 Analysis of participants' demographic information**

Item	Findings
Age group	Eight (8) participants are in the middle age group, ranging between 46 and 55 years, while four (4) participants are between 36 and 45 years old.

The highest qualifications	Most of the participants have doctorate degrees, two have completed their doctorate, one with a master's degree and another is currently busy studying her master's degree.
Professional roles	The groups comprised individuals in their mid-researcher careers, i.e., senior researchers and those who hold more senior positions, such as principal researchers, chief researchers, middle managers, and senior managers. Senior researchers are established professionals with a proven track record in research-related activities. Principal researchers are well-established and nationally recognized individuals within their area of expertise with proven leadership capabilities in their field. Chief researchers are internationally recognized with proven leadership capabilities in their field. Middle managers are professionals who possess STEM leadership capabilities to lead their research teams within a defined scientific domain. Senior managers are more experienced managers responsible for providing strategic leadership to diverse research teams and driving socioeconomic programmes in a broader field.
Years of experience in the current position	The years of experience of the participants range from 2 to 9,5 years, with the average work experience of all participants in their current roles being $\pm 5,5$ years. This holds true for those in the STEM leadership group and for those in the leadership pipeline group.
Career backgrounds	The participants come from diverse backgrounds, while some joined the organization through studentship opportunities and grew through the ranks, some were appointed for specialized roles and ended up in the research space.

#### 4.2.2. Overview of the data analysis process

The data were transcribed verbatim. Initially, the recordings were listened to several times to ensure the exact words of the participants and the interviewer. After the transcripts were completed, they were read and reread to ensure the information was correct and made sense. In the cases where the participants mentioned the name of the organization and their actual positions, the transcripts were edited to anonymize the organization's name and the subjects. Any identifiable context of the organization was also anonymized to comply with the approval requirements of the gatekeepers.

Data from participant responses to research questions were identified and coded. A combination of deductive and inductive approaches was used to identify potential codes. This involved reading the statement and analysing what it meant. In some instances, the statement itself would be straightforward and provide a possible code, while, as in certain cases, the participant would be expressing their feelings about a phenomenon, and potential codes would be derived from there. For example, Emerald stated: *“There is no room for basic research. And our funders have indicated as early as last year that if you're looking for funds for basic research, they're not going to fund us”*, and this was coded as funding constraints. She further stated, *“The general feeling will be that, you know, this person favours males more than females, you know”* and this was coded as perceived internalized gender bias, as the person the participant was referring to is a female executive manager.

After the initial coding, the entire dataset was reviewed. Using reflexivity, the codes were revisited several times to ensure they captured the essence of what the participants were saying and to mitigate the risk of the potential influence of personal bias and views while developing the codes. During this process, the literature review section was consulted as part of the reflexive process to check whether the interpretation of certain statements was consistent with existing phenomena. An example is a statement by Amethyst: *“I sit in a position where I need to lead certain things and so on. And I sometimes feel out of my depths because I feel I lack in the knowledge that I need to have to truly lead and truly fully fulfil the role that I have.”* This statement signifies an imposter syndrome as the individual is already in a managerial role but feels that she lacks knowledge in fulfilling her role. Thus, this statement was coded as imposter syndrome. The literature review section was consulted to check if the interpretation of the sentence and its identified code was consistent with the meaning of imposter syndrome in the existing literature. After the reflexive process, a summary table was developed containing all the codes identified in the transcripts per person. With the help of ChatGPT, the main themes and subthemes emerging from the data set were identified. Then, these themes were reviewed to ensure clarity and accuracy of the data set. The key themes were then interpreted to understand their meaning. The interpretation is then followed by the data extracts or quotations from the transcripts to support the interpretation. The following section provides a discussion of the themes and their interpretation.

#### **4.2.3. Analysis of themes**

Several themes emerged from the data set under each research question. These themes are discussed and analysed under each main research question in the next section.

## 4.3 FINDINGS

### 4.3.1. Research question 1: What challenges hinder the career advancement of women in STEM to leadership roles within the South African Research Institute?

Seven (7) themes emerged from the dataset, and these include:

- Disempowering culture
- Funding constraints
- Career ladder constraints
- Leadership constraints
- Workload and role challenges
- Work-life imbalance
- Social expectations and support

These themes are discussed, each first described and narrowed down into subthemes.

#### 4.3.1.1. Disempowering culture

##### Definition

This theme emphasizes how culture in an organization largely influences how people behave and disempowers marginalized and previously disadvantaged minorities.

##### Key findings

Participants spoke about the type of culture they experienced within the organization in their early days when the organization was mainly male dominated. Most of the participants talked about masculine or patriarchal cultures they initially encountered. This culture manifested itself through the marginalization of women at the project level or in the boardroom. Some decided to challenge these cultures and forge ahead to achieve their goals, while others decided to comply passively. While this culture discouraged some from aspiring to leadership roles, some found ways to navigate these challenges.

##### Subthemes

###### ***Subtheme 1: Masculine Workplace Culture***

***Emerald:*** “I do feel that male leaders are, you know, still at an advantage compared to females. Just think I don't know if it's a trust issue, but I just find that organization is more lenient towards males”.

***Opal:*** “He was so bad that he would tell you straight that what you wrote is nonsensical to that level”.

These quotations illustrate the masculine workplace cultures that some of the women experienced in the past and the perceptions that male leaders were favoured over females. Such cultures reinforce gendered biases, creating environments where women are marginalized, their leadership potential overlooked, and male candidates perceived as more suitable for leadership roles. This is typical of gendered organizations where men exercise their masculinity and power dynamics. This aligns with the social role theory which contends that people generally reward conformance to gender roles through acceptance and sustained engagement while penalizing nonconformance with disrupting social interaction and imposition of sanctions.

*Jade: “And then also, like in meetings, you would feel like your voice is, to a certain degree, not really heard because males are used to listening to each other, strategizing with each other, and together. So now for them to listen to a female voice is something that, you know, their culture doesn't really readily allow because they are so used to talking with each other and planning as boys. And now this female is trying to talk and trying to get their voice across. You would be ignored, for lack of a better word, because the culture is not used to a voice from a different gender type than that of a man”.*

*Aventine: “If you are considered part of the project, you will be given minor projects and placed under constant supervision.”*

These quotations additionally demonstrate how participants experienced marginalization in meetings and projects, potentially because of the dominant masculine cultures of that era. This perspective aligns with the ‘think-manager-think-male’ mindset, which historically perceives men as inherently more competent than women and better equipped to contribute meaningfully to projects and meetings. Additionally, it aligns to gendered interactions and social relations process of the gendered organization theory, which argues that in such settings, men dominate discussions. Consequently, women have often been marginalized, denied an equal voice, and subjected to greater scrutiny and supervision. This results in a sense of tokenism and self-doubt. It is important to acknowledge that this dynamic has shown signs of improvement. Participants in the study highlighted a gradual shift toward gender equity, noting that women are increasingly being afforded the same opportunities as their male counterparts.

*Rosequartz: “I need more women in there because at the group, I'm the only woman that sits in there, and at the organizational level, I am the only woman that sits in there”.*

*Ruby: “But in terms of maybe if there are meetings and they say ‘hey we have group meetings strategic meeting, bring your leadership, your leaders, the ones that report to you and even others, and then only males appear, what are they saying?’”.*

The above quotations illustrate how the masculine cultures shaped the gender imbalance in leadership structures and decision-making bodies. This is typical of male-dominated environments with fewer women in leadership structures. The statements link to social identity threat, as they underscore how women in male-dominated environments experience heightened awareness of their minority status within leadership structures and decision-making bodies. Social identity threat occurs when individuals perceive that their social group is devalued or marginalized in a given context, leading to feelings of inadequacy or exclusion.

In this case, the masculine workplace cultures and gender imbalance in leadership reinforce women's sense of being outnumbered and undervalued, creating a dynamic where they feel powerless or tokenized. Tokenism further exacerbates this threat by making women feel as though their inclusion is symbolic rather than based on their merit, reducing their ability to contribute meaningfully and undermining their confidence in such environments.

### ***Subtheme 2: Stereotypes and power dynamics***

**Ruby:** *"I remember when we had a meeting not so long ago. And our PA was not around. And I remember the manager asked if we could have a volunteer take minutes. And like I kept quiet, I kept quiet. We kept quiet. I was the only female researcher, I think. Yeah, yeah, I kept quiet. And then, like any volunteers, then, like, oh Professor Doe, I'm not a professor, by the way, you'll take minutes for us. I paused. And I'm like, oh, OK noted. I'm like, oh, OK, noted"*

**Sapphire:** *"Yes, we are sometimes heard in terms of our ideas. In other instances, you would be in a group where you're the only female. And often they say, you know, the one with the loudest voice gets heard. So, it's that kind of dynamic which I have experienced."*

**Aventine:** *"I have noticed that women in leadership tend to put up an aggressive face; I don't know how to explain this, but I see most of them appearing aggressive, which I don't understand."*

Both quotes reveal how deeply ingrained gender stereotypes shape the experiences of women in the workplace, from task delegation to perceptions of leadership style. Women face systemic biases that force them into traditional roles or compel them to adapt behaviours to fit into male-dominated cultures, often at the expense of authenticity or acceptance. The finding also aligns to the gendered division of labour in gendered organizations where certain roles are deemed suitable for certain genders. These dynamics contribute to the challenges women face in being recognized and valued as equals in their professional environments, further perpetuating gender inequality in leadership. This puts women in STEM leadership roles in a double bind where they are criticized for behaving assertively, and if they appear too nurturing and weak. There is

also subtle power dynamics and gender expectations at play. While the first participant is expected to do administrative tasks as a form of reinforcing gender stereotypes, others resort to what is deemed as ‘aggressiveness’ to counter the power dynamics. Assertiveness in male leaders is typically viewed as a strength, while similar behaviour in women is often labelled as aggression. This double standard reinforces challenges for women in leadership, as their behaviour is judged more critically.

### **Theme sub conclusion**

Due to masculine workplace cultures that result from patriarchal social norms, women in STEM find themselves in compromising positions where they are sometimes marginalized and treated unfairly. These patriarchal norms also cause internalized bias in some women, including those in leadership roles. It results in those women perpetuating the bias through their actions toward themselves and other women. Some women find themselves in a double-bind situation due to gender bias. This also affects women’s self-confidence and the leadership aspirations of those in the pipeline. Due to gender bias, those who experience it end up questioning themselves. This type of disempowering culture undervalues the critical contributions of women in STEM fields. These cultures result in the under-representation of women and lead to fewer role models.

#### **4.3.1.2. Funding constraints**

##### **Definition**

This theme illustrates the critical importance of having enough funding to support women in STEM’s research activities, livelihoods, and career advancement. Women in STEM, including men, depend on the availability of funding to carry out the necessary research activities. This funding covers the cost of their salaries, equipment, and facilities. The projects they work on are critical for their career advancement, as one of the career ladder requirements is that the individual must attract a certain amount of funding. Funding is also critical for the training of women in STEM to enable them to improve their skills and advance their careers to leadership roles.

##### **Key findings**

Securing funding for projects is a significant challenge within STEM fields. This sentiment was widely echoed by participants, who noted that budget cuts to parliamentary grants, which previously facilitated basic research, have exacerbated the issue. While this challenge impacts all scientists and researchers irrespective of gender, participants suggested that women are disproportionately affected by the lack of funding compared to their male counterparts. This is particularly the case where private sector funding is involved.

## **Subthemes**

### ***Subtheme 1: Limited project funding***

**Ruby:** “So me being at the like lowest, you know like their fundamentals, it's very much difficult to get funding for research. It's very much difficult”.

**Amethyst:** “Well, that is now, irrespective of whether you're a woman or a man, there isn't a lot of funding available, but so it means that that it doesn't always allow you to work on a project, uhm, especially when it comes to being part of collaboration teams.”

**Opal:** “And I think the last one then becomes the ease of funding. Yeah. We are a government entity, strongly reliant on government funding and competitive funding. And like I said, we need a new culture, and in the new culture is that now we have to bring in that stream of income from industries, and the language you have to have for the industry is completely different when you're actually requesting money from a public sector. So yeah, there are serious challenges”.

**Rosequartz:** “But in terms of private sector, private sector is very much still a boys' club. I have to say. So, like we had a project with an external funder who have a preference for certain people over other people, I won't be specific about it. Right, so yeah, you still find that, you know, a male's voice will be a little bit more, have more weight in terms of securing funding than a female voice would, you know. And that also speaks to why the organization is recruiting and appointing males in positions of leadership and management because they are the ones they would be the face when the client comes through and talk to a boardroom full of men and then they give them 10 million, but a boardroom full of women, it's something unheard of instant”.

The quotations highlight the challenges women in STEM face in securing funding for their projects. Participants agree that funding, in general, is a challenge. However, one participant emphasized that obtaining private sector financing is particularly difficult for women, reflecting persistent gender biases within the private sector. Given the limited availability of government funding, this financial constraint hinders women from pursuing projects that could strengthen their evidence portfolios and support career progression, considering that private funding is more lucrative and more available than government funding. The lack of funding results in missed opportunities to meet key performance indicators (KPIs) required for promotions, such as income generation and publications. Since publications often depend on access to research funding, this creates a significant barrier for women researchers seeking leadership roles. The findings align with the literature, which suggests that securing funding is more challenging for women than for men.

### ***Subtheme 2: Limited training budgets***

***Coraline:*** “I’ve struggled to get funding for my studies, as I mentioned. I got a signed agreement from my boss that I could fund my studies from PG, but that did not come through”

***Rosequartz:*** “So, the programme through HC, so they did have funding to support. But last year last year the funding got cut. So, but it was a good initiative because it allowed for dedicated funding to be given through specific groups and specific people who showed career progress in a way where they can be supported to go to the next level”.

The above quotations illustrate the impact of limited training budgets on the career advancement of women in STEM. Although the organization requires specific qualifications, it does not have sufficient resources to support those who intend to study further to advance their careers. The lack of consistent training budgets not only stymies individual career advancement but also undermines broader efforts to foster diversity and inclusion in STEM. This could, however, also be attributed to the financial position of the organization, as the allocation of a specific training budget is reliant on the financial sustainability of the organization. Since the statements do not highlight any gender-specific issues, it is reasonable to infer that men are also impacted by the constraints of the training budget.

### ***Subtheme 3: Financial constraints***

***Sapphire:*** “Yeah, but I mean, in certain instances, there’s been people who apply, and they qualify. But I mean, finances within the broader unit or the group don’t enable you actually to qualify for a formal promotion. So, then, what would that do to your morale? You know it will demotivate you from doing all that work next year, and you end up just not applying”.

***Jade:*** “The fact that our organization is not doing well financially is a big dampener for a lot of people who are working in the organization, both women and men, in the sense that there are people who are due for promotion, but promotion is just on paper and not necessarily monetary.”

***Crystal:*** “I remember one of the saddest days in my time at the South African Research Institute was when I got a promotion letter after I got my PhD. My heart broke. My heart broke because, yes, I had seen, I know this case, but I was really hoping that instead of being on the minimum, it would be moved to the midpoint or the maximum”.

The quotations underscore the impact of financial constraints on organizational recognition and reward initiatives. While these challenges are not unique to women, affecting men as well, they highlight the specific frustrations and disappointments experienced by women in STEM. The lack of fulfilment in achievement awards, stemming from financial limitations within

organizations or their respective units, exacerbates these frustrations. Consequently, this diminishes interest in pursuing career advancement, as the rewards offered are perceived as disproportionate to the increased responsibilities and job expectations.

### **Theme sub conclusion**

Limited budgets have a profound negative impact on women in STEM, affecting various aspects of their careers, including funding for projects, salaries, access to equipment, and opportunities for skill development. These challenges are further exacerbated by general financial constraints within organizations. The ability of scientists to attract income is critical to an organization's financial sustainability. However, insufficient income generation directly impacts the availability of funds for adequately rewarding high-performing individuals.

While promotions are typically associated with increased income and an improved quality of life, the failure to meet these expectations can lead to significant demotivation and demoralization. Aspiring leaders may become discouraged when they observe that those in leadership roles are not significantly better off. This disconnect between the income generated and the rewards received creates a sense of disillusionment, particularly when employees compare their contributions to their compensation.

The financial sustainability of the organization relies on the collective efforts of all units, meaning that even high-performing groups or units may not receive rewards proportional to the income they generate, as their contributions support the broader organization. Addressing these challenges by assisting women in STEM in obtaining project funding and allocating sufficient training budgets can significantly enhance their career prospects and encourage their progression into leadership roles.

### **4.3.1.3. Career ladder constraints**

#### **Definition**

This theme refers to preparing and supporting women in STEM for career advancement to leadership roles. This includes giving them the training, knowledge, support, mentorship, and resources necessary to grow in their career.

#### **Key findings**

The participants highlighted a lack of clarity regarding the career ladder system, noting that its structure and requirements are not adequately explained at the onset of employment. This results in confusion and a limited understanding of the career progression pathway. Furthermore, participants expressed concerns about the stringency of the career ladder criteria,

which discourages them from submitting applications for advancement. Additionally, there are perceptions of inconsistencies in the evaluation process by the appointed career ladder assessment panel members, further contributing to dissatisfaction and disengagement with the system.

### **Subthemes**

#### ***Subtheme 1: Undefined career ladder requirements***

***Aventine:*** “I only knew about the funding requirements late in my career, and it was a surprise that I had to find funding for my salary when the organization employed me.”

***Topaz:*** “The South African Research Institute is structured differently to many organizations. So, when you get there, you don't even understand the career ladder process and how it's supposed to work and no one explains that to anyone. And you hear about it when it's time to do the career ladder. Once a year? Yeah.”

The quotations highlight the challenges faced by women in STEM when appointed to positions without receiving adequate induction on the requirements of the career ladder, which is essential for career advancement. Delays in accessing critical information about career ladder requirements hinder timely preparation and limit opportunities for progression. This finding is not unique to women in STEM but applies to men as well. To address this, the career ladder evidence portfolio and action plan should be initiated and compiled early in an individual's tenure. This proactive approach ensures readiness when the career ladder submission system opens, reducing the risk of employee anxiety and dissatisfaction with the process.

#### ***Subtheme 2: Stringent career ladder criteria***

***Aventine:*** “As a scientist, you get satisfaction and fulfilment when you see your idea working and contributing to improving the lives of ordinary citizens. However, the requirements for progressing your career to the next level do not encourage you.”

***Sapphire:*** “So I had a look at the career ladders once, and then I said I can't do this. It's just too much of admin. The burden is just too much. So that just put me off from applying through the career ladder.”

***Crystal:*** “But sometimes I do think it's almost sometimes; this is my observation, and unfortunately, based on what I've heard from people, when they tell their discomforts about their career ladder, for me, it seems like they don't want you to grow”

***Topaz:*** “I think the career ladder process is also discouraging. You should add that to your list. Because I've spoken to a number of people who like they don't even apply. They were like, ‘this process, I know what they want, and I know they want a whole lot of things that I'm not gonna be able to achieve.’ It's like the process is just trying to exclude you for stuff. It's like it's

*like an elimination type of thing. It's not meant to help people to advance in the organization. That's how I feel about the career ladder process.”*

***Emerald:*** *“Career ladder structures and systems - this is my pain point at the moment. The organization promote people with PhDs. If one does the work, and I mean, I've been acting middle manager from January 2023 up until now. There are people, so I've been acting in this role for the third time now. I'm still acting because I don't have PhD, they can't give me the opportunity.”*

***Amethyst:*** *“Career ladders is always a topic of contention because yeah, the career ladders, especially when you start progressing to the most senior levels, I mean your principal and your chief researcher levels, the requirements and the expectations that you need to fulfil to reach those levels are very high.”*

While some participants viewed the career ladder process as fair, noting that the requirements are uniform across genders and attainable, the majority perceived the process as overly stringent and disempowering. Participants expressed concerns about the administrative burden involved, citing a lack of adequate support for applicants. As a result, some individuals have opted not to apply, deterred by the rigorous criteria and the extensive time required to compile the evidence portfolio. This finding aligns with women's lack of work-life balance and time needed to prepare for the submission. There is no explicit evidence of gender bias in the evaluation process. Instead, the challenges arise from systemic issues embedded within the traditional career ladder model, which is structured around masculine workplace cultures. These cultures emphasize continuous and high-volume outputs from scientists, creating barriers that disproportionately affect individuals with caregiving responsibilities or other commitments outside of work, many of whom are women. Balancing the requirements of the career ladder criteria with professional responsibilities is a challenge to some of the participants.

### ***Subtheme 3: Inconsistent, subjective and flawed career ladder systems***

***Emerald:*** *“As far as I'm concerned, the career ladder process is flawed because there's no way that my manager cannot give me scores, and yet it goes through the group, and then the organization level panel gets me down, and I'm told that the scores from the line manager don't matter. So, that whole process is flawed.”*

***Opal:*** *“OK, I fought the career ladder system because it has always been subjective to the reviewer. If they don't understand what you do, then you are compromised. It was never. It's never been like, saying OK, three cakes equal three cakes. You know, so the reviewing process is what I've got a challenge with. The structure could be good, but the system is flawed.”*

***Jade:*** *“What becomes a problem, then, is the evaluators of these judging metrics, like the career ladder or the performance review and everything. Because at the end of the day, you know what*

*the career ladder is looking for is standard across males and females, but now sometimes you find the assessors themselves, those panels that sit and assess, are the ones that do not want, like the interpretation of what is expected can be changed very quickly depending on who the panel is, like criterion change and goal posts get moved”.*

The quotations underscore significant gaps within the career ladder system that discourage women researchers from pursuing leadership roles. Inconsistencies in the evaluation of applications emerge as a critical concern, undermining researchers' confidence in the process and fostering perceptions of systemic flaws. Additionally, the integrity of the panellists is called into question, as they are perceived to approach evaluations subjectively rather than maintain objectivity, further eroding trust in the system. Once again, there is no clear evidence of gender bias within the system. The sentiments expressed by the participants are their perceptions of reality, which may not necessarily represent the actual situation. However, the perceived subjective views and gendered power dynamics embedded within these structures present significant challenges.

#### **Theme sub conclusion**

The career ladder process and its standards pose several hurdles for participants. These issues include a lack of clarity regarding the career ladder itself and the proper way to submit applications for evaluation, along with inconsistent assessment practices. Such obstacles prevent women in STEM from effectively preparing and submitting their applications on schedule. Since the evidence portfolio accumulates over time, it is vital for individuals to be aware of the requirements to strategically plan their career advancement. Participants have highlighted the demanding and rigid nature of these requirements. The presence of numerous challenging requirements poses a significant problem for female researchers, often discouraging them from applying. Additionally, perceived inconsistencies in evaluating applications raise concerns, demotivating women in STEM and compromising the process. Well-defined criteria with achievable requirements are critical for the organization to promptly advance women into STEM leadership positions.

#### **4.3.1.4. Leadership constraints**

##### **Definition**

This theme refers to preparing and supporting women in STEM for career advancement to leadership roles. This includes giving them the training, knowledge, support, mentorship, and resources necessary to grow in their career.

## **Key findings**

The study's results reveal that women in STEM fields are not adequately prepared to assume leadership positions. This is attributed to their limited access to the necessary managerial support, training, and coaching required to excel in these roles. As a result, they start to question their ability to succeed. Furthermore, they are set up for failure from the outset if they accept roles for which they are insufficiently prepared. The study also points out that mentorship opportunities for women in STEM are limited, obstructing their advancement and exposure to vital leadership tasks. Additionally, participants noted that management support is not reliably available.

## **Subthemes**

### ***Subtheme 1: Lack of leadership training***

**Crystal:** “. Right now, of course, I can't blame it on the organization, really, because maybe that is what makes it difficult for me now to move into a proper leadership role. If I could have maybe some form of qualification for leadership.”

**Coraline:** “No, no, they don't, because that's specifically where I've promoted a woman, and she isn't ready and I can't get access to that leadership program”.

**Amethyst:** “For instance, I have applied as part of my career, my performance development plan. I've indicated my interest in attaining some of these leadership development programs the organization offers now, so you get nominated, and then it goes to human capital. Then you get you are not considered to do that. What more can I do? How can I ensure that I'm also considered for that?”

**Opal:** “Now you will need, in terms of the SET staff, more analytical research based. Yet there are managerial duties like HR and managing HR, which include performance matrices and finances. All these things are not included in our academic curriculum”.

Participants think that managers, regardless of gender, lack adequate preparation or development for leadership roles. This is mainly due to leadership training being absent from the STEM curriculum. As a result, there is no gender bias in how individuals are prepared for leadership positions. However, not making sure that women, as marginalized individuals, are properly prepared for leadership roles is setting them up for failure and continuing gender imbalances in STEM leadership roles. This results in the stereotypical views that males are better suited for leadership positions than females. The focus of the scientific curriculum on technical knowledge rather than managerial or leadership skills means women in STEM frequently miss out on crucial leadership development necessary for success in higher roles. This lack of training also undermines their confidence in their leadership capabilities. Women aspiring to leadership see this as a hurdle to advancement. As a result of this obstacle, women

often encounter glass cliff scenarios, being placed in roles where failure seems inevitable. Moreover, these challenges their self-confidence in leading and contribute to feelings of imposter syndrome. Although the organization implemented leadership development programs, the number of people that can be trained at any given moment is low, and that is understandable as the organizations needs to operate within its financial constraints.

### ***Subtheme 2: Lack of mentorship opportunities***

**Ruby:** “OK, in my own experience. I think lacking mentorship can, you know, like can be a challenge as a woman”.

**Amethyst:** “But there are no formal courses or mentorship, or something provided to actually teach you the soft skills of what true leadership is and how to apply it to your day-to-day job when you are in a managerial position.”

**Crystal:** “So I have not been very open to mentorship as much as I know it's beneficial, but I've always, I think I've for the longest time I had looked at it negatively in the sense that I perceived it as something where one would want you to be like them.”

While some women desire mentorship opportunities and perceive them as scarce within the organization, others view them unfavourably, believing that mentorship aims for the mentee to replicate the mentor. This reflects a misunderstanding of the true goals of mentorship programs, as there may be several women in STEM who share this view and therefore do not seek out these opportunities. This observation is consistent with literature that suggests women face a shortage of mentorship opportunities, which can result in career stagnation and potentially severe negative outcomes.

### ***Subtheme 3: Limited managerial support***

**Emerald:** “I mean, to get into a leadership position, you need, you need a line manager that supports and believes in you.”

**Jade:** “Now, the problem sometimes becomes how one's manager supports that individual's application, you know, and then it escalates to how the different panels beyond the manager support the application. Because now, the manager in these things plays a significant influence”.

**Amethyst:** “Uhm, what was difficult as a middle manager is that there was very little support in preparing and supporting one of taking on the leadership responsibilities of a middle manager”.

Participants consider managerial support essential for career progression. The perceived absence of managerial assistance in career development harms their self-assurance and

effectiveness. Women attribute their success to the influence management has on their professional paths rather than their proficiency in their roles. The above statements highlight the significance of managerial backing for women in STEM fields to achieve their goals and ascend the career ladder towards leadership. Line managers hold a crucial role in an employee's leadership path. Without their confidence, advocacy, and assistance, individuals encounter significant obstacles in moving up to leadership roles. This backing is particularly important for navigating the complexities of career ladder evaluation panels.

***Subtheme 4: Lack of gender equality targets***

***Rosequartz:*** “If you have a 0 KPI for a female in a specific position of leadership, then you are not intentional or you're not serious about it.”

***Ruby:*** “We don't have a lot of chief females researchers up there. And we don't, even see that space. There was a document that was shared with us. We don't see that space. So OK, we are short of three females or whatever, it's not a must to have a female up there, so I feel like they should be a policy whereby there needs to be a balance in terms of male and female leaders. It becomes KPI.”

The statements highlight how the absence of gender equity goals sustains male-dominated environments and obstacles to women's progression into leadership positions. Without these targets, glass ceilings are formed for women. Women who manage to shatter these barriers often become viewed as token figures. This phenomenon also reinforces internalized gender biases among women in STEM regarding their societal and professional standing. Additionally, it can foster the queen bee syndrome, where women in leadership do not support their peers in advancing their careers.

**Theme sub conclusion**

The theme of leadership development sheds light on the organization's deficiencies in leadership. Participants pointed out significant challenges in leadership training, which leads to individuals in these roles not performing sufficiently and effectively due to inadequate training. Additionally, the absence of mentorship opportunities was identified as a barrier that prevents women from progressing into leadership positions. This observation is backed by literature findings that a lack of mentorship is an obstacle for women in STEM fields seeking leadership roles.

Another issue is the organization's efforts to promote women into STEM leadership positions. The absence of ambitious goals for advancing women leads to a perception that the organization is not genuinely committed to this initiative, creating a sense of tokenism. It appears the

organization is satisfied with a male-dominated hierarchy and unaware of the imbalance. When women do reach these roles, they often lack preparedness and do not receive sufficient managerial support to ensure their success. As a result, women in STEM are set up to fail, experiencing the glass cliff effect. Ironically, their lack of proper training and readiness confines them to specific roles, resulting in a glass ceiling.

#### **4.3.1.5. Workload and role challenges**

##### **Definition**

This theme refers to the challenges women in STEM face in managing their responsibilities due to increasing workloads, excessive demands, and achieving their set targets.

##### **Key findings**

Participants indicated that as individuals climb the career ladder, both expectations and workloads rise. This affects their daily planning because they must handle competing priorities. Many participants find that they need to give up family time for work obligations since heavier workloads demand more time to accomplish tasks, reducing time available for personal and family life. This observation is backed by literature that indicates a lack of work-life balance is an obstacle to the progression of women into STEM leadership roles.

Additionally, when individuals assume a new role, the responsibilities and expectations may not always be clearly defined, leading to confusion and frustration as they try to establish themselves. Women in STEM particularly face the dilemma of balancing the need to generate income with the need to conduct research and publish articles. Both are essential for their career progression, requiring them to strike a balance. To finance their research and sustain their livelihood, women in STEM often engage in various projects, some outside their field of expertise, which leads to a lack of focus and specialization. This lack of focus can hinder their progress to senior positions such as principal or chief researcher due to insufficient specialization.

##### **Subthemes**

###### ***Subtheme 1: Increasing work demands***

*Topaz: “Yeah, the workload is a bit much 'cause I'm female, as you can understand, I have small kids.”*

*Amethyst: “So the workload is quite big. The workload increased significantly, when I started with being a manager compared to when I was a researcher, not that the researcher has a less stressful or less of a workload. But the challenges that you have when you sit in a management*

*position, or the responsibilities that you need to juggle are far more when you are in management than when you are a researcher”.*

Participants reported that as they advanced in their careers, their workloads grew. Holding a leadership position is more demanding because of the heightened workload, as individuals must still produce publications, generate revenue, and oversee the performance of others. This reflects environments dominated by males, where workload is organized around male traits and lifestyle and results in work-life imbalance.

### ***Subtheme 2: Long working hours***

***Sapphire:*** “*If you're in a leadership position, there's no such thing as an 8-hour day. You end up working much longer hours than that”.*

***Amethyst:*** “*So it's very quick that that the workload becomes such that you need to work longer and longer time or hours to get to it and that you become a bottleneck in some processes because the more overloaded you are, the less time you have, the less time you are afforded to actually complete tasks.”*

The mentioned quotes highlight the effect of workloads on women in STEM fields. With workloads rising, participants find themselves putting in more hours. This has a detrimental effect on their family time and rest, ultimately impacting women in STEM’s mental and physical health. Furthermore, this can lead to women experiencing reduced self-efficacy and confidence in fulfilling the dual roles expected of them.

### ***Subtheme 3: Role clarity***

***Topaz:*** “*Generally, I feel like there's not much support. It's like it's your career; you sort yourself out. I understand that you can't be, you also have to be able to initiate the process, and you also have to show that you want to and ask questions and find out the processes. But it should be well understood from the beginning. It shouldn't, everyone should understand”*

***Aventine:*** “*When I was appointed to the role, no one told me that I would need to look for funding to pay for my salary; I was not trained to do this as a scientist.”*

The quotations highlight the frustrations faced by women in STEM fields due to an unclear understanding of their role requirements upon appointment. Although this issue is not exclusive to women, gaps in role clarity result in employee dissatisfaction as they are unsure of their responsibilities and how those roles contribute to the larger goals. As a marginalized group, women might perceive this as a gender-related issue leading to self-doubts and feelings of imposter syndrome.

#### ***Subtheme 4: Conflicting priorities***

***Amethyst:*** “And then there is a very fine balance between being busy with bringing in funding into the organization as we are expected to do and then having time to do things like writing publications. Or being part of work groups and international things. So, there's always, there's always a tension between being busy with what is expected from you to grow on the career ladder and day-to-day requirements from the organization.”

***Topaz:*** “You supposed to be making money and at the same time you're supposed to do research, and the two, they don't really balance 'cause now, when are you gonna, which one gets priority? When do you have time to do number one? Which one do you prioritize and you are expected to do both at the at the same time?”

***Sapphire:*** “It does but given your workload at the specific point in time, and then your manager says to you, OK, the career ladders are open, whoever wants to apply must apply before a certain date and then you realise oh damn, I have this report you on this day and I have something else due then and you look at the career ladder and you see all the work that it entails and you end up prioritising your projects over your career ladder application.”

The above-mentioned quotes demonstrate how conflicting responsibilities impact women in STEM. They are required to generate income while creating publications and participating in daily obligations. These competing priorities also hinder their capacity to prepare and submit applications for career ladder reviews and evidence portfolios, as they are often informed about them at short notice, leading to confusion and dissatisfaction with their jobs. Competing demands affect the work-life balance of women in STEM and their family connections. Eventually, they might perceive a diminished competence in leadership positions while simultaneously feeling unsuccessful in their personal lives.

#### ***Subtheme 5: Task misalignment and lack of specialization***

***Sapphire:*** “So because now there's maybe capacity constraints within the team. You end up doing something you don't necessarily align with regarding your background experience. So, that can hinder your progress towards a specialty field”.

***Amethyst:*** “And in some cases when you do work for clients, today you work on a project for a client on this and tomorrow on that. So it is not something where you can say that you have deepened your knowledge in your research field. And if you don't deepen your knowledge and gain that experience, it actually sets you back to a certain extent. Because you do not keep up with the practises and technology available in your field. So you're not focused, and what is needed to actually grow as a researcher is being more focused in your field”.

The above-mentioned quotes highlight the difficulties faced by women in STEM as they attempt to secure income or engage in projects that can support their time. They often accept any available projects, which may not pertain to their fields of interest or expertise. At times, these projects are dictated by the sponsor's requirements and needs. This involvement in varied projects leads to task misalignment and a lack of specialization, preventing women in STEM from concentrating on their fields. Such circumstances hinder their progress to positions like principal and chief researcher. Furthermore, the struggle between earning money and producing publications is a source of frustration, as it is challenging to accomplish both without sacrificing one.

### **Theme sub conclusion**

Career advancement in STEM fields presents difficulties for women in these areas, including increased workloads and longer work hours. This has deterred some participants from seeking leadership positions. The challenge is exacerbated when the roles and expectations are not clearly defined from the start. Many women in STEM enter these positions without full awareness and only understand the demands at a later point. Extended working hours and competing priorities adversely affect these women. This not only causes issues related to role alignment, leading to negative reactions from others, but also fosters self-doubt and imposter syndrome.

#### **4.3.1.6. Work-life imbalance**

##### **Definition**

This theme refers to the ability of women in STEM to balance work responsibilities with family responsibilities. Work-life balance occurs when there is harmony between the two roles. As STEM careers are challenging, this balance may not always be possible.

##### **Key findings**

Work-life balance is challenging for most participants, particularly those already in leadership roles. This is due to the increasing demand for the positions. Women in STEM tend to take on more work than they can handle to overcompensate and prove their worth. This negatively impacts them and their families.

##### **Subthemes**

###### ***Subtheme 1: Family and caregiving responsibilities***

***Sapphire:*** “Yeah. Look, I think as a woman, you are often the primary caregiver to your children, so if you don't have a support structure and your child is relying on you, you have to knock off work at a specific time to fetch them from creche to see to their needs, and so on, and

*I think that puts you in the light that you don't. How? How can I put it nicely? I think you will probably get me.”*

**Rosequartz:** *“But I think when you talk to the other women who are mothers and you've had to stop their careers, maybe they can, you know, give a little bit more. But through having conversations and seeing them because one of them just came back after four months of maternity. And I can see already here that it's going to be a struggle because she needs to finish her PhD. She needs to do this and she's breastfeeding and she's that.”*

**Amethyst:** *“. I'm in this situation where I have a mother. She is not dependent on me in the sense that I am financially caring for her, but she is aging. And I am the primary caretaker and say, for instance, I need to take her to the hospital for a medical test or whatever the case may be, go and see a specialist, and so on, and I need to drive her there. Then I'm not allowed to take family responsibility leave because she's not dependent on me”.*

The preceding quotes highlight the crucial role women in STEM serve as caregivers within their families. These duties impact their capacity to focus on job-related demands beyond the workplace. Caregiving obligations also hinder women's progression to higher-level positions. According to social role theory, women are perceived as nurturing and caring, leading to the expectation that they will easily assume this role. However, this expectation clashes with their professional responsibilities, resulting in role incongruence. This situation places stress and pressure on Women in STEM as they attempt to balance both spheres.

### **Subtheme 2: Work-life integration**

**Ruby:** *“Within the unit itself, we have several pieces of equipment that need to be commercialized, and you find that you are in at 7, you knock off at around 5:00. You can be called. You have kids' homework and so forth. You know that culture of women wanting to do everything. Yeah. So, it's a bit difficult at some point, but yeah, we try.”*

**Opal:** *“You can interview another woman in my team, and you'll hear that you know what we take on a lot. And it's unconscious, I would say, because maybe we are women, and we are also trying to prove to ourselves that we can take on a lot.”*

**Rosequartz:** *“. But the one thing that I've always believed for a long time, and you know, it's that as a woman, scientist or engineer, you have to prove yourself 10 times more than a man for anybody to give you even two rands?”*

The cited quotations show the lengths to which women in STEM will go to display their abilities and skills to gain equal standing in their professions. They often take on extra duties to demonstrate traits perceived as masculine. Sadly, this effort to prove themselves can lead to burnout, exhaustion, and sometimes decreased performance. Studies support that women in

STEM frequently feel compelled to overexert and overextend themselves to obtain the acknowledgment they merit.

***Subtheme 3: Work-life trade-offs***

***Aventine:*** “Your workload also affects your work-life balance as this career has no downtime”.

***Opal:*** “Because you have to be everything in every way, take on the challenges. And most times, there's no work-life balance in our work life. Now I'm learning it now because I was a robot.”

***Sapphire:*** “Being in a leadership position is very demanding of your time, of your energy. And it often involves you sacrificing your personal time to put into your work. If you're in a leadership position, there's no such thing as an 8-hour day”.

Referring to the above quotes, finding equilibrium between professional and personal life in STEM occupations is challenging, especially for women. This challenge arises because women are crucial members within their family structures. Moreover, there is a belief that they must exert more effort than men to establish their worth. Consequently, this leads to compromises between familial and professional obligations, frequently disadvantaging women in STEM, who often face the tough choice of choosing between career advancement and family planning. Women thus face a dilemma or double bind, where opting for the first option could lead to possible criticism, as they might be perceived as lacking strength and ill-suited for leadership positions. Opting for the first scenario may also trigger backlash due to the conflict with societal expectations of women's roles and place in society.

**4.3.1.7. Social expectations and support**

**Definition**

This theme refers to the social norms, cultural values, and structural dynamics that shape the roles, responsibilities, and opportunities available to women in STEM fields. This theme captures how societal and organizational expectations about gender roles influence women’s career progression, as well as the presence or absence of support systems that enable them to navigate these challenges effectively.

**Key findings**

Although women in STEM play an essential role at work, they are still expected to conform to traditional gender roles at home and in society. Women in STEM perform primary caregiving responsibilities at home, including taking care of their families and raising their children. Those with young families find it harder to cope due to the demands of parenting young children. The family and social structures to which women belong play a critical role in supporting or thwarting their career advancement aspirations.

## **Subthemes**

### ***Subtheme 1: Gender role expectations***

**Amethyst:** “And where it becomes a problem for women is that we are still the primary caretakers and primary housekeepers in our family units, so it has a very big impact on you actually performing. I can say performing your duties because it sounds very discriminatory, but in a household, the woman still carries the biggest responsibility.”

**Opal:** “At home I was when I was reflecting on this, I have to be, I'm a wife. I'm a mother. At work, I have to be the manager, I have to give instructions, and I have to behave in a certain way. When I come home, I must, I must be submissive”.

**Rosequartz:** “Society still looks at women, as you know, barefoot in the kitchen. So, like what you said it's difficult for people to support if they don't believe that a woman needs to reach these heights.”

The above quotes highlight the differing gender role expectations imposed on women in STEM by their families, society, and communities. Such expectations are influenced by traditional views of a woman's societal role and prevailing gender stereotypes. Women in STEM often find themselves having to alternate between various roles, which can be stressful. The continual need to adjust to different roles can lead to inner conflict and self-doubt if these women do not meet all expectations. This can also subject them to backlash, imposter syndrome, and a sense of not fitting in. Ultimately, they will lose their self-confidence and self-efficacy, which can have undesirable results. Support from the immediate family, community and society at large is crucial for the advancement of women in STEM.

### ***Subtheme 2: Socialization challenges***

**Crystal:** “One of the things that is affecting me like the way one was raised in the sense of being submissive, where sometimes you are scared to ask questions”

**Opal:** “So, our personalities also influence as our background influences us a lot. So, you find our church structure gives us to be very submissive at church and in the world. In the way you dress, say I am a ZCC or whatever, you know, so that also affects my behaviour. So, our background strongly affects how some, some not most, and some of our female colleagues would behave. Yeah, would face obstacles. And some of them, this particular one because of that, are not level of respect; they are level of humbleness that you have grown up with, that level of, you can't talk back at somebody. You can't stand up for yourself; rather, retreat from conflict. So that is a serious obstacle that, you know, some females have to overcome.”

**Rosequartz:** “If you were raised with no expectations of being a leader or something like that, then it becomes difficult for people to support your ambitions and your growth. So yes, so it's important to have a community of people”.

The above quotations illustrate the critical foundation that socialization lays in the career and growth prospects of women in STEM. How individuals are socialized ultimately affects how they will behave in a work environment. This goes back to the issue of internalized bias or misogyny, where women accept minority treatment from their male counterparts; they see it as normal, as their worldview is based on how they were raised in their family and community structures. Unfortunately, this does not work in their favour in the work environment. As a result, those raised to challenge traditional gender norms seem to have better success prospects in their leadership aspirations.

#### **4.3.2. Research question 2: What strategies are women in STEM using to advance their careers and overcome challenges at the South African Research Institute?**

This research question aims to understand the strategies used by women in STEM to advance their careers. Women in STEM use different strategies to advance their careers to leadership roles. The following common themes were identified as strategies that women in STEM use to advance their careers.

- Personal development
- Relationships and networking
- Leadership and professional engagement

In addition to the strategies that the participants used or are using, they were asked to recommend additional strategies for those who want to become leaders. The following section discusses the common themes identified from the current strategies used by the participants, followed by the themes identified from the additional strategies recommended by the participants.

##### **4.3.2.1. Strategies used by the participants**

The following strategies used by the participants were identified.

###### **a) Personal development and self-growth**

###### **Definition**

This theme refers to the process or initiatives that an individual takes to improve their skills, knowledge, and potential. It involves a proactive approach to personal growth in identified areas of improvement.

## **Key findings**

Some participants adopt self-directed learning through informal courses and reading relevant leadership material.

**Amethyst:** *“I have in my own time read about leadership and management literature books and articles, listen to YouTube videos that talk about it, spoken to people.”*

**Rosequartz:** *“I attended a leadership course.”*

**Opal:** *“I read a lot. I did business administration at home without getting a qualification, so I invest time in understanding things that I don't understand.”*

Some enrol in formal programs and courses, such as the expedited principal and chief researcher programs and formal studies.

**Aventine:** *“However, the expedited program that I am busy with has helped me in some areas. This is the program that Human Capital organized to develop the required skills for female scientists so that they can advance.”*

**Sapphire:** *“But also I've pursued my MSc.”*

**Coraline:** *“I engage in continuous professional development and learning”.*

Some set intentional goals about where they want to be and practice self-awareness.

**Rosequartz:** *“So that is how I overcome challenges. You must always know where you are and where you're going.”*

**Jade:** *“So, as a scientist, automatically you cannot do your own finances, and you know, like dealing with people issues like, as in being like, you know, dealing with HR matters and so as a scientist, I've also made it intentional that at least every year I take a leadership and management course.”*

**Gemma:** *“The only thing is you just need to, you know, put on your blinkers and just go ahead. You forge your path, work, and try to get as many things done as possible.”*

Some adopt a positive mindset to advance their career and focus on their goals.

**Emerald:** *“It's just to keep positive.”*

**Crystal:** *“I always focus on delivering that which the employer desires of me, expects of me.”*

**Rosequartz:** *“So, I was like, whatever you, as long as I'm learning and I'm moving forward. So, for me, that was the attitude now that I think about it as I've always have a ‘let's do this’ type of attitude”.*

### **Theme sub conclusion**

Participants employed diverse strategies for self-improvement. In the face of financial limitations, engaging in self-directed learning through online platforms or studying pertinent materials related to one's field of interest is ideal for gaining a comprehensive understanding of the topic, which can be applied in their professional settings. Enrolling in formal programs or courses is suitable, particularly when the desired job necessitates those qualifications. The initiatives mentioned above demonstrate a deliberate approach to personal advancement. Based on the participants' assertions, it is essential to be purposeful in pursuing a specific goal and devising strategies to accomplish those objectives. This requires a positive mindset and concentration, as numerous factors can hinder one from reaching their goals on their journey. A positive attitude and clear goals will aid them in enduring challenges as they arise. This aligns with literature findings which highlighted self-motivation and goal orientation as key to advancement.

### **b) Relationships and networking**

#### **Definition**

This theme refers to the ability of women in STEM to build mutually beneficial relationships and increase their social capital. Increasing social capital is important for collaboration and attracting funding.

#### **Key findings**

Some participants networked to get sponsors for their projects and collaborated with other researchers.

**Ruby:** *“What I normally do, I do a lot of networking and collaboration within South African Research Institute, you know. I've realized that even if you don't get that support within your group, you can go like talk to other colleagues from other groups and do collaborations”*

**Sapphire:** *“So I speak to a lot of older women that more who are in leadership positions. I develop a relationship, a good relationship with them and I tend to leverage of that relationship to gain my motivation and to pick up on, you know, tips on how to navigate between your career and your personal life and to overcome challenges in in my career. So, I always look up to these women. And that's how I've been doing it.”*

**Emerald:** *“I just maintain my good stakeholder relationship, secure income so that you know my salary is covered.”*

Some participants rely on mentorship and role models to guide them in their leadership journey.

**Ruby:** *“I'm part of the mentorship programs within the South African Research Institute”*

***Coraline:** “I did mention a mentorship, and my mentors have mostly been men that are accepted university. I did have some good role models and mentors who are women”*

### **Theme sub conclusion**

For women in STEM fields, networking and mentoring are essential elements. Networking allows them to connect with influential individuals and sponsors who can assist in their career advancement and help access opportunities that might otherwise be challenging to find. It's crucial to maintain and nurture one's network, as it may prove valuable in varying work environments or organizations. Similarly, mentorship is vital for the professional growth of women in STEM. Given their scientific expertise and typically limited business experience, they require mentors to guide them through their leadership development and provide feedback for major decisions. The literature review highlighted the significant advantages of mentoring and networking, which cannot be understated.

### **c) Leadership and professional engagement**

#### **Definition**

This theme refers to the ability of participants to lead in their areas of expertise and volunteer in organizations that will add value to their growth and development.

#### **Key findings**

Certain participants discovered that taking initiative in their area of expertise, instead of waiting for promotions, was rewarding and aided in their career advancement.

***Jade:** “Then I started leading at the level I am at as opposed to leading at a particular position higher than my current one. You start leading at the position you’re at.”*

***Gemma:** “You know, training, being able to take on young researchers as students, training them for their master’s and PhD”.*

***Crystal:** “So right, right now in, as now as an in a leadership role, I think I can say I am now starting to get into that space because now I've got students that I also supervise”.*

Certain individuals discovered that participating in professional organizations as volunteers enhanced their career goals.

***Rosequartz:** “. Like I said in the beginning, volunteering for things and you know, putting my name on committees and all these other things where it gives networking opportunities, you get to see and sit in rooms with people higher above you, even though it's in a role of an, you know organising committee, but you get to sit in those types of meetings and learn”*

***Coraline:** “So I think between, I can’t recall exact dates. But let’s say from 2011 to 2013. I was the President of the one of the South African Engineering federations, which is a voluntary association as registered with ECSA.”*

### **Theme sub conclusion**

Some participants chose to take the initiative in their areas of expertise to gain acknowledgement and recognition within the industry. Others opted to make a positive impact on the scientific community by offering their services voluntarily and joining specific industry bodies. These endeavours enabled them to develop and practice leadership skills across various environments. This approach is consistent with the literature that indicates women favour a multifaceted strategy aimed at attaining role proficiency and preparing for career advancement.

#### **4.3.2.2. Additional recommended strategies**

In addition to the strategies discussed in the previous section, the participants recommended the following strategies, which will just be listed and not discussed in detail.

- Resilience and calm problem-solving
- Early career mentorship and finding mature mentors,
- Learning from others and leadership through followership.
- Forming support networks and intentional networking
- Self-promotion, visibility, and mutual respect.
- Early preparation for career ladder submissions and systematic goal setting
- Alignment with organizational strategies.
- Set family time, meditation, spiritual moments, and self-care.
- Understanding organizational strategy, aligning with stakeholder priorities, and stakeholder relations.
- Assertiveness, pushing boundaries, mutual respect, and reciprocation.

The suggested strategies advocate for a diverse approach to tackling career and personal obstacles. They emphasize enhancing inner resilience and being deliberate about growth through initial mentorship experiences, learning from others, and getting ready to ascend the career ladder early to meet objectives. Moreover, building external support networks is crucial for career progression. Early navigation of the organizational landscape and staying alert to strategic shifts is similarly vital to ensure readiness and capability for future challenges. Crucially, finding a balance between personal well-being and professional goals is necessary, as professional aspirations cannot be fulfilled if one is physically exhausted. These suggestions

offer a thorough framework for breaking down barriers in STEM fields and achieving advancement.

### **4.3.3. Research question 3: What is the perceived role of leadership in advancing women in STEM to leadership roles within the South African Research Institute?**

There were varying opinions among participants about the role of leadership in promoting women in STEM to positions of power. Nonetheless, a strong consensus was on the importance of training and developing women in STEM, with deliberate goals set to reach gender equality. The next section emphasizes the feedback from participants. The discussion will first examine the perceived role of organizational leadership in promoting women in STEM and then move on to consider the additional support systems or policies required to aid their rapid advancement.

#### **4.3.3.1. The perceived role of leadership in advancing women to STEM leadership roles within the South African Research Institute**

Participants view the role of leadership in advancing women in STEM to positions of power as follows:

##### **a) Training and development**

Participants consider ongoing leadership training and development, specifically designed for women in STEM, essential for their progress, since the core training for STEM fields lacks leadership or management instruction. This encompasses fundamental training in areas like financial management and people management. Such training will better prepare women in STEM with the necessary skills and expertise to confidently take on leadership positions. Additionally, participants identified mentoring as a primary requirement. However, even though the organization offers mentoring programs, the opportunities remain scarce. Having targeted training and development programs for women is vital for their accelerated development.

##### **b) Transparency and role clarity**

The importance of making clear the essential requirements for each role, such as the career progression process, was emphasized. Organizational leaders are expected to implement initiatives that guarantee women in STEM comprehend their responsibilities from their appointment, providing transparency about the career advancement process and its prerequisites. Further, clarity regarding the various KPIs at the management level is necessary as they are translated from strategic to operational levels to ensure alignment.

**c) Accountability, equity, and intentional empowerment of women in STEM**

Senior leaders are anticipated to hold individuals accountable for their performance and foster diversity within the organization. This involves aligning the organization with equity KPIs and integrating these into managerial KPIs to guarantee their execution. Furthermore, any actions or behaviours intended to weaken diversity, and empowerment should be discouraged and addressed firmly.

**d) Career ladder reforms**

Senior management is expected to guide the change of conventional career ladder frameworks to more inclusive standards that consider the unique needs of women. This entails assessing the career ladder systems and processes to simplify them, reduce administrative burden, and eliminate subjective biases from evaluators or line managers. Additionally, the system should encourage cooperative efforts and teamwork, as opposed to isolated work and individualistic mindsets.

**e) Resource provision**

The top leadership's role is also viewed as that of allocating financial resources to recognize the efforts of women in STEM, which is essential. This involves securing ample funding for career advancement and ensuring women in STEM have the necessary materials and support to fulfil their responsibilities. The allocation of resources also covers the availability of dedicated funds for the training and development of these women to accelerate their progression into leadership positions. Resources further include providing commercialization mechanisms to aid research efforts, along with administrative support for career ladder applications.

**4.3.3.2. Additional support required for the advancement of women to leadership roles**

To cultivate an inclusive atmosphere for women in STEM, participants outlined the following extra support needs:

**a) Wellness and family support**

As women in STEM balance multiple responsibilities, it is advised to offer wellness support through localized mental health resources, organized initiatives for women's health, and workplaces that support families. This encompasses providing affordable childcare options at workplaces and maintaining flexible working hours for mothers.

**b) Dedicated empowerment programs and policies**

The career trajectories of women in STEM are distinctly different from those of men, influenced by factors such as pregnancy, motherhood, and leading caregiving duties within the family. There is a need for targeted empowerment programs and policies. These should incorporate the formulation of caregiving policies, empowerment strategies, and networking opportunities for women.

**c) Mentorship and coaching**

Women in STEM aspire for the establishment of more organized mentorship programs, with senior leaders heading these initiatives and taking on mentorship duties. These programs should be systematically designed, carried out, and assessed consistently.

**d) Product commercialization support**

Women in STEM fields seek specialized support for product commercialization to alleviate the stress of securing funding, enabling them to focus on their core research responsibilities without the pressure of income generation. This need arises because scientists or researchers often lack entrepreneurial skills or training, making it challenging for them to market and sell their innovations.

**4.3.3.3. Practices or policies that need to change**

Participants were asked to indicate which policies or practices require a change to better support women in STEM and help them advance to leadership positions. The participants identified the following:

**a) Unmanaged workloads leading to work-life imbalance**

With workloads on the rise and extended working hours, it is perceived by participants that introducing measures to enhance work-life balance is crucial for effectively managing their duties and maintaining optimal performance. This involves conducting regular workshops to encourage work-life balance and ensuring managerial supervision over employees' workload and abilities. It necessitates that managers make an effort to comprehend the workloads of their team members and allocate tasks as appropriate.

**b) Family responsibility leaves shortcomings.**

Certain participants argue that the existing family responsibility leave does not cover caregiving duties like attending to parental obligations, such as taking them to medical appointments. Revising the family responsibility leave policy to encompass these needs would assist women

in STEM to care for their family members without having to use their leave days intended for rest.

**c) Lack of organizational equity related targets**

Participants believe that the existing strategic KPIs fail to promote women's progression to leadership roles or gender equality in authoritative positions. This creates a perception that the organization lacks dedication to gender transformation in STEM fields. Participants desire the organization's commitment to inclusion, diversity, and equity to be evident in its policies, strategic goals, and targets.

**4.3.3.4. Additional policies or programs required**

Participants were requested to suggest any additional policies or programs, beyond what the organization currently offers, that could better assist women in STEM in pursuing leadership roles. The following suggestions were made:

**a) Gender equity and inclusion policies**

Current policies fall short in tackling gender equity in strategic or leadership roles. It is advised to formulate gender equity and inclusion policies to ensure that managers at all levels are committed to meeting diversity objectives.

**b) Pay equity and recognition policies**

Though women in STEM are anticipated to meet the same goals as their male peers, there is a view that their compensation is lower. To ensure that women in STEM earn competitive and market-aligned salaries, the organization needs to create a pay policy to steer management decisions.

**c) Leadership development and mentorship policies**

The organization has put in place leadership development and fast-tracked researcher programs. However, it is essential to resource and maintain these programs adequately for long-term success. It is advisable to establish policies that provide guidance for the organization and ensure proper oversight.

#### **4.3.4. Research question 4: What strategies and interventions can South African Research Institutes implement to promote the advancement of women to leadership roles in STEM fields?**

The findings of the study revealed multiple approaches and measures that the South African Research Institute might employ to promote the advancement of women in STEM fields to leadership roles. These approaches were discussed in the previous section. Further recommendations for the organization will be addressed in the next chapter.

#### **4.4 REFLEXIVE CONSIDERATIONS**

Having worked as one of the few women in a management role within a male-dominated field, I empathized with the participants' struggles with balancing work and personal life, as well as the prevailing masculine cultures in that setting. I took mental notes on how the participants shared their stories to maintain my reflexivity. I was attuned to their emotions and the impact of their difficulties. In my role as a researcher, I needed to remain open-minded and highly sensitive by actively listening to the participants with minimal interruption. I continually reminded myself that the entire process focused on their experiences and how they addressed their challenges. I made sure not to offer advice to the participants, even though I sometimes felt the urge. This approach ensured that I did not introduce my own biases into the process and remained as objective as possible, concentrating solely on the participants' lived experiences.

Additionally, my role as a manager within the same organization could have influenced my interaction with participants who were my coworkers and clients, or how they engaged with me and their openness about their experiences. This shared background might have encouraged a sense of unity or agreement, but it could have also resulted in suspicion and insufficient critical analysis of some aspects of their experiences. The intention was also to build trust before and during the interviews to foster an environment conducive to trust for this study. I also set aside my previous knowledge of organizational processes, policies, and procedures to better comprehend the participants' experiences and thoughts from their perspectives.

During the data analysis phase, I needed to fully engage with the transcripts to grasp the participants' experiences. The way they expressed certain things also provided insights into their emotional state and helped determine if the statements pertained to past or recent experiences. Given that most participants are over 45, I had to consider that some of their experiences might span a long period, and the challenges they referenced might differ for younger individuals, considering that organizations evolve.

At the conclusion of each interview, I inquired about the participants' feelings regarding the research question to ensure it did not evoke negative emotions. The majority affirmed that the questions were pertinent; however, they experienced sadness as they revisited their unhappy experiences. Those in leadership roles found that the questions not only reminded them of the difficult periods they faced while ascending the career ladder but also highlighted their limited efforts in promoting other women to influential positions. This prompted me to contemplate my own journey and my role in supporting the advancement of women to leadership roles.

In the end, the reflexivity process was crucial for this research. It enabled me to critically examine my biases and assumptions, ensuring that the themes drawn from the data truly represent the participants lived experiences instead of being overly influenced by my viewpoint.

#### **4.5 CONCLUSION**

This chapter explored the obstacles faced by women in STEM at the South African Research Institute, encompassing systemic, cultural, and organizational barriers. Research Question 1's themes reveal the subtle existence of patriarchal norms and cultures within the organization's structure. Moreover, the career progression process and its prerequisites are significant challenges for numerous participants, hindering their advancement. Overcoming these obstacles will facilitate the promotion of women in STEM to leadership roles. Additionally, various themes aimed at answering Research Question 2 were identified. The methods women in STEM employed to progress to leadership roles were highlighted, including self-directed learning, where they take charge of their personal development, and engaging in networking and professional activities. Discussions also covered the necessary review of practices or policies, emphasizing the need for extra support and policies to aid women in STEM in advancing within the organization. The perceived impact of leadership on promoting women to leadership positions was addressed, aiming to resolve Research Question 3. Lastly, the chapter briefly covered suggested strategies and interventions for the South African Research Institute to implement. The key findings presented in this chapter form the basis of the conclusions drawn and recommendations proposed in the next chapter.

## CHAPTER 5

### CONCLUSION AND RECOMMENDATIONS

#### 5.1 INTRODUCTION

The study aimed to investigate and understand the challenges and strategies for advancing women in STEM to leadership roles at the South African Research Institute.

The objectives of this study were as follows:

- To identify specific challenges faced by women in STEM within the South African Research Institute as they strive to advance into leadership roles.
- To investigate the various strategies employed by women in STEM to navigate obstacles and progress in their careers within the South African Research Institute
- To explore the perceived role of leadership in the advancement of women into STEM leadership positions within the South African Research Institute
- To recommend strategies and interventions that the South African Research Institute can implement to promote the advancement of women into STEM leadership roles.

By examining existing literature, conducting semi-structured interviews, the study provided valuable insight into challenges faced by women in STEM already in leadership and those aspiring to leadership roles at the South African Research Institute. It also suggests possible practical strategies and initiatives the organization can implement to assist women in STEM advancement discourse.

This chapter reflects on the summary of the findings, provides practical recommendations for the South African Research Institute, and highlights implications for academia.

#### 5.2 SUMMARY OF FINDINGS

The following summary seeks to capture the key findings of the study per research question.

##### **Research question 1: What challenges hinder the career advancement of women in STEM to leadership roles in the South African Research Institute?**

The research revealed that women in STEM at the South African Research Institute encounter numerous obstacles. Among these, the career ladder criteria and assessment process stood out as significant issues. Most of the participants expressed strong disagreement with the requirements, labelling them as overly strict and inflexible. Additionally, the career ladder evaluation process is susceptible to subjective opinions and perspectives of the reviewers or panellists. This jeopardizes the integrity of the process, leading some participants to determine

that the system is flawed. Consequently, some choose not to pursue growth opportunities through career ladder advancements or managerial pathways.

Several participants believed that managerial influence is crucial in career progression, as the panels place great importance on their input. This implies that if one's relationship with their manager is troubled, the chances of progressing to senior positions are reduced. The career ladder criteria and process must undergo a comprehensive review to eliminate any subjective or biased decisions that adversely impact some STEM women, resulting in significant dissatisfaction and discontent.

Moreover, the scarcity of training and mentoring opportunities hinders STEM women's progress into leadership positions. This lack of training is attributed to funding limitations and conventional academic or vocational training, which does not encompass leadership or business-oriented training. Furthermore, funding for research initiatives and training purposes is absent.

Although some participants managed to move up the career ladder successfully, they found themselves unprepared for the workload and time demands accompanying such roles. Some experienced conflicts between their familial roles as mothers, wives, caregivers, and professional responsibilities, creating pressures on their work-life balance and family dynamics. These conflicts between social and professional roles resonate with the role congruity theory, which suggests that social and gender roles are interconnected; they can be harmonized, mismatched, or adopted simultaneously. Despite efforts by STEM women to simultaneously adopt these roles, they often face difficulties in doing so effortlessly.

The presence of gender dynamics also emerged. This relates to women internalizing gender bias and the dynamics of gender power at play. This aligns with the social role theory, which assumes that people generally reward conformance to gender roles through acceptance and sustained engagement while penalizing nonconformance by disrupting social interaction and imposing sanctions (Eagly & Wood, 2016). Although some participants confirmed that transformation is taking place in the organization, there is evidence of a gendered organization where males still predominantly occupy senior positions. In addition, there is unconscious or unintentional marginalization of women in projects and decision-making bodies. The expectation of STEM women to work longer hours due to work overload reflects a masculine culture.

These intertwined issues contribute to the underrepresentation of women in leadership positions. Aligning the literature review with the findings reveals that gender inequalities in

organizations are complex and influenced by many factors. This is also true for leadership, which is multi-dimensional and context-dependent. According to the study's results, some participants believed their professional progress and development relied on their relationship with their managers. When managers support women's empowerment and strive to assist their team members, these individuals progress more quickly than those lacking managerial support. Managers establish the standards for operations, define roles and responsibilities, and ensure their team members have adequate resources. The leadership style adopted by managers or those in senior roles significantly affects the experience of women in STEM fields.

**Research question 2: What strategies are STEM women using to advance their careers and overcome challenges at the South African Research Institute?**

The study confirms that STEM women's journeys are full of twists and turns; If they do not navigate gender stereotypes on the job and other social areas, they navigate role conflict issues that destabilize their work-life balance and family structures. The study findings indicate that the participants use different strategies to navigate these challenges and advance their careers. Although some are intentional and goal-oriented, some are passively progressing through the career ladder, while some are stagnant. The most used strategies include self-directed learning through online platforms, learning about leadership or management content, and reading books or materials related to subjects. Some have considered mentoring and coaching, which greatly expose these individuals to leadership roles. Some are learning to lead in their field by supervising students. Some participants are highly dependent on their networks and see these networks as their key to success. Self-awareness and resilience are essential for individuals to understand their strengths and weaknesses and work toward self-development. These findings are in good agreement with the findings of the literature review.

**Research question 3: What is the perceived role of leadership in advancing STEM women to leadership roles in the South African Research Institute?**

The study indicates that the perceived role of leadership in the South African Research Institute is to allow STEM women to function in a conducive environment. This includes, among others, training and development to ensure STEM women are well equipped to take leadership roles, mentorship, specifically by senior leaders, resource provision by making funds available for training and promotions, intentional women empowerment through strategic KPIs and programs, and most importantly, career ladder reforms. Several practical recommendations that arise from the study findings will be discussed in the next section.

### **5.3 RECOMMENDATIONS FOR PRACTICE**

The following recommendations are made for the South African Research Institute to address the challenges identified by the study in no priority order:

#### **a) Inclusive leadership**

First, it is recommended that the organization must consider inclusive leadership practices at all levels. This will ensure that STEM women feel welcomed and valued by the organization. The inclusion model discussed in Chapter 2, developed by Ferdman, can be effective in helping the organization create a conducive and inclusive environment for STEM women. This framework recognizes the fundamental and multilayered nature of inclusion in an organization at the individual, group, and organizational levels. Inclusion should be reflected at all these levels, and it is essential that the organization also increases its quotas for female leaders in STEM. This should be part of the organization's strategic intent supported by relevant key performance indicators for the management team. Additionally, it is recommended that the organization's succession plans address the employment equity targets. The organization should aim to enforce diversity in project teams to ensure that all researchers have an equal chance of participating and contributing to projects regardless of who secured the funding. Diversity in project teams will create an atmosphere of collaboration, teamwork, and excellence rather than promoting individualism and competition. In general, this calls for an inclusive leadership approach.

#### **b) Training-related challenges**

It is recommended that the organization assess the induction or onboarding program, particularly for STEM personnel, to incorporate role-specific induction and career ladder induction. Integrating role-specific induction into the onboarding process will assist employees in comprehending their expectations from the outset and clarify their commitments. This includes a conversation on how the role aligns with the organization's broader structure and strategy, the available career path opportunities, the distinction between the fixed role and the career ladder roles, and how one can move from one to the other, including the associated risks of such a transition, and the relevant key performance indicators as outlined from the organizational level to the individual level. Proof of these discussions should ideally be provided to the Human Resources Department as evidence of the employee's complete integration and preparedness to commence responsibilities.

Including career ladder discussions in the onboarding program will mitigate the risk that employees do not know what a career ladder is. It will also provide an opportunity for the organization to clarify the requirements for successful submission and career promotion

prospects. Additionally, this will mitigate the risk that employees do not have time to attend career ladder workshops at a later stage due to work pressures and conflicting priorities. It will also provide employees and their line managers with an understanding of developmental needs, allowing them to develop a clear training plan to address identified training gaps. Having career ladder discussions as part of an onboarding program will also allow recruits to actively participate meaningfully in discussions or have a point of reference when discussing career path aspirations and developmental needs with their line managers. It will also enable them to work towards achieving the requirements of the career ladder promotions early in their careers. When all information is provided to an employee as part of their induction program, this will alleviate the need for them to attend full-day workshops, such as career ladder sessions, when they are fully immersed in their jobs.

**c) Career ladder-related challenges**

To address the challenges experienced by STEM women regarding stringent career ladder promotional requirements or criteria and inconsistent evaluations, it is recommended that the organization develop a career ladder policy document to provide the principles and rules on career ladder promotions. This must be supported by a clear framework that provides guidelines on the criteria per progression stage, the evaluation process, the appeal process, and the document review intervals. The criteria need to be revised and aligned with best practices and the overall mission and goals of the organization. Furthermore, the requirements must be free from bias and subjective views of line managers and assessment panels. The criteria should be objective, fair, and transparent. Ideally, the line manager should not be part of these assessments as they also play a role in the individual's success by managing their daily performance. Career ladder evaluations must be purely based on the evidence presented.

The validity period of the evidence must also be reviewed to ensure that it is practical and achievable. Provision must be made for work disruptions due to life events such as maternity leave, caregiver or family responsibility leave, prolonged sick leave, and so forth, by adjusting pro-rata adjustments, promotion timeline adjustments, or any other feasible option. This will assist female researchers in moving up the career ladder quickly, whilst ensuring that they do not need to sacrifice their family structures and well-being in favour of career ladder promotions. The possibility of submitting additional evidence after the panel sitting should be carefully considered with clear guidelines on the circumstances under which an individual should be requested or allowed to submit.

The human resources team should play an important oversight role in this process. Additionally, the process should be subjected to rigorous audits to maintain its credibility and integrity before

the final confirmation letters are issued to the applicants. The framework must be easily accessible on the organization's intranet. Training and appointment of assessment panel members is critical to ensure uniform application of rules and principles. In addition, the composition of these panels must reflect the organization's commitment to equity and inclusion. This will mitigate the risk of any form of bias in the evaluations.

**d) Leadership skills gap**

To address the leadership skills gap in STEM women, it is recommended that the organization conduct a skills audit on women in STEM leadership and those in the pipeline. The information obtained from the skills audit can be used to develop customized leadership development programs for women that target specific skills. This will allow these women to function optimally and have confidence in their abilities. Additionally, it is recommended that the mentorship program for women be strengthened by including both male and female leaders as mentors for future leaders. Although having female mentors is valuable for support and sharing experiences, having male allies is critical to promoting gender diversity, challenging gender biases, and providing women with a different leadership perspective. The organization must also consider including women's mentorship as part of the career ladder requirements. Moreover, it is recommended that the organization develop a structured mentorship program, where mentors are rewarded for their efforts through financial incentives or other means. This will motivate potential mentors to participate in this program, benefiting the intended target group. For this program to succeed, mentors and mentees must have a specified number of hours on this program. Ideally, a sufficient budget should be allocated for this program for participants to book their time against.

In conclusion, while these recommendations aim to offer solutions to the challenges observed, they are provided without a specific prioritization, allowing flexibility in their implementation based on the context and needs of the organization. Moreover, the recommendations offered are grounded in the study's findings, they are not foolproof and may not achieve desired results in every case. The success of these recommendations will depend on various external and internal factors, and their effectiveness should be evaluated and adjusted as required.

#### **5.4 IMPLICATIONS FOR ACADEMIA**

Given the identified gap in higher education curricula, the study findings offer essential academic insights. Higher education institutions are recommended to review their STEM-related curricula and consider including business management or leadership-related content in STEM-related qualifications to ensure future STEM leaders are equipped for the workplace.

## **5.5 SUMMARY OF CONTRIBUTIONS**

This study helped to understand the challenges that STEM women face in the South African Research Institute and the strategies women use to navigate these challenges. Several practical recommendations were made for the South African Research Institute. Additionally, the study contributed positively to academia by highlighting the gap in traditional STEM-related curricula. The implication for academia is that it is profoundly pushing higher education institutions to review their STEM-related curricula and consider including business management or leadership-related content in STEM-related qualifications to ensure that future STEM leaders are equipped for the workplace.

## **5.6 SUGGESTIONS FOR FUTURE RESEARCH**

As this study aimed at women scientists or researchers, it is suggested that future research consider including male participants to understand their perspectives on the cause of the underrepresentation of women in STEM in leadership roles. Including male participants will provide a broader understanding of these issues. Second, future research can consider investigating the impact of these challenges on the leadership styles adopted by STEM women. Future studies can also consider exploring the unique challenges faced by women with special needs or members of the LGBTQ+ community. In addition, future studies can consider exploring the challenges faced by women in other previously male-dominated sectors, such as mining, engineering, and information technology, to see if the challenges are similar. This study can also be replicated in other research institutes in third-world countries.

## **5.7 CONCLUSION**

A multi-theoretical approach guided by the social role, role congruity, gendered organizations, and inclusive leadership theories informed this study. This approach provided a framework to understand the dynamics at play in the experiences of STEM women within the South African Research Institute. The study findings justified the adoption of a multi-theoretical framework by proving that the challenges faced by STEM women in advancing their careers to leadership roles are complex and multifaceted; as a result, there is no single theory that can fully explain these challenges.

The theory of social role underscores how societal norms infiltrate organizations and shape the culture of that organization. Some participants discussed how their teams marginalized them, and this is an indication of how societal norms influenced the behaviour of some of the male colleagues. Many participants discussed the challenges they faced in balancing family demands with work demands and how their professional roles affected their ability to fulfil their social

roles. This aligns with the congruity theory of roles, which predicts that women may face more significant challenges in leadership positions because their gender roles are seen as incongruent with the expected traits of leaders.

The theory of gendered organizations further contextualizes these findings by highlighting organizational practices that perpetuate gender inequalities, suggesting that these dynamics are not merely individual challenges but are embedded in broader organizational processes. The experiences shared by participants, such as marginalization from key projects, lack of mentorship opportunities, and the underrepresentation of women in key positions, resonate with the theory's assertion that organizational norms and practices often uphold gendered assumptions about leadership.

On the other hand, inclusive leadership theory was reflected in the strategies some participants used to overcome these barriers. For example, a participant stated that she assigns responsibilities equally between her male and female team members. Two other participants mentioned that their male colleagues mentored them. The study's findings suggest that inclusive leadership responds to organizational diversity and inclusivity as an active tool for breaking the barriers and addressing the underrepresentation of STEM women in leadership roles. This aligns with the theory's emphasis on organizational diversity, inclusion, and equity.

The interpretative phenomenological approach of the study was suitable for understanding the lived experiences of STEM women in the organization and how they make sense of those experiences and allowed exploration of how theoretical frameworks manifest in real-world contexts. At the same time, the RTA method helped uncover key themes from the lived experiences of participants, allowing an in-depth understanding of the organizational factors that hinder STEM women's advancement to leadership roles and the strategies used to overcome these challenges. Reflexivity in data analysis also ensured that researcher biases and interpretations were critically examined, helping to produce more prosperous and authentic insights.

In conclusion, the interaction between these theories and the methodological approach enabled a comprehensive understanding of the experiences of the participants at the South African Research Institute. The findings illustrate how social expectations, organizational structures, and inclusive leadership practices converge to shape the leadership journey.

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## ANNEXURE A - INFORMED CONSENT FORM

### Information Sheet and Consent to Participate in Research

Date:

Dear colleague,

My name is Mpho Moeketsi. I am studying at the University of KwaZulu-Natal, Westville Campus, towards an MCom in Leadership Studies.

You are being invited to consider participating in a study that involves research on “Advancing women in science, technology, engineering, mathematics to leadership roles at a South African Research Institute”. The aim and purpose of this research are to investigate and understand the challenges and strategies related to advancing STEM women to leadership roles at the South African Research Institute. The study is expected to enrol 7 participants per group. It will involve using a structured guide for interviews. The duration of your participation if you choose to enrol and remain in the study is expected to be between 30 to 45 minutes. The organization funds the study.

No known risks and/or discomforts are associated with participation in the study. The study will provide no direct benefits to participants. However, the findings and recommendations will be communicated with the organization for consideration.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number HSSREC/00007631/2024)

In the event of any problems or concerns/questions, you may contact me at email address 222102880@stu.ukzn.ac.za or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details are as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION  
Research Office, Westville Campus  
Govan Mbeki Building  
Private Bag X 54001  
Durban  
4000  
KwaZulu-Natal, SOUTH AFRICA  
Tel: 27 31 2604557- Fax: 27 31 2604609  
Email: [HSSREC@ukzn.ac.za](mailto:HSSREC@ukzn.ac.za)

Please note that participation in this research is voluntary. Participants are allowed to withdraw participation at any point should they so wish. In the event of refusal/withdrawal of participation, the participants will not incur any penalty or prejudice from me and will not lose any benefit associated with participation in the study. Should participation be withdrawn, kindly let me know about this decision as soon as possible. Participants may be terminated from the study should sufficient information be obtained before the scheduled interview.

All participants are required to sign the informed consent form. The identity of participants will be protected in the actual dissertation. Pseudonyms or identification codes will be used to identify each participant. The interview guide does not require any personal information of the participant. The signed informed consent forms will be used purely for academic purposes and stored in the UKZN OneDrive folder. This information will only be accessed by the researcher and academic supervisor.

Should you have any questions relating to the participation in this study not covered by the above information, please feel free to contact me.

Kind regards,  
Mpho Moeketsi

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## CONSENT

I \_\_\_\_\_ (Name & Surname) have been informed about the study entitled 'Advancing women in science, technology, engineering, mathematics to leadership roles at a South African Research Institute' by Mpho Moeketsi.

I understand the purpose and procedures of the study.

I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at (provide details).

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

### **HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION**

Research Office, Westville Campus  
Govan Mbeki Building  
Private Bag X 54001  
Durban  
4000  
KwaZulu-Natal, SOUTH AFRICA  
Tel: 27 31 2604557 - Fax: 27 31 2604609  
Email: [HSSREC@ukzn.ac.za](mailto:HSSREC@ukzn.ac.za)

Additional consent, where applicable

I hereby provide consent to:

Audio-record my interview/focus group discussion      YES / NO

\_\_\_\_\_  
**Signature of Participant**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**Signature of Witness  
(Where applicable)**

\_\_\_\_\_  
**Date**

## ANNEXURE B - INTERVIEW GUIDE

Research objective	Research questions	Main questions
<p>To determine the participant's demographic information and eligibility to participate in the study as per the predefined criteria for inclusion.</p>	<p>Demographic and eligibility criteria questions</p>	<ol style="list-style-type: none"> <li>1. Please confirm your age group. Select between the following:               <ol style="list-style-type: none"> <li>a) 18-25</li> <li>b) 26- 35</li> <li>c) 36-45</li> <li>d) 46-55</li> <li>e) Above 55?</li> </ol> </li> <li>2. Kindly confirm your highest qualification.</li> <li>3. What is your current position?</li> <li>4. How many years have you been in your current position?</li> <li>5. Kindly share your personal experience and journey as a female researcher in terms of career path and leadership aspirations.</li> </ol>
<p><b>Research objective 1</b> To identify the challenges faced by female researchers in South African research institutes in advancing their careers to leadership positions</p>	<p><b>Research question 1</b> What are the challenges that hinder the career advancement of female researchers to leadership positions in South African research institutes?</p>	<ol style="list-style-type: none"> <li>1. Kindly share your perspectives on the key factors or barriers that might affect the representation of women in leadership positions within the organization, with a focus on:               <ol style="list-style-type: none"> <li>a) Organizational culture and practices</li> <li>b) Policies</li> <li>c) Performance metrics/ research outputs and evaluations</li> <li>d) Ease of funding availability</li> <li>e) Workloads and work-life balance</li> <li>f) Career ladder structures and systems</li> <li>g) Personal factors</li> <li>h) General support structures for women</li> </ol> </li> <li>2. Please share any personal experiences or instances where you or your female</li> </ol>

Research objective	Research questions	Main questions
		<p>colleagues may have faced obstacles in pursuing leadership roles</p> <ol style="list-style-type: none"> <li>3. Are there any specific organizational or cultural factors within research institutes that you believe either encourage or discourage female researchers from aspiring to leadership positions?</li> <li>4. What is your view on the current career ladder process requirements and developmental programs in place? Do you think the programs effectively address the needs of women who aspire to leadership roles or already occupy these roles?</li> <li>5. Do you believe these factors could influence the aspirations of female researchers to take on leadership roles? Why or why not? Your recommendations and insights on potential improvements would be highly valuable.</li> </ol>
<p><b>Research objective 2</b></p> <p>To investigate the various strategies employed by women in STEM to navigate obstacles and progress within their careers within the South African Research Institute</p>	<p><b>Research question 2</b></p> <p>What strategies are women in STEM using to advance their careers and overcome challenges at the South African Research Institute?</p>	<ol style="list-style-type: none"> <li>1. What strategies have you used or are using to overcome the challenges you alluded to earlier?</li> <li>2. Which measures have you taken to invest in your personal and professional growth as a woman in STEM with leadership aspirations/ responsibilities?</li> <li>3. How have professional networks and/or mentorship opportunities supported your career journey?</li> <li>4. Which advice/ strategies would you recommend to other women aspiring to leadership positions to succeed in their endeavours?</li> </ol>

Research objective	Research questions	Main questions
<p><b>Research objective 3</b></p> <p>To explore the perceived role of leadership in advancing women to STEM leadership positions in South African research institutes.</p>	<p><b>Research question 3</b></p> <p>What is the perceived role of leadership in advancing women to STEM leadership positions within South African research institutes?</p>	<ol style="list-style-type: none"> <li>1. In your view, what is the role of organizational leadership (upper-echelon leadership positions) in advancing women to positions of power and accountability? Can you share any specific instances or examples where leadership has played a significant role in supporting women's career advancement?</li> <li>2. What kind of additional support structures or resources do you believe are essential for fostering an inclusive and supportive environment that encourages women to aspire to and succeed in leadership roles within the organization?</li> <li>3. If you had the opportunity to change or implement one policy or practice to better support female researchers in advancing to leadership roles, what would it be, and why?</li> <li>4. What additional policies or programs do you think could be implemented to support the leadership development of female researchers?</li> </ol>