Effect of Technical Competencies of Women in Core Mining Activities on Team Operational Performance in South Africa

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DECLARATION

I, Suneshnee Munilal, declare that this research article is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Suneshnee Munilal

Signed at …Meyersdal……

On the …28…….. day of ……February…… 2024…..

DEDICATION

This research study is dedicated firstly to my loving parents, Sunil Munilal and Neera Munilal, for making this MBA journey at Wits Business School possible. I appreciate all the hard work and dedication you have invested into my education and all that you have done to sculpt me into the woman I am today.

To my amazing husband Dhivasan for his kindness, love, remarkable patience and support.

To my adorable son Sankarah who came into our lives a few months ago, you have added so much light into our lives.

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ABSTRACT

The objective of this study was to establish the relationship between the technical competencies of women in the core mining activities and team operational performance in the South African mining industry.

A gold-mining company in South Africa was selected for this study and 15 interview participants were chosen based on their discipline being a core mining activity. Thematic analysis was used to analyse the collected data and the common themes were concluded.

The findings of this study highlighted that the issue of inclusion of women in the core mining activities is not a matter of the technical competencies of women, but rather the lack of exposure of women in the technical environment, which disadvantages women from having the technical competencies required for team operational performance. Women have the technical competencies to thrive in the mining industry and the technical competencies of women are comparable to those of their male counterparts.

The lack of inclusion of women in the mining industry is also due to prehistoric misconceptions of women in a technical environment, and this social exclusion of women can be resolved by leaders in the mining industry making a deliberate effort to give recognition to women who are keen to succeed in the harsh mining industry. Women who have the technical competencies in the core mining activities should be selected for technical roles based on their identified technical competencies.

The technical competencies required to thrive in any core mining activity are problem-solving skills, decision-making skills, delegation of tasks, listening and communication and knowledge of risk and safety management, planning, task scheduling, people management, and team collaboration and cohesion.

It was found from this study that women are more risk averse than men and women-led teams in the mining industry have been found to have improved safety statistics.

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1 Introduction

The historic perception of mining in general as an environment that is masculine in nature has led to the lack of involvement of women in the industry. In South Africa prior to 1994, women were also prohibited from the underground workings and from core mining activities such as drilling, blasting and material handling (Kansake et al., 2021). Women were only given the right to work underground when the Mines Health and Safety Act of 1996 was enforced (Van Vuuren et al., 2021).

Women in the South African mining industry make up only 11% of the total workforce despite the legislature that was enforced to increase the number of women in this male-dominated industry (Ledwaba & Nkomo, 2021). The South African mining company's organograms include women at various levels in the organisation ranging from women in managerial positions to women in the lower levels who do the actual hands-on work in the underground working environments (Ledwaba & Nkomo, 2021).

Women are still underrepresented at all levels and due to socially constructed perceptions of women in such a harsh industry, the incorporation of women in South African mines is still not fully supported (Ledwaba & Nkomo, 2021).

This paper seeks to establish the relationship between the technical competence of women in the core mining activities and team operational performance using the management theory of diversity in the workplace and inclusion of women as a basis for this study.

1.1 Research Objectives.

The first objective of this research study is to establish how far have we evolved in terms of the inclusion of women into the mining industry in South Africa by gaining an understanding of how are women perceived in the mining industry and to establish the relationship between the inclusion of women and team operational performance.

The second objective of this research study is to identify the core skills that are required in the core mining activities and to establish the relationship between perception of the technical skills of women and team operational performance.

The third objective of this study is to explore the relationship between the technical competencies of women and team operational performance.

1.2 Research Questions

The research questions of this study that will need to be answered are the following:

1.2.1 *What is the current perception of the inclusion of women in the South African mining industry?*

1.2.2 *What technical competencies are required in the core mining activities and what is the impact of having women in the team?*

1.2.3 *How do the technical competencies of women in the core mining activities affect team operational performance?*

1.3 Rationale for the Study

The reason for this study is to investigate the effect of the inclusion of women in the mining industry and how this affects team operational performance with a focus of the inclusion of women in the core mining activities, being in the disciplines of mining, engineering, metallurgy and safety.

The study also aims to identify the technical competencies required in the above-mentioned core mining activities for team operational performance in the South African mining industry.

1.4 Study Context: The Mining Industry

The Mining Charter requires 40% of the workforce to be made up of Historically Disadvantaged South Africans (HDSA) and women are included in this percentage (Botha, 2016). The minimum percentage requirement of 40% should comprise HDSA representation at executive, senior, middle and junior management positions and in core mining activities (Botha, 2016). The Mining Charter also required that 10% of women should fill core mining activity positions by 2009. These core mining activities would include mining, metallurgy, engineering and geology, all of which should be manual-labour activities in mining (Botha & Cronjé, 2015).

1.5 Definition of Terms

The key definitions or keywords are the following:

Inclusion: "[T]he extent to which employees believe their organizations engage in efforts to involve all employees in the mission and operation of the organization with respect to their individual talents" (Shore et al., 2011)

Technical competence: According to (Male et al., 2011) technical competence is referred to as having the following abilities: problem-solving skills and practical engineering skills.

Team Operational Performance: A team's operational performance can be defined as ability to create innovative solutions by bringing together the individual contributions of each team member and a team's operational performance is closely linked to an organisation's success (Silberg et al., 2021).

1.6 Delimitations

The delimitations for this study were set to sample a population of 15 interviewees within a chosen organisation within the gold-mining industry in South Africa.

The interviewees were selected deliberately by selecting individuals who were involved in the core mining activities within the South African gold-mining industry. These interviewees were selected based on their years of experience in the mining industry.

A combination of male and female interviewees were chosen as part of the sample in an attempt to establish the perceptions of women in the mining industry from both a male and a female perspective, however the majority of the selected females were not as willing to participate in this study as compared to males that were selected.

2 Literature Review

2.1 Background of Diversity and Inclusion

Diversity in the workplace is a term used to describe the differences between individuals within an organisation and how these differences may affect an individual's performance within the organisation. Inclusion in the workplace refers to how accepted the underrepresented groups feel within the organisation and the degree to which these underrepresented groups are valued for their distinctiveness (Morfaki & Morfaki, 2022).

An organisation with an inclusive atmosphere preserves a "*speak up*" culture and appreciates "*out of the box*" ideas and thinking (Chaudhry et al., 2021).

Diversity within an organisation can refer to several types of diversity, however the focus of this paper will be on gender diversity, which supports gender inclusion (Farndale et al., 2015). Gender inclusion refers to the inclusion of women in positions that were traditionally occupied by men based on the preconceptions of women in a male-dominated industry (Farndale et al., 2015).

2.2 Inclusion of Women in the Mining Industry

The inclusion of women in the mining industry worldwide has shared a common constraint: the harsh nature of the work environment at mines in general. However, recent mining legislation in South Africa caters for the inclusion of women in core mining activities with the aim of remedying the previous disparities and shortcomings (Botha & Cronjé, 2015).

Research has noted that the management of mining houses faces the challenge of integrating women into core mining activities due to male perceptions of women in this harsh environment. There is a prevalent belief that the inclusion of women affects the productivity of mines due to females having much less physical strength than males, which would lead to production delays. In addition, there is a view that

the pregnancy factor puts a strain on teams when the women in the teams have to go on maternity leave, leading to less team productivity (Botha, 2016).

Inclusion initiatives are dependent on the mindset of organisational leadership to promote the inclusion of women in the mining industry by driving the changes in the organisation that are necessary for the inclusion of women (Miyen & April, 2022).

“Inclusion is one of being involved in the process of creating societies and organisations in which all people, irrespective of their diversity, can prosper and progress and it is about creating empowering environments of difference, where people can be themselves, comfortably contributing their full selves and all the ways in which they differ from others, and respecting others without making it difficult for others to be their full selves” (April, 2012).

The definition that applies to this research paper is most closely linked to the definition of “inclusion [being] the extent to which employees believe their organizations engage in efforts to involve all employees in the mission and operation of the organization with respect to their individual talents (Shore et al., 2011).

Diversity in teams benefits team performance and this can be noted in strong problem-solving, decision-making and creativity skills in complex tasks (Nederveen Pieterse et al., 2013). Team diversity can affect team performance either positively or negatively (Nederveen Pieterse et al., 2013).

The skills that women bring to the table in a diverse workforce have shown to complement men’s skills since women are good at supporting others, listening and communicating, which contributes to the improvement in health and safety statistics in the mining industry (Fältholm & Norberg, 2017).

2.3 Perceptions of Women in the Mining Industry

***Related Research Question**: What is the current perception of the inclusion of women in the mining industry?*

Even though the inclusion of women in mining is a priority for the diversification of the workforce, discussions reveal that women are perceived as being problematic to the industry due to the nature of women in the household conflicting with the dangerous nature of the mining environment (Norberg & Fältholm, 2018).

Inclusion in an organisation is more about how to increase the number of the minorities within an organisation by making them feel welcome. The inclusion of women can be achieved by disseminating inclusivity through the various organisational levels, which can be brought about by organisations adopting an integration and learning view of organisational inclusion and supervisors following their organisations' inclusivity initiatives (Rice et al., 2021).

Organisations that lack an atmosphere of inclusion have been seen to have high employee turnover and high levels of team conflict. This makes it difficult for organisations to take full advantage of the organisational performance that can be realised by a diverse workforce (Nishii, 2013).

Organisations' inclusivity action plans often seek to change women rather than changing the work environments that disadvantage women in their career progression. It has been noted that the perspective of a female's career path is rooted in social contexts that "push-out" women in the workplace (Kossek et al., 2017).

Sheryl Sandburg, who was in a technical and male-dominated career, encourages women to "lean in" at the workplace and make themselves heard with confidence and find their seat at tables that were traditionally occupied by men, as this will add to an inclusive work environment (Bledsoe, 2014).

The inclusion of women in mining industries in Mongolia has been noted to have had a significant impact on decision-making due to the unique perspective that women bring to the table in the form of their comprehensive approach in the decision-making skills (Ochir et al., 2023).

Factors that lead to the lack of women in mining include the hazardous environment, safety of women, physical requirements, gender prejudice and secluded workplace locations (Kansake et al., 2021). One of the adaptive strategies applied by women in the mining industry is a behavioural strategy comprised of solution-focused actions, which are carefully chosen strategically as a way for women to compensate for their lack of physical ability and are used as a mechanism to help women qualify to be in such an environment and earn their male counterparts' respect (Van Vuuren et al., 2021).

Research also shows that only 9% of women who work in the mining environment in South Africa hold managerial or professional positions and that the rest of the women work as general workers. The main challenge facing women in the South African mining industry was found to be the lack of career advancement (Kaggwa, 2020).

A study to investigate the issues relating to the lack of women in senior structures in South Africa revealed that society's cultural stereotypes of women affects the career trajectory of women and male-dominated company cultures (Barkhuizen et al., 2022).

Internationally, the mining industry is seen as a workplace predominantly for males, even though women have entered the industry. The problem of integrating women into the workforce is deeply rooted in the strength of mining cultures historically and the masculine identity associated with mining, making it a very difficult issue to address (Salinas, 2013).

The "invisible" barrier hindering the success of women in the mining industry is still prevalent due to male supremacy that has disregarded women. Despite the increase in numbers of women in the mining industry in South Africa in the past 15

years, attempts to try break the gender-based barriers in the core mining activities must be addressed (Moalusi & Jones, 2019).

The barriers to inclusion of women in the South African mining industry were noted as being the lack of awareness of career options in the mining industry, the idea that mining-related jobs are physically demanding, challenges faced by women to balance work and life, and workplace cultures at the mines being hostile to women (Mashaba & Botha, 2023).

The literature review for this study will seek to establish the relationship between the technical competencies of women in the mining industry and team operational performance.

2.4 Organisational Performance

Related Research Question: How do the technical competencies of women in the core mining activities affect team operational performance?

The relationship between women leaders and organisational performance depends on whether the culture within the organisation is a conducive one for women (Hoobler et al., 2018). Women in leadership positions bring a different dynamic to the business environment due to the unique skills that women have. Through these unique attributes women are able to influence a firm's performance (Hoobler et al., 2018).

The glass ceiling is the invisible barrier that exists preventing women from climbing up the corporate ladder. The glass escalator refers to the fast-tracking of men to the top in a female-dominated profession (Ryan et al., 2007).

According to Ryan et al. (2007) women in leadership positions face a challenge referred to as the "glass cliff", since women in these positions are seen to face increased risk and a high possibility of failure at the top (Ryan et al, 2007).They argue that the glass cliff for sets up women to fail in leadership roles. Studies have

shown that 50% of men deny the existence of the glass cliff and only about 5% of women do not believe that the glass cliff exists (Ryan et al., 2007).

Haslam et al. (2010) argue that the link between women in leadership positions and the performance of an organisation can been seen such that the poor performance of a firm has led to the appointment of women in leadership positions rather than poor performance in firms resulting from women in leadership positions (Haslam et al., 2010). A number of issues arise when women are appointed in leadership roles, such as the competence level of women, career path prospects, gender prejudices regarding role suitability and the dynamics of preconception and discrimination (Haslam et al., 2010).

Studies show that the following issues have been examined: the effect of women directors on financial performance, organisational strategy, reputation of an organisation, and processes of the board (Kirsch, 2018).

Financial performance of an organisation is attributed to two important measures: stock-based performance and accountancy performance. Stock-based performance is influenced by investors' opinions of women in leadership positions (Kirsch, 2018). Women in director positions seem to have a positive effect on firm innovation and friendly human resource policies (Kirsch, 2018). Higher firm performance will increase the likelihood of firms to increase the number of women employees by adopting policies and procedures to retain women in management positions (Schwab et al., 2016).

The relationship between female directorship in an organisation and firm performance has been explored with the finding that women bring a renewed perspective to company boards, which differs from the old boys' club of having men only as directors (Bennouri et al., 2018).

Females also bring a new insight due to their problem-solving skills, innovative ideas and creative ways of thinking (Bennouri et al., 2018). The attributes of female directors are related to the higher monitoring perception of females on company

boards and the attributes of females are related to corporate strategic decisions (Bennouri et al., 2018).

Ferreira (2015) suggests that “[w]hen discussing policies that promote women in business, it is better to focus on potential benefits to society that go far beyond narrow measures of firm profitability”. A greater quantitative impact has been seen on high-performance firms with female directors than low-performing firms (Conyon & He, 2017).

The mining industry in South Africa is a high-risk environment and for mining houses to remain competitive in the industry they must comply with the Mines Health and Safety Act and regulations. Effective supervisory skills by line management are directly related to high safety performance targets, which closely tie into organisational performance in the mining industry (Prinsloo & Hofmeyr, 2022).

Effective supervision and proper delegation of tasks and the ability to effectively support and guide employees in complex tasks have a direct impact on the safety behaviour and performance of work teams and ultimately contribute to organisational success (Fang et al., 2015).

2.5 Technical Competencies of Women

Related Research Questions: *What technical competencies are required in the core mining activities and what is the impact of having women in the team?*

The gender prejudices of women in engineering still exists and the technical competence of women in these core mining activities is still questionable, which could be the reason for the under-representation of women and the exit of women in these technically inclined careers (Schmitt, 2021).

Technical ability or technical competence in mining projects is crucial since mining projects in all disciplines have to be theorised, established, planned, executed,

functioned and closed (Stacey et al., 2008). Technical competence is referred to as an individual having the following abilities: problem-solving skills and practical engineering skills (Male et al., 2011).

All engineering-related occupations in the core mining activities require technical competencies, with academic knowledge, management skills and engineering principles as a priority (Motsoeneng et al., 2015).

A study for an underground coal mine to determine the type of technical competence that was needed to have a significant impact on safety statistics in the mining environment concluded that it was necessary to have subject-matter expert knowledge to adequately perform tasks, knowledge of safety management, and the ability to transfer this knowledge and give instructions to subordinates (Martyka, 2014).

Employees at the middle and higher supervisor level should also have the technical competence to make effective decisions and the ability to solve problems. In addition, they should have organisational skills such as planning, effective delegation of tasks and efficient management of resources such as labour (Martyka, 2014).

For supervisors to achieve good safety statistics, they need technical competence, which includes a good knowledge of the safety procedures, policies and rules (Martyka, 2014). The core competencies related to safety levels in mines are the technical knowledge related to proper execution of tasks and good knowledge of the safety rules pertaining to the high-risk environments (Martyka, 2014).

A socially constructed stereotype associated with engineering, a core mining activity, is that an engineer is a man with a high technical ability who is conversant with mathematics but lacking in social and human interaction skills. In contrast, women are seen as non-technical and but emotionally intelligent, which enables them to handle social and human interactions (Hatmaker, 2012).

Gender prejudices associated with women in engineering still exist and the technical competence of women in these core mining activities is still questioned.

This could be the reason for the under-representation of women and the exit of women in these technically inclined careers (Schmitt, 2021).

2.6 Required Technical Competencies

In summary, the technical competencies required in the core mining activities in the South African mining industry are problem solving, knowledge of risk and safety management, decision making, delegation of tasks, and listening and communication skills.

These technical competencies will be elaborated on in the sections below:

2.6.1 Problem solving

Technical or engineering competencies do not relate research skills to problem-solving competencies. The relationship between research skills and problem-solving skills is recognised by international engineering bodies as a key engineering technical competency (Missingham et al., 2018).

Problem-solving skills by an individual is seen as a process that includes the problem being clearly defined, taking an expanded thinking approach in the way the problem is perceived, and clarification of the problem through effective communication. Problem- solving begins with a data collection for problem understanding, consideration of possible solutions, presentation of information relevant to solving the problem, critical analysis of the solution and effective communication of the proposed solution to the problem (Missingham et al., 2016). The systematic approach to solving a problem reflects an engineering technical way of thinking by applying logic to solve a problem (Missingham et al., 2016).

Problem-solving skills require an individual to have the following set of sub-skills: task-related behavioural skills, problem-analysis skills, solution action planning and teamwork skills (Polyak et al., 2017).

2.6.2 Knowledge of risk and safety management

A study by Zhang et al. (2022) explains that the safety knowledge level in the mining industry affects the miners' perception of risk, which is an important factor in mine safety management. A better perception of risk reduces safety-related incidents directly related to organisational performance.

Adequate knowledge of safety management practices results in higher safety performance statistics in mining organisations (Sanmiquel et al., 2014).

The safety level of middle managers on the supervisory level was examined to assess the safety culture at an underground coal mine. The results reveal that poor application of the safety standards by supervisors and miners negatively impact safety statistics directly related to team and operational performance (Martyka & Lebecki, 2014).

A systems thinking approach to safety management in the mining industry should be applied to allow leaders to apply a proactive approach in the assessment of workplace hazards. This will increase safety performance by taking the learnings from previous incidents rather than applying this approach only when current systems fail (Donovan et al., 2017).

2.6.3 Decision making

Effective decision making is considered as a technical competency in engineering projects due to its complexity and levels of uncertainty in the thriving mining environment. Hence, the ability to make good decisions hinges on individuals having additional professional qualifications, a good body of knowledge based on experience in the industry, good decision-making judgement and the ability to apply a broadened approach to the decision-making process (Philbin & Kennedy, 2020).

Managers need to know how to differentiate between "pull the plug" or "take the plunge" decisions within an organisation by having the ability to identify potential opportunities or potential threats to the business early in the decision-making

process, which comes with experience in the mining industry (Bakker & Shepherd, 2017).

2.6.4 Delegation of tasks

The effective delegation of tasks means having the ability to assign tasks to team members where they are able to manage the task effectively with minimal intervention and are responsible for the results thereof by taking full accountability for the task-execution process (Tomescu-Dumitrescu & Mihai, 2019).

Effective leadership within an organisation requires suitable delegation of authority to employees based on their capabilities whilst taking responsibility to ensure that organisational performance targets are met. This process will only be efficient if the leaders trust their subordinates' decision making on delegated tasks when transferring some of their authority (Shulepov & Shulepova, 2016).

2.6.5 Listening and communication skills

The communication process in an organisation can be regarded as a two-way process, where the speaker communicates or sends a message with the intention to convey important information regarding organisational performance, and the listener listens with the intention to receive and acknowledge the communication being received (Lidh, 2013). Communication is only successful when the receiver of the message hears the same message as required by the sender. Hence, in an organisational setting it is referred to as the ability to transfer knowledge and instructions adequately to subordinates by ensuring that the communication process is successful (Reddy, 2019).

The skill to communicate also means having the ability to address difficult topics or issues within teams in a dynamic business environment by knowing how to speak in an appropriate manner to team members, listening attentively and by displaying interest in the conversation when being spoken to (Rathod, 2022). Studies by Lakshmi (2017) explain how engineering students have great technical

competencies but are lacking in communication skills, with the art of listening forming a critical component in the communication process, and the failure to listen effectively leading to misinterpretation of what is being said.

2.7 Team Operational Performance (TOP)

Related Research Question: How do the technical competencies of women in the core mining activities affect team operational performance?

A team's performance can be defined according to its ability to create innovative solutions and is closely linked to an organisation's success (Silberg et al., 2021). Team performance is more than just the number of people on a team but more about the collective orientation and the behaviour of individual team members. The team's performance is improved by the individual contributions of each team member in terms of their individual abilities and skills (Silberg et al., 2021).

A team's operational performance is affected by issues such as negative team member behaviour, and the critical trait that hinders a team's performance is the team members' ability to adapt into a team (Lee et al., 2013).

Operational performance is based on the ability of a firm to find more effective ways of doing things, thus increasing their operational efficiency (Santa et al., 2010). Operational performance in teams results from the ability of team members to add value to a team and the ability of each team member to achieve the key deliverables within the specified time constraints. Hence, the teams operational performance refers to the ability of a team to innovate and make effective use of its resources to ensure that the organisation performs better than its stakeholders (Santa et al., 2010).

Team performance is measured by a team's ability to have the adequate skills composition and the right team connectivity to enable the team to be successful (Dorn et al., 2011).

High-performance teams are dependent on the integration of skills and experiences of the individuals in a team (Castka et al., 2001). The skills and knowledge of an individual in a team are the perceived barriers to team performance (Castka et al., 2001). Team performance is measured by the value added by the individual contributions in a team by the accomplishment of individual tasks, and by their participation in a team (Castka et al., 2001).

A study done in India to establish the reason for the increase in the employability of women showed that women have strong multi-tasking skills and exceptional behavioural competencies together with technical competencies, namely decision making, self-management, problem solving and analytical abilities (Tiwari, 2016).

2.8 Relation between Technical Competencies of Women and Team Operational Performance

The technical competencies required by teams in general were summarised as an individual having problem-solving skills, knowledge of risk and safety management, delegation of tasks, decision-making skills, and listening and communication skills.

Men and women require the above-mentioned skill-set in order to thrive in any of the core mining activities in the South African mining industry.

This study will address any additional skills that may be required that were not mentioned in the literature.

This study will also seek to answer the relation between the technical competencies of women and its effect on team operational performance in the South African industry in the core mining activities.

2.9 Summary of Literature Review

This research study aims to fill the gaps established from the above literature review. The gaps in the literature are lack of the research and investigations into the perceived technical competence of women in teams and how this affects team

operational performance in terms of the technical key performance indicators of the technical disciplines within the core mining activities of engineering, mining, metallurgy and safety.

3 Research Method

3.1 Research Methodology

The study will adopt the qualitative data collection method due to the non-numerical nature of the research topic. Qualitative research is used when the views of an individual's experience are required on a certain topic (Scalcău, 2021). This method was also chosen due to the small sample size of only 15 participants and the data collected had to be from experienced professionals in the core mining activities within the gold mining industry in South Africa.

The research model will be limited to a gold-mining company in South Africa. This will comprise the primary data collection over the various divisions of the gold-mining company based in the various provinces in South Africa. This mine was chosen due to the availability of the sample population. The participants are readily available to participate in this research.

Judgemental sampling will be used for the qualitative research (Farrugia, 2019). The sample size chosen for this research is 15 individual interviews. The interview schedule is included in Table 2 in Appendix A. The research will be conducted and the data collected from departmental-level heads and the levels below in the core mining activities of mining, engineering, metallurgy and safety in the mining industry to determine the perceived effect that women have in the mining industry. Judgemental sampling will be applied as the individual participants have been deliberately chosen based on the belief that the most information will be gained from the chosen sample.

3.2 Research Instrument

Unstructured or semi-structured interviews have been chosen because this allows for a more comfortable and informal type of interview and not all the questions posed by the interviewer will be known at the start of the interview (Qu & Dumay, 2011). The semi-structured interview will be conducted by posing open-ended

questions posed to the interviewee, which will allow for a better response since most of the data gained will be from the interviewee's perspective (Qu & Dumay, 2011). The interviews will be held in such a way to ensure equal balance of power between the interviewer and interviewee to prevent the interviewees' answers from being biased as a result of the interviewer's authoritative nature. As interviewees will be made to feel comfortable and free from pressure, the answers they provide will be a true reflection of their perceptions relating to the research topic.

3.3 Sample and Population

The measuring instrument comprised of a sample 15 individual interviews conducted across all the core mining disciplines and the interviews were semi-structured with interview guiding questions to guide the direction of the interview. The population for this research study were individuals in the technical fields from the core mining departments across various levels on the departmental organogram. The primary data gained were voice recorded during the conducted interviews.

As the operations of the mine are located in different provinces in South Africa, the interviews were conducted online with the selected participants. Traditional face-to-face interviews were replaced by interviews held on the online platform to allow for practicality and convenience for the interview participants.

The COVID-19 pandemic fast-tracked the online meetings via Microsoft Teams (MS Teams) application. Hence, for the ease of data collection, all meetings were held online on MS Teams. MS Teams was used to voice record all data collected during the interview process. MS Teams was used to easily transcribe the data rather than producing manual handwritten transcripts.

The online qualitative interview is advantageous as it allows for ease of access to participants across long distances, allows time for the participant to reflect before answering and also provides a better environment for sensitive topics or questions during the qualitative interview (Saarijärvi & Bratt, 2021).

Qualitative interviews are the chosen method of data collection since the perceptions of the interviewees need to be established concerning women in mining in the South African mining industry. The interviewees chosen to participate in this research project were selected based on their personal experiences in the mining industry in South Africa in an attempt to answer the research questions of this paper (McGrath et al., 2019).

The interviewee and the researcher both contribute significantly to data collection in a qualitative interview where the researcher is the prime instrument to guide the interview with a non-biased approach in an attempt to create meaningful data for the research project (McGrath et al., 2019).

According to Malterud et al. (2016), the sample size of a qualitative interview is dependent on a few factors, such as the quality of the dialogue and sample specificity – whether participants' experiences or knowledge are adequate to meet the objectives of the study.

The sample size of this research was determined based on the initial estimate of the number of interviewees to be selected for the study. Then the progression of the interview and the quality of the dialogue would be assessed at every interview to determine if the dialogue between the interviewer and interviewee is strong or weak. The information power of each qualitative interview will determine if the sample size is increased or not.

The power dynamics between the researcher and interviewee during a qualitative interview must be carefully managed throughout the data collection and data analysis process by the researcher being aware of the interviewee's answers to the interview questions, deciding on suitable follow-up questions and finalising the conversation (Anyan, 2013).

3.4 Sampling Strategy

The sampling strategy applied for this study was to choose both male and female interviewees with the chosen gold-mining organisation in South Africa. The

perspectives of both females and males are crucial for this study since the technical competencies of women is being assessed in the core mining activities.

The number of women employed in mining has increased over the past few years and the core mining departments all have women now as part of the team. The perception of women in mining and the technical competencies thereof needs to be established from both a male and female perspective.

3.5 Ethical Considerations

Permission was requested from the mine legal department and formal permission was granted. The interviews were conducted according to the interview schedule with the selected participants. The data was conducted during work hours during the mining company shift times with the informed consent of each interviewee.

The participation of the interviewees in this research study was voluntary and all participants who are selected and willing to participate in the research study signed an informed consent form to make them aware of the details of this study.

According to research ethics standards, individual participants who are part of the sample in research projects have a right to be protected. The information provided by the participants should be protected and confidential (Anyan, 2013). The participants also have the right to anonymity.

The Milgram's experiment is a perfect example of how unintended harm can be caused to participants of a research experiment. According to research ethics, the psychological harm of participants must be avoided (Stacey & Stacey, 2012).

The data gathered during research must be restricted in terms of its use and hence the data collected via interviews in this research project will be restricted to use as confidential. It is the researcher's responsibility to identify and eliminate potential threats posed by their research, and human participants' rights should be given sufficient focus according to research ethics protocol (Stacey & Stacey, 2012).

False data that is used as an alternative to real research data is referred to as data fabrication, whereas data falsification refers to the altering of research data (Stacey, 2016).

Data Fabrication and data falsification are classified as research misconduct and should not be condoned by researchers (Stacey, 2016). Researchers have an ethical obligation to disclose research analysis used to prove the absence of fabricated or falsified data. The full disclosure of the true source of the data and the analysis of the data serve as evidence in backing (Stacey, 2016). A proper record of all data collected during this research will be kept to avoid any academic misconduct possible due to data fabrication and falsification.

3.6 Validity and Reliability

The internal validity/truth value of a qualitative study is classified as credible when the human experiences are so well interpreted and accurate in description that when other persons who share common journeys recognise the accuracy in the descriptions (Krefting, 1991).

Guba's model for the assessment of any research type suggests that transferability/fittingness is also important, which means that research findings applied in contexts outside of the study have a degree of similarity between the different contexts and hence the research findings are transferrable (Krefting, 1991).

Validation of qualitative data refers to the assessment of the credibility of the research findings (Koro-Ljungberg, 2008). External validity will be ensured in this research by ensuring that data will be collected from experienced professionals in the mining industry, with the sample selection based on participants with a minimum of five years' experience up to 40 years' experience in the mining industry (Laurent, 2000).

The researcher in a qualitative study is regarded as a primary research instrument and it is vital that concise interpretations of the participants' responses in a

qualitative study are concluded (Jones & Donmoyer, 2021). It is important for the researcher to ensure trustworthiness of the qualitative study and to minimise bias on the responses received from the interviewees by the researcher (Jones & Donmoyer, 2021).

3.7 Data Analysis Method

Data collected in this research study will be analysed using a technique called thematic analysis in an attempt to create meaning from the data. Thematic analysis is a thorough form of analysis for setting the scene of the analysis process to try to derive patterns and relationships in the data by first sorting the data, transcribing the data, coding the data and eventually drawing valuable themes and categories from the collected data (Lester et al., 2020).

All data collected from the 15 interviews will be saved in a common location and all voice recordings and automated transcriptions obtained from the MS Teams application during an interview will be saved with appropriate file names. The data collected via the audio recordings will be summarised using an Excel spreadsheet where data will be coded and themes established.

The data will then need to be categorised, which simply means the development of wider interpretation of the data from codes to categories, and finally the themes that can be concluded from the data analysis process will be identified (Lester et al., 2020).

This qualitative research study will be explored and understanding will be gained from the individual interview responses to gain answers to the organisational problem of how the technical competence of women affect team operational performance in the core mining activities.

Thematic analysis is advantageous when analysing a large data set since it summarises the important facts revealed in the data by requiring the researcher to first become familiar with the data through repetitive reading to identify patterns and ideas before coding of the data can commence. Secondly, coding of qualitative date

is done to convert the raw unstructured data into ideas by looking for texts or phrases that relate to a common theme (Nowell et al., 2017).

The third and fourth step in thematic analysis are to search for themes from the coded data, review the themes and finally define the themes and establish what is of use from the themes in relation to answering the research questions of the study (Nowell et al., 2017).

Common keywords and phrases amongst the responses were noted and the relevant themes were derived, the data set is analysed for repeated terms and patterns and these are encapsulated into keywords (Naeem et al., 2023). Coding of data is a process that takes the keywords identified and groups the data into meaningful and intuitive units (Naeem et al., 2023).

The above-mentioned steps in thematic analysis are simply the initial phase of the thematic analysis process. This leads to the deeper analysis of the data, which comprises of the researcher scanning for patterns that precisely exposes the relevant data that focuses on answering the research questions of the study (Liebenberg et al., 2020).

Qualitative interview transcripts data are analysed and common statements are identified and categorised into themes. These themes signify the facts being highlighted in the data on a specific topic (Creswell & Creswell, 2017).

3.8 Summary of Research Method

The method of data collection for this research study was qualitative in nature since the interviewees experience within the South African mining industry was required. The population for this research study were experienced individuals from the technical fields within the mining industry which are involved in the core mining activities. A total of 15 participants were selected based on judgemental sampling and were subjected to a semi-structured interview in order to gain the perspective of the participant’s experience. The data collected from the interviews were voice recorded and transcribed using MS Teams as an online interview platform.

4 Research Findings

This chapter will summarise the demographic profile of the interview participants and include a discussion of the findings across all participants.

The objective of this study is to establish the current perception of the inclusion of women in the mining industry, identify the unique core skills that women add to the mining industry and to establish how the technical competencies of women in the core mining activities affect team operational performance in the South African mining industry.

4.1 Demographic Profile of Participants

The findings of the demographic profile of the interview participants will be presented followed by a discussion and the conclusion of the demographic profile will be presented.

A total of 15 interviews were conducted with participants across all the core mining activities of mining, engineering, metallurgy and safety. The 15 interviews formed part of the study for further analysis in this report.

Figure 2 shows the demographics of the participants according to gender, highlighting that 33% of participants interviewed were female and 67% of the interview participants were male.

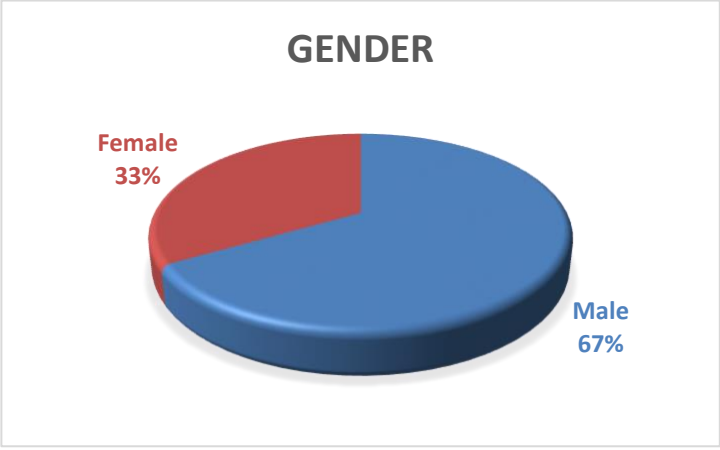

Figure 2: Demographics of participants – gender

Figure 3 shows the percentage of participants from various organisational levels ranging from supervisory level up to middle management level and senior level.

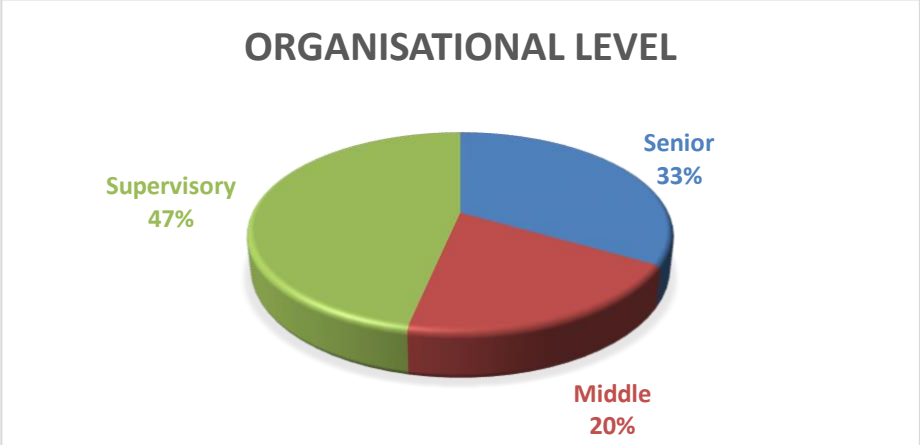

Figure 3: Demographics of participants – organisational level

The majority of the participants were from the supervisory level, forming 47% of the participants. The participants from the senior management level formed 33% of the interview sample and 20% of the interview participants were from the middle management level.

Figure 4 shows the demographics of the participants according to qualification level, ranging from participants who only attended technical courses to participants who have a national diploma, bachelor's degree and a master's degree.

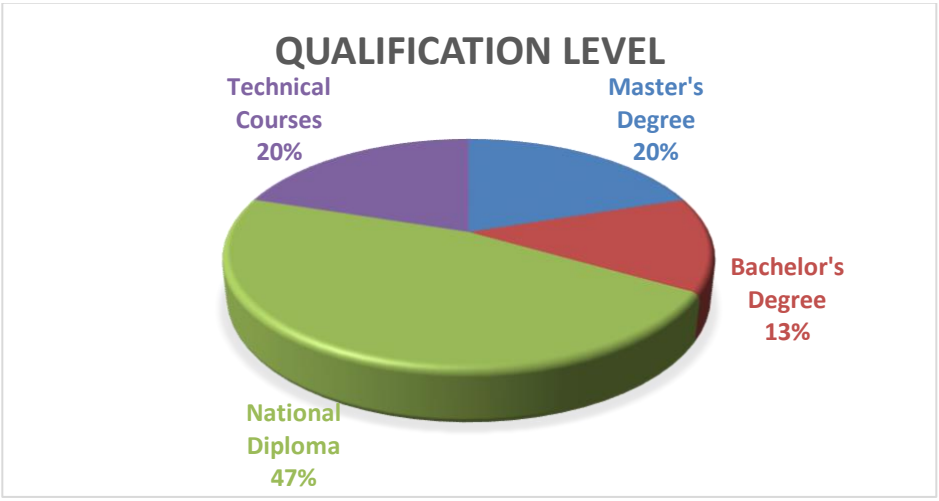

Figure 4: Demographics of participants – qualification level

The majority of the participants hold a national diploma qualification from a technical institution and this segment comprises 47% of the interview sample. The participants holding a bachelor's degree level of education comprises of 13% of the participants and 20% of the participants also hold a master's degree level of education. The sample also contained interview participants whose level of education comprised only technical courses that were attended at a technical college or institution.

Figure 5 shows the demographics of the participants in terms of years of experience in the mining industry in South Africa, ranging from 5 to 10 years up to participants who exceed a total of 40 years' experience.

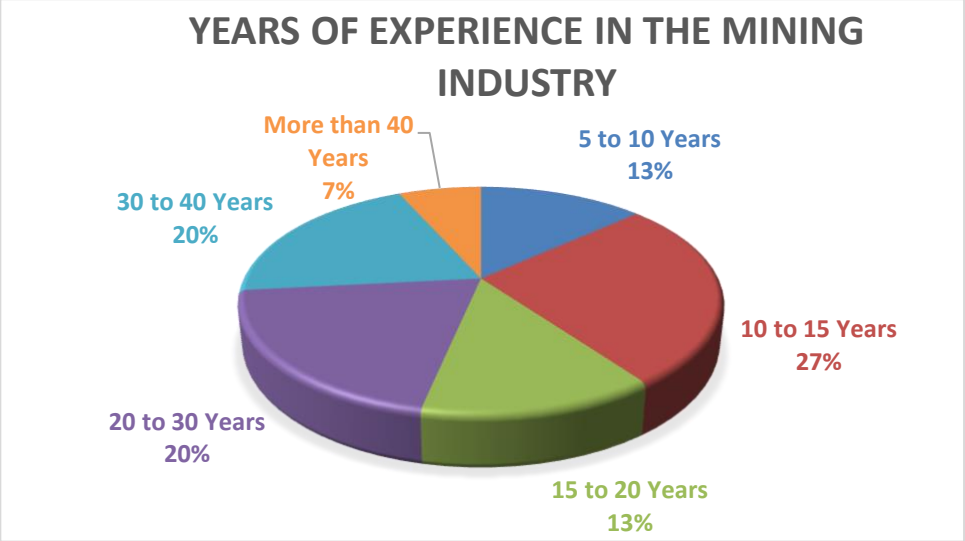

Figure 5: Demographics of participants – years of experience in the mining industry

The majority of participants interviewed have between 10 and 15 years' experience in the mining industry and this segment comprises 27% of the interview sample. The smallest segment of participants have in excess of 40 years' experience, comprising only 7% of the sample. The interview participants with 20 to 30 years' experience made up 20% of the interview sample. The interview participants with the least years of experience from 5 to 10 years' experience comprised 13% of the interview sample.

Figure 6 shows the demographics of the participants in terms of which part of the core mining activities they are employed in, namely mining, engineering, safety and metallurgy.

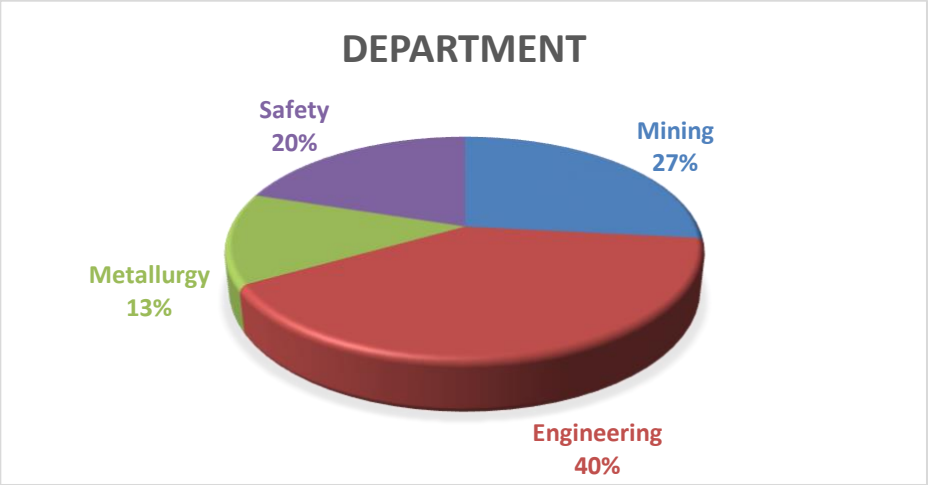

Figure 6: Demographics of participants – department

The majority of the participants were from the engineering department, making up 40% of the interview sample, and the least were from metallurgy comprising 13% of the sample.

Table 1 shows a summary of the demographics of the interview participants. A total sample of 15 interview participants formed part of the data collection process. A combination of females and males were interviewed for this study. The females were not very keen to participate in the interview process, which formed part of the women in mining research interview schedule, hence it was not possible to achieve equal numbers of male and female participants. The males were surprisingly very keen to participate in the interview process, hence the excess in male participants.

Table 1: Summary of demographics

Demographics of the interview participants			
Total number of interview participants	**15**		
Department		**Organisational level**	
Engineering	6	Senior management	5
Mining	4	Middle management	3
Metallurgy	2	Supervisory	7
Safety	3		

4.2 Results and Discussions Pertaining to Research Question 1

Results from participants that provide answers to research question 1 will cover the inclusion of women in the mining industry.

Research Question 1: What is the current perception of the inclusion of women in the South African mining industry?

Research question 1 stated above was answered by asking the interview questions in section 4.2.1 below.

4.2.1 Results from the inclusion of women in the mining industry

Question 1: How do you view the inclusion of women in the mining industry?

The inclusion of women is viewed in a very positive way and is definitely supported in general with women adding unique attributes to the mining industry such as innovative thinking. A participant said that "[t]here are unique attributes that women bring to the mining industry".

Some of the views expressed by male participants showed a deep hesitancy to include women in the industry with a common factor being that women are limited in terms of physical strength for the on-the-tools type of designations in the lower levels.

The hesitancy to include women was clearly illustrated by a senior management-level participant who said, "*I don't mind women in the mining industry but some positions are better suited for women* and some are well suited for men."

Some female participants felt that the inclusion of women in the mining industry is just a numbers game and that the mining industry is far from being fully supported due to infrastructure and policy changes that need to be implemented. This view was clearly illustrated by a female participant who said, "*Women are included in the mining industry but are not fully supported."*

An interesting view on the inclusion of women highlighted the deeply rooted mind-set issue that still persists in the mining industry where due to an individual's culture they tend to have a distorted view of women in the industry and that this needs to be changed in order for the industry to be more accommodating to women. The participant said, "Different *groups have a diminished view of the value of women in the industry."*

Question 2: How does your team implement the inclusivity initiatives set out by the organisation to include women in your team?

Most of the participants highlighted that the way the organisations are including women in the industry are by including both men and women in the recruitment process when vacancies arise in the core mining activities. The candidate is ultimately selected based on their competence level, hence irrespective of gender the role can be filled by a woman who qualifies to be in a role.

In the working teams a deliberate effort is being made to include the women in the team in every task and it was also highlighted by one of the participants that leaders need to be "*more deliberate about identifying positions where women would be best suited and hire women for these positions"* and other participants highlighted that *"women that are keen to be developed in mining are to be selected"* and this will contribute positively to the inclusion of women in the mining industry.

Question 3: How does increasing the number of women in your team affect team operational performance?

The general perception of increasing the number of women in a team was positive in the sense that women have a positive effect on team operational performance due to the special attributes that women bring to teams, such as good communication, innovative thinking, commitment, dedication, attention to detail, faster processing time for tasks and multitasking ability.

Some of the participants feel that adding more women to a team makes no difference since women are just as capable as men to perform tasks and it has been noted in the metallurgical department that women perform the tasks so well

that the team doesn't really notice that there was a woman in the team actually executing the tasks. This was a participant from senior management level who said "The ladies are heading the metallurgical plants and are in line with what their male counterparts are doing irrespective of gender and all this are due to competencies."

The negative impact of increasing the number of women in the team was centred on family planning and the impact faced by a team when a woman goes on maternity leave without a replacement, which leaves a gap in the team. It was highlighted by a participant that "*[m]aternity leave causes a loss of continuity in the team and the team is losing a skill for up to five months."*

Question 4: How do you feel that the women in your team show initiative to be included as part of the team?

The majority of the participants feel that women speak up and want to be heard and included as part of the team. Women participate and are putting themselves forward to be heard. This depends greatly on personality type just as with males where some women shy away and like to be at the back and some women want to be included.

One of the participants highlighted the success of women showing initiative by saying that "[w]omen *have accepted their role in the mining industry and women that have taken initiative have progressed through the organisational structures".*

Table 2: Summary of common themes relating to Research Question 1

Prevailing Themes: Research Question 1	**Supporting Quotations from Data**
Women bring a uniqueness to the mining industry and are putting themselves forward to be heard.	"Women *have accepted their role in the mining industry and women that have taken initiative have progressed through the organisational structures."*
Cultural stereotypes of women undermine women's ability in the mining industry.	"*Women are included in the mining industry but are not fully supported."*

	"Different groups have a diminished view of the value of women in the industry."
The efforts to include women in the core mining activities are deliberate by management.	*"Women that are keen to be developed in mining are to be selected and* this will contribute positively to the inclusion of women in the mining industry."

4.3 Results and Discussions Pertaining to Research Question 2

Results from participants that provide answers to research question 2 will cover the technical competencies required in the core mining activities and the impact of having women in the team.

Research Question 2: What technical competencies are required in the core mining activities and what is the impact of having women in the team?

Research question 2 stated above was answered by asking the interview questions in section 4.3.1 below.

4.3.1 Results from the technical competencies of women in the mining industry

Question 5: What technical competencies are required from members in your team?

The technical competencies that are required across all the core mining activities have been noted to be strong communication skills, problem-solving ability, planning and task scheduling, people management, and team collaboration and cohesion.

The common thought process of all the participants included the fact that a suitable technical qualification is a must for any of the core mining activities and the main point that was made was that an individual must be able to "*apply the technical*

knowledge to solve practical problems" or have *"the ability to translate the theoretical technical knowledge into the field by displaying it practically".*

Question 6: Do you feel that the women in your team have these technical skills required for team operational performance?

The majority of the participants felt that women do have the core skills required for team operational performance, however they feel that the core skills of women need to be developed by more exposure to the technical environment.

One participant highlighted very positively that "*Yes, women do have the core skills hence ladies have been appointed as managers".*

Question 7: How do the technical skills of women within your team add value to the team's operational performance?

The majority of the participants say that the core skills of women are comparable to those of the men in the industry and that women bring the same value-add to the team as men.

A participant supported this by saying that "[t]heir *skills are equal to their peers; the value-add is seen as equal irrespective of gender."*

A second participant added that *"[r]egardless of [being] a man or a woman, an individual with the correct portfolio of skills would contribute to team performance".*

Table 3: Summary of common themes relating to Research Question 2

Prevailing Themes: Research Question 2	**Supporting Quotations from Data**
Technical skills of women need to be developed.	"*Apply the technical knowledge to solve practical problems"* *"The ability to translate the theoretical technical knowledge into the field by displaying it practically"*

The technical competencies of women are comparable to those of men in the mining industry.	"Regardless of [being] a man or a woman, an individual with the correct portfolio of skills would contribute to team performance."

4.4 Results and Discussions Pertaining to Research Question 3

Results from participants that provide answers to research question 3 will cover the technical competencies of women and their effect on team operational performance.

Research Question 3: How do the technical competencies of women in the core mining activities affect team operational performance?

Research question 3 stated above was answered by asking the interview questions in section 4.4.1 below.

4.4.1 Results from the technical competencies of women and their effect on team operational performance

Question 8: How do the decision-making skills of the women in your team add to the team's operational performance?

The majority of the participants feel that women have good decision-making skills and are definitely able to make the right decisions, which greatly impact team operational performance in a positive way. There is no distinction between the decision-making ability of men and women. However, some participants feel that the empathy of women has been seen to have a positive impact in their decision-making ability, which greatly impacts team operational performance.

Women are thorough in their decision making and are able to look at the bigger picture when making decisions.

Some participants have highlighted that women have decision-making ability, however this needs to be developed. They suggest that sometimes their lack of practical exposure in the technical environment impacts their decision-making ability resulting in their taking longer to make a decision, which negatively impacts team operational performance.

Question 9: How does the ability of women to transfer knowledge and instructions to subordinates (listening and communication skills) in your team contribute to the overall team operational performance?

Women are noted as having excellent listing and communication skills, which significantly aid their ability to transfer knowledge and clear instructions to subordinates, positively affecting team operational performance with a notable positive impact on safety statistics in the mining industry. Women in teams tend to have the ability to value the opinion of others and therefore encourage two-way communication allowing the opinion of both parties involved in a communication to be heard.

One participant said, “Women always want more details on issues, making them very effective when communicating” and another participant mentioned that “[w]omen communicate with their hearts and minds and are better at communicating”.

Some of the participants mentioned that women are good communicators at the management levels, however they tend to struggle at the supervisory levels due to cultural beliefs where men tend to not want to take instructions from a woman and where men believe that women are not capable. As a result, the women in lower levels struggle with transferring knowledge and instructions to subordinates.

Some participants noted that women’s lack of experience and technical background affects the way the team takes instructions from women in the mining industry.

A participant said that the way women transfer knowledge and instructions to subordinates is “dependent on their amount of experience in the industry and on the amount of knowledge in the field”.

Question 10: How do the problem-solving skills of women in your team add to the results of your team's performance?

The majority of the participants feel that women are more than capable of solving problems in teams, which contributes positively to team operational performance. A participant said that "[w]omen are able to solve problems timeously and effectively".

A participant also responded that "[t]he problem-solving skills are aligned to their male counterparts without noting any lack in competence because of gender".

A participant noted that the lack of technical exposure of women in the field has affected the problem-solving ability of women in the mining industry and that experience in the industry plays a huge role in the problem-solving ability of women.

It has been noted that women are capable of solving problems effectively due to their attention to detail, however "[t]he problem-solving ability of women needs to developed".

Question 11: How does the delegation of tasks by women in your team ensure that the team's operational performance targets are effectively achieved?

Most of the participants responded positively saying that women are able to effectively delegate tasks in teams, which ensures a positive effect on team operational performance. This can be noted in the significant reduction in safety-related incidents in teams led by women since women tend to do more follow-ups on delegated tasks than men.

It has been noted that women in the lower levels tend to struggle with the delegation of tasks due to their lack of assertiveness and also due to the cultural beliefs of the illiterate lower levels that women do not have the ability to qualify to be in the mining industry. Because of this, women have to win team trust first before they can be successful in the delegation of tasks. This implies that a shift in mindset and culture of individuals in the mining industry is required for women to be successful.

Question 12: How does the knowledge of risk and safety management of the women in your team contribute to the team's operational performance?

The majority of participants feel that women take fewer risks than men and this comes from the fact that women are "natural protectors" in the home, hence making them more risk-averse than the men in the industry.

The safety statistics in the mining industry are proof that women have a good knowledge of the risk and safety management systems and are able to positively add to team operational performance.

Some participants mention that due to women's effective listening skills, they are able to better engage with teams, which wins the hearts and minds of the people in their teams. As a consequence, the team tends to go the extra mile to identify workplace risks, making a significant difference in the safety statistics, which positively affects team operational performance.

"The motherly instinct of women" makes them more aware of risks and hence they have a good knowledge of safety and risk management policies and procedures, which greatly contributes to team operational performance.

Question 13: How do the innovative skills (ability to have creative ways of thinking) of women in your team add to the team's operational performance?

The majority of participants feel that women have creative ways of thinking and bring a fresh perspective to the team with their new ideas. The "nurturing nature of women to make people and teams feel valued is what stimulates the innovation in teams led by women".

A participant said that "[w]omen are always thinking of how to do things better" and that "women know how to better utilise their resources".

A participant mentioned that "[w]omen are able to work with what they have to get the same job done hence they are very innovative for team performance".

Question 14: What technical competencies do you feel women have that are required for team operational performance in the South African mining industry?

Several participants feel that women have excellent problem-solving skills and insightfulness required for innovative problem solving in the mining industry.

Women also have good delegation skills and communication skills required to thrive in leadership positions, in particular management positions in middle to senior management. One of the responses highlighted that due to women being natural leaders in the home setting, they naturally bring teams together and have strong empathetic leadership skills and lead with empathy, which is required for team operational performance.

Some participants feel that having technical qualifications is crucial for women to enter the mining industry, however participants feel that women lack exposure to the technical environment, which hinders their ability to reach their full potential in the workplace.

One participant from senior management highlighted that the skills transfer step in women's development in the mining industry is not done adequately. This is possibly due to cultural views about the inclusion of women in the mining industry and the fact that women are seen as a threat in the industry, which affects the skills transfer to women in the field. The participant mentioned that "[t]he cultural views have a distorted view of women and this is the main reason why women are not given the platform to succeed".

The technical competency of adequate exposure in the technical environment to gain hands-on practical exposure and the ability to translate the theoretical technical knowledge practically in the field is a competency that is lacking in women in the South African mining industry.

Table 4: Summary of common themes relating to Research Question 3

Prevailing Themes: Research Question 3	Supporting Quotations from Data
Women are more risk-averse due to their attentional to detail, making a positive contribution to team operational performance.	"The motherly instinct of women" makes them more aware of risks and hence they have a good knowledge of safety and risk management policies and procedures, which greatly contributes to team operational performance.
Women lead with their hearts and minds and are able to make teams feel valued, which has a positive effect on team operational performance.	The "nurturing nature of women to make people and teams feel valued is what stimulates the innovation in teams led by women".

4.5 Summary of Findings/Results

*4.5.1 **Findings – Research Question 1:** What is the current perception of the inclusion of women in the South African mining industry?*

The overall general perception of the inclusion of women in the mining industry in South Africa is a positive one showing that the industry has created space for women to thrive in this male-dominated environment. Women in the industry have accepted their role in the industry and are thriving by making themselves heard. Teams are including them just as men are included in all team discussions. It has been noted that women are putting themselves forward as "leaning in" to be included.

There are three notable limiting factors that were established from the interview responses. These considerably hinder women's career trajectory in the mining industry.

The first limiting factor was the fact that women are still very much doubted in terms of their ability to succeed in such an environment due to the cultural mindset of some individuals who have a very "diminished view" of a woman's ability in a technical environment.

The second limiting factor was the fact that women in the industry, especially on the lower levels, are limited in terms of their physical capability and is it said that men have the physical strength required for the mining environment. The physical skill required in terms of the technical engineering trades such as boiler making, which require heavy lifting of steel, has been shown to be a common concern regarding women in the industry.

The third limiting factor was centred around the "family planning" aspect pertaining to women when they leave the workplace for long periods for maternity leave. The issue isn't one of incompetence but rather the fact that when women go on maternity leave it often results in a loss of team continuity since there isn't always a suitable replacement.

*4.5.2 **Findings – Research Question 2:** What technical competencies are required in the core mining activities and what is the impact of having women in the team?*

The technical skills required in the core mining activities on the mine were highlighted as being good communication skills, problem-solving skills, planning and task scheduling, people management, and team collaboration and cohesion.

Including women in teams had a positive impact, highlighting that women bring a different dynamic to the mining industry with their attention to detail, strong communication and listening skills, innovative skills, faster processing time for tasks and multitasking ability.

Technical qualification was highlighted as being important to qualify for the core mining activities. However, more importantly, it was pointed out that the ability to translate the theoretical knowledge practically in the field by solving practical problems is a technical skill that is required.

It was highlighted that women in the industry need more exposure to the technical environment for their skills to be developed in the industry. Some participants felt that women bring the same skill sets as men to the industry.

*4.5.3 **Findings – Research Question 3:** How do the technical competencies of women in the core mining activities affect team operational performance?*

Women have good decision-making skills and are able to impact team operational performance positively due to their empathetic nature. However, women's lack of exposure to the technical environment negatively impacts their decision-making ability since they tend to take longer when making decisions due to the lack of experience in the field.

The delegation of tasks by women has a positive effect on team operational performance, which is evident in the mining safety statistics that show a significant reduction in safety-related incidents. Women in lower positions and supervisory level positions struggle with effective delegation of tasks due to their lack of assertiveness and also due to the mindset of the lower-level illiterate employees who still do not feel they should take instructions from a woman and who also feel that women do not belong in the mining industry.

Women have excellent listening and communication skills and are better able to transfer knowledge and instructions to team members. This has a positive impact on team operational performance. Women also want more detail when communicating and tend to communicate with their hearts and minds, making them much better communicators than men. Women at the lower levels also struggle with communication due to the cultural mindset issue of their subordinates who still feel that they shouldn't take instructions from a woman.

Women are more risk averse than men and tend to take fewer risks than men, which has a positive impact on team operational performance in the mining industry as evidenced by the positive safety statistics in women-led teams. Women have a good knowledge of the safety policies and procedures and are more likely to obey the safety rules required for safe production.

5 Data Analysis

5.1 Research Question 1

To answer questions about perceptions of women in the mining industry in South Africa, questions were asked relating to research question 1 in Section 4.2.1.

What is the current perception of the inclusion of women in the South African mining industry?

The perceptions of integrating women into the workplace in the mining industry are mostly positive in that a space is being made for women in the technical environment with women being given a fair chance to perform and prove themselves in technical roles.

The common theme that *women bring a uniqueness to the mining industry* is aligned with studies by Ochir et al. (2023) and Bennouri et al. (2018). Women are putting themselves forward to be heard. This shows the initiative of women wanting a platform to succeed in technical roles and they are now “leaning in” as per Sheryl Sandburg’s theory reviewed in the article by Bledsoe (2014). Women bring a renewed perspective to the mining industry in that women pay more attention to detail and are innovative and creative, aligned with literature by Bennouri et al. (2018).

In an effort to support to the above-mentioned theme is the common theme that *the efforts to include women in the core mining activities are deliberate by management,* which is aligned with the literature by Miyen and April (2022), which is in agreement that organisational leadership needs to drive the change for the inclusion of women in the mining fraternity.

The literature on perceptions of women does not include the fact that managers need to be proactive to identify women that are keen on being developed and select them for positions in the core mining activities. Hence, this is a new finding.

Women have been previously excluded from participating or being part of the workforce in the harsh environment of the mining industry. This is supported in the literature by Kansake et al. (2021), who state that women still remain the minority sex and hence it is important that leaders take up the responsibility to identify women who have what it takes to succeed and compete on the same platform as men equal in technical ability.

Women need to be pushed to the front. This depends on the individual's personality type, since some women do not tend to "lean in". They could be waiting for leaders to identify them for certain positions and earmark them for promotions based on their technical competencies in the mining industry, which is aligned to Sheryl Sandburg's notion about women needing to "lean in" to be included in the technical environment (Bledsoe, 2014).

The issue is presented in the next theme: the *cultural stereotypes of women undermine women's ability in the mining industry* in South Africa. This is aligned to literature by Barkhuizen et al. (2022) and Kansake et al. (2021). As much as women could be "leaning in" and as much as managers or leaders try to push the agenda for the inclusion of women in the technical roles, the cultural stereotypes still remain of certain individuals who simply do not have the faith that women have what it takes to compete in line with men in the mining industry.

The discrimination of women in the mining industry is evident in the collected data in which the competence level of women is doubted with the suggestion that some roles are better suited to men rather than women. This is not aligned with literature on organisational performance by Haslam et al. (2010), who argue that poor performance in firms does not result from the appointment of women in leadership positions.

Women are immediately undermined and this hinders their career progression and also counteracts any other efforts of inclusivity and diversity that organisations have implemented to include women in the workforce. The inherent notion of how women are perceived in the harsh mining environment still remains a deeply-rooted issue

in line with literature by Botha & Cronjé (2015), which affects women's career progression within the mining industry.

The diversity and inclusion literature for this study closely link to the findings of the study in terms of the way women are perceived in the mining industry. The cultural preconceptions of women hold true.

Deliberate efforts need to be made by leaders to focus on the career development path of women and ensure that women who are keen to have a successful career in mining are identified and selected for roles in the core mining activities.

5.2 Research Question 2

To answer the research question regarding the technical competencies required by women in the mining industry and the impact of having women in teams in the mining industry, the interview questions covered in Section 4.3.1 were asked.

What technical competencies are required in the core mining activities and what is the impact of having women in the team?

The technical competencies required by women in the technical environment were highlighted in the interview responses and were in line with the common core skills mentioned in literature by Martyka (2014), which are problem-solving skills, delegation of tasks, knowledge of risk and safety management, decision-making skills, and communication skills.

The new technical competencies required in the core mining activities identified from the collected data are planning and task scheduling, people management, and team collaboration and cohesion.

Academic knowledge that translates to having a suitable tertiary qualification was mentioned as a core skill required in the core mining activities in literature by Motsoeneng et al. (2015), which is aligned with the collected data in which one of the participants mentioned that having a suitable technical qualification is regarded as a core skill to qualify for a role in the core mining activities.

The most frequently occurring theme regarding the technical competencies of women required was the theme that *the technical skills of women need further development.* There was no indication that women are not capable of having the technical skills and in fact the majority of the participants agree that women bring several good core skills to the team and their skills are comparable to those of men in the mining industry. Focus needs to be given to the practical exposure of women in the practical environment, which will upskill women in terms of technical competencies that directly affect team operational performance.

Women who want to succeed in the technical field are aware that they must qualify for the role with the suitable technical qualifications to take up such roles in the mining industry, which is aligned to literature by Van Vuuren et al. (2021) where solution-focused actions are taken up by women to ensure that they qualify for technical roles in the mining industry earning the respect of their male counterparts.

The lack of technical exposure in the field must still be addressed since some of the data collected shows a shortfall in technical ability. However, the issue is not technical competence but rather the amount of exposure of women in the practical environment.

There is a gap in the research since the lack of practical exposure of women in the technical environment has not been mentioned, making it a new finding from the collected data. The lack of practical exposure or insufficient time spent by women in the technical field helps the mining industry to understand why women struggle to achieve a career-growth trajectory in technical roles in the mining industry.

The lack of technical exposure in the environment could result from the transfer of skills to women in the technical field not being fairly implemented by some individuals due to prevalent mining company cultures, in line with literature by Salinas (2013). These mining cultures disadvantage women by preventing them from gaining the full benefit of their career development programmes with regard to practical exposure in the technical environment.

Some individuals do not fully support the inclusion of women in the industry. Hence the data collected reveal that women are included to support the game of increasing the representation of women in mining statistics. However, women are not given a platform to genuinely succeed but are rather being set up for failure by being purposefully disadvantaged from getting the same technical exposure and training development as received by men in the field.

The literature does not cover the exposure of women being an issue. This is one of the important findings of this study and it brings to light an important factor hindering women's success in this technical field.

Women have the necessary technical qualifications to be in the mining industry and to work in teams with men. However, they lack the ability to bring this technical knowledge and display it practically in the field. This is aligned with the literature by Male et al. (2011), which mentions that having practical engineering skills is a technical competency. No mention is made in the literature that practical exposure is required as a core skill in the mining industry or that women are lacking in terms of practical exposure.

The diversity and inclusion literature did not mention the fact that women struggle to translate the technical knowledge gained from a technical qualification into solving practical problems in the field. It has been seen to be a concern from the interview responses that, for some reason, women are not exposed enough to the technical environment.

The literature by Botha (2016) does highlight the physical constraint that women have in the harsh mining environment, since for women to get full training and exposure, they have to spend some time in the underground sections of the mine.

This exposure involves entering the underground workings and shadowing other teams on the job, walking long distances to gain entry to the underground stopes, physically carrying necessary tools/instruments for monitoring and measuring technical parameters. Some strenuous physical activity such as climbing up ladderways, stairways, cat ladders and travelling in the conveyances with mine

workers for an entire shift, and the physical strength required of females was emphasised in the literature by Botha & Cronjé (2015).

On a high level, the participants feel that the numbers game of increasing women in the environment is being chased, possibly meaning that organisations are pushing women through the system or are being given the soft treatment of not having to fully experience the harsh environment when undergoing their training of practical exposure in the mining industry. The reason as to why women lack exposure in the technical environment will need to be further researched.

The fact that women have to enter the harsh working environment to gain the technical exposure to gear them up for practical problem-solving ability in the field could be the reason why there is a lack of technical exposure, since women may tend to want to avoid spending long periods at a time in the harsh environment. The environment is predominantly male dominated too, which is why women could be shying away from spending adequate time understanding the workings of the mine.

The next most frequently occurring theme regarding the core skills of women required was the theme that *the core skills of women are comparable to those of men.*

Both male and female participants feel that there is no difference in men and women's technical abilities, which is a new finding since studies by Moalusi and Jones (2019) show that women are still disregarded in the mining industry in South Africa even though the number of women in the workforce has increased. This is indicative of the evolution that is happening in the mining industry in an attempt to diversify and include women in the harsh mining environment. The technical ability of women, according to Schmitt (2021), still remains questionable.

An interesting new finding from the collected data, which was not mentioned in literature for diversity and inclusion nor in the core skill and technical competencies literature, is the fact that any individual, irrespective of gender, who has the correct portfolio of skills for the roles in the core mining activities will positively contribute to team operational performance. The literature by Hatmaker (2012) highlights that

the notion that men are seen to have technical ability and are seen as being conversant with mathematics, and women are seen as non-technical in nature. The responses from the collected data that women have the same capability as men is not aligned with the literature by Hatmaker (2012).

The next new finding that has not been mentioned in literature and that also shows the evolution in the South African mining industry is the fact that irrespective of gender, women add the same value to a team's operational performance compared to their male counterparts. This is indicative of the fact that the core skills of women are comparable to those of men in the team with no significant difference noted in the team's operational performance.

5.3 Research Question 3

To answer the research question regarding the technical competencies of women in the mining industry and how these affect team operational performance, the interview questions covered in Section 4.4.1 were asked.

How do the technical competencies of women in the core mining activities affect team operational performance?

The responses to the decision-making skills of women were mainly positive in the sense that when it comes to decision-making skills, women definitely tend to bring a more holistic view in the decision-making process since they pay more attention to detail. This is aligned with literature by Tiwari (2016), which supports the increase in employment of women due to their decision-making ability.

The responses did raise the issue that women do not have enough practical exposure to make technical decisions, but the assertion was not that women are poor in their decision-making ability. Better decisions can be made if women are more experienced in the field, which can further enhance their decision-making ability.

Women's problem-solving skills and listening and communication skills are noted to be very good and women are definitely seen to be capable in these areas. The issue of lack practical exposure in the field can affect women's problem-solving ability and the way that teams take instructions from them. Teams with women in them feel hesitant to take instruction from women who are seen to be new to the environment and lack experience in the field.

The delegation of tasks by women were seen to be adequate aligned with literature by Tiwari (2016) and more prominent in women in the higher levels. There was no evidence to prove that delegation of tasks by women is affected by lack of practical exposure. Women are seen to struggle with delegation at the lower levels and development is required at the lower levels since women in the lower levels could be less assertive and less confident than women in the upper levels.

The first frequently occurring theme for research question 3 was that *women are more risk-averse due to their attention to detail, making a positive contribution to team operational performance.* This was evident from the majority of responses that women significantly affect the safety statistics on mines due to their excellent capability to manage risk in such a harsh environment.

The literature review for this study on technical competencies showed no evidence that women are more risk-averse than men and this can be viewed as an interesting finding of this study due to this unique technical ability being displayed by women in the field.

Safety in mines is a top priority that directly affects team performance in that the idea is to ensure safe production without incurring any injuries or fatalities on mines. This is seen a top key performance indicator, hence the technical ability of safety and risk management and the fact that women thrive in this technical competency should be highlighted. Women's skill of having a good knowledge of safety policies and procedures is in line with the technical competency highlighted in the literature by Martyka (2014).

The second most frequently occurring theme from the responses relating to research question 3 was that *women lead with hearts and minds and are better able to make team members feel valued, which has a positive effect on team operational performance.*

This is a new finding and even though not seen explicitly as a technical competency, the fact that women in this technical environment lead technical teams and are responsible for more team operational success is interesting. This core skill makes teams feel valued through women leading with their hearts and minds. This can be seen as a powerful inherent technical ability by women who tend to lead with empathy due to their feminine nature. The unique leadership skills displayed by women directly affect team operational performance since teams naturally perform better and go the extra mile. Leading with empathy is a key technical skill displayed by women in the mining industry affecting team operational performance by bring significant improvements to the safety statistics in mines with women-led teams.

5.4 Summary of Data Analysis

The cultural stereotypes of women in the mining industry are still applicable and could be the reason for the slow integration of women into the harsh mining industry. A new finding which is not mentioned in the literature on the perceptions of women in the mining industry is the fact that women need to be pushed to the front through the deliberate identification of women who are successful in technical roles and ear-marking these women for future positions.

The core skill of having academic knowledge in the form of a suitable technical qualification from a tertiary institution is a must to qualify for a position in any technical field. In addition to having the academic knowledge, am individual needs to have problem- solving skills, the ability to delegate tasks, the ability to make decisions, knowledge of risk and safety management and communication skills. The newly identified core skills required which were gathered from this research study is having the ability to plan and execute tasks, the ability to manage people and team collaboration and cohesion.

Women are seen to be excellent in problem- solving, decision- making, delegation of tasks and communication however the lack of exposure in the technical environment hinders their success affecting all of these core skills, all of which directly impact team operational performance.

Women-led teams have seen to have better safety statistics than men and women are believed to be more risk- averse than men. There no mention of this fining in the literature and can be seen as a technical ability unique to woman.

An interesting finding was the fact that women lead with their hearts and minds which makes individuals in a team more valued and they tend to do more than expected which in turn has a positive effect on team operational performance.

6 Conclusion and Recommendations

6.1 Research Summary

The purpose of this research was to investigate the effect of the technical competencies of women in the core mining activities on team operational performance in South Africa.

The objectives of this research were to evaluate what the current perception of integrating women into the mining industry in South Africa is, what core skills are required in the core mining activities, and how the technical competencies of women affect team operational performance.

A total of 15 participants were interviewed for this qualitative study. The findings from all the transcriptions of the interviews were summarised in an Excel spreadsheet and thematic analysis was used to analyse the data. The common themes were identified in an attempt to answer the research questions in order to meet the objectives of this study.

6.2 Conclusion

6.2.1 Perceptions of women in the mining industry

The perception that women bring a uniqueness to the mining industry due to their attention to detail and innovative and creative ways of thinking is in line with previous studies by Ochir et al. (2023) and Bennouri et al. (2018). It is also perceived that simply increasing the women in mining statistics to meet the numbers is inadequate to promote the inclusion of women in the mining industry.

The finding from this study that has not been mentioned in previous literature revealed that managers must be deliberate about inclusion initiatives in the mining industry by identifying women with technical competencies who are keen to prove themselves in the industry and selecting them for roles in core mining activities.

The cultural stereotypes of women that undermine women's ability in the mining industry in South Africa are aligned to work in previous studies by Barkhuizen et al. (2022) and Kansake et al. (2021). The technical competencies of women are still doubted in the mining industry due to the historical preconception of women being physically constrained and the negative effect that women have on team operational performance when they have to go on maternity leave, which forms part of their family planning.

6.2.2 Technical skills required in the mining industry and the impact of having women in the team

The technical skills required by individuals in the core mining activities are problem solving, listening and communication skills, delegation of tasks, decision-making skills, and knowledge of risk and safety management, all of which were identified in previous studies by Martyka (2014). Having technical qualifications is a key requirement for team members to qualify for a role in the core mining activities, as identified in studies by Motsoeneng et al. (2015). The technical skills that were identified from the collected data are planning and task scheduling, people management, and team collaboration and cohesion.

The finding of this study is that women's technical skills need to be developed by ensuring that women spend more time on practical exposure in the technical field since this will ensure women's success in the technical industry of mining. Women need sufficient exposure in the field to develop their technical competencies in the core mining activities, which will have a positive effect on team operational performance.

6.2.3 Effect of the technical competencies of women on team operational performance

The technical competencies of women, which translate to the technical skills of problem solving, decision making, knowledge of risk and safety management, delegation of tasks, and listening and communication skills, are comparable to

those of men and no significant difference has been noted when compared to those of men.

Women are able to solve problems, make adequate decisions, effectively delegate tasks, and they are seen to have excellent listening and communication skills. Literature on diversity and inclusion by Fältholm and Norburg (2017) reveal that the listening and communication skills of women also have a positive impact on safety statistics in the mining industry. This was also a common finding in the collected data from interview participants.

This study has found that women are more risk-averse due to their attention to detail, making a positive contribution to team operational performance in the mining industry since significant improvements in safety statistics have been noted in women-led teams in the mining industry. The literature review for this study on technical skills and technical competencies showed no evidence of this finding and this can be viewed as an interesting finding of this study due to this unique technical ability being displayed by women in the field.

6.3 Recommendations for Future Research

The reason for women lacking exposure in the technical environment in the mining industry will need to be further researched to understand the root cause for the hesitancy of the mining industry to employ women in the core mining activities.

The literature review of this study reveals that some of the reasons could be due to cultural views of women not belonging in the harsh mining industry and hence women do not have the same practical exposure in the field as their male counterparts do. Women could also be given an easier training experience as compared to men when out in the field since literature identifies the physical capability of women being a constraint for women in the mining industry.

An interesting finding of this study revealed that women are more risk-averse than men and that women –led teams produced better safety statistics than that of their

male counterparts. This is an area for further research since it a finding that's was based on the experience of the interview participants.

The fact that women are lacking exposure in the technical environment poses a serious concern in terms of this being a disadvantage to women hampering their technical ability in the core skills namely: decision- making, delegation of tasks, problem-solving and communication. The reason as to why women are not adequate exposed to the technical environment need to be investigated and is an area for further research since this directly affects team operational performance in women –led teams.

The same research study can also be carried out with data collected from various other mining houses since this will give a more accurate understanding of the technical competencies of women and how this affects team operational performance due to the sample size and population that would be over a wider spectrum.

6.4 Recommendations for Mining Houses

It is recommended that leaders at South African gold-mining houses should encourage the deliberate identification of women who are driven and have an outstanding technical ability, and these women should be earmarked for vacant positions that were previously occupied by men. These women should only be given these vacancies based on their technical skills which qualify them for the role and not simply to change the statistical figures relating to women in mining in South Africa.

It is also recommended that attention is given to the training experience for the core mining activities of engineering, mining, safety and metallurgy. Mining houses need to ensure that women are given the same training experience as that given to men to expose them to the technical environment. Women should not be shielded in any way from getting the full technical exposure in the practical environment since this hampers their technical competencies.

6.5 Study Limitations

Judgemental sampling was applied for this research study in that the sample chosen was deliberate since it was known that it would be possible to collect the most information from the selected participants based on their experience in the industry. The sample size and sample method could be a limitation in that it may not have fully represented the holistic view around women in mining and their technical competencies.

The next limitation was that the data was analysed using thematic analysis where patterns in the data revealed common themes. There could have been a better method of analysis chosen.

The status of women in mining has definitely evolved in the South African context and only one mining company was selected for this study, which could be a limitation as it possibly reflects just one view of the effect of technical competencies of women on team operational performance. Other mining houses could be used to broaden the results of this study.

Only the core mining disciplines were selected for this study, namely engineering, mining, metallurgy and safety. This could limit the study since more females enter other disciplines, such as geology. A study of different disciplines could have influenced the results.

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Appendix A

Table 1: Consistency Matrix

Effect of Technical Competencies of Women in Core Mining Activities on Team Operational Performance in South Africa					
Sub-problem	**Literature Review**	**Hypotheses or propositions or questions**	**Source of data**	**Type of data**	**Analysis**
The perception of women in the mining industry and its effect on Team operational performance	Various factors lead to the lack of women in the mining industry, hazardous environment, physical constraint etc. (Kansake et al.,2021)	What is the current perception of the inclusion of women?	Interviews	Qualitative	
The impact of having women in teams and its effect on Team Operational Performance	Knowledge of risk and safety management etc. (Martyke, 2014)	What technical competencies are required in core mining activities and the impact of having women in the team?	Interviews	Qualitative	

Effect of Technical Competencies of Women in Core Mining Activities on Team Operational Performance in South Africa					
Sub-problem	**Literature Review**	**Hypotheses or propositions or questions**	**Source of data**	**Type of data**	**Analysis**
The technical competencies of women and its effect on Team Operational Performance	Not covered in the Literature. Data collection through interviews to obtain the perception	How do the technical competencies of women in the core mining activities affect Team Operational performance?	Interviews	Qualitative	

Table 2: Interview Schedule

Interview Schedule: Potential Respondents			
Participant Number	**Discipline**	**Job Grading**	**Type of Interview**
Participant 1	Engineering	Senior Management	Semi-structured
Participant 2	Engineering	Middle Management	Semi-structured
Participant 3	Engineering	Middle Management	Semi-structured
Participant 4	Engineering	Supervisor Level	Semi-structured
Participant 5	Engineering	Supervisor Level	Semi-structured
Participant 6	Mining	Senior Management	Semi-structured
Participant 7	Mining	Middle Management	Semi-structured
Participant 8	Mining	Supervisor level	Semi-structured
Participant 9	Safety	Senior Management	Semi-structured
Participant 10	Safety	Middle Management	Semi-structured
Participant 11	Safety	Middle Management	Semi-structured
Participant 12	Safety	Supervisor Level	Semi-structured
Participant 13	Metallurgy	Senior Management	Semi-structured
Participant 14	Metallurgy	Middle Management	Semi-structured
Participant 15	Metallurgy	Supervisor Level	Semi-structured

Appendix B

Research Instrument: Interview Questions

Proposed interview questions to participants – Semi-structured interview

Introductory questions

1. Which department are you working in?
2. What is your current designation?
3. What is your qualification?
4. How many years of experience do you have in your department?
5. Do you have women working with you in your team?

Interview questions on the inclusion of women in the mining industry that aim to answer the first research question:

Research Question 1: What is the current perception of the inclusion of women in the South African mining industry?

1. How do you view the inclusion of women in the mining industry?
2. How does your team implement the inclusivity initiatives set out by the organisation to include women in your team?
3. How does increasing the number of women in your team affect team operational performance?
4. How do you feel that the women in your team show initiative to be included as part of the team?

Interview questions on the technical competencies of women and team operational performance that aim to answer the second research question:

Research Question 2: What technical competencies are required in the core mining activities and what is the impact of having women in the team?

5. What technical competencies are required from members in your team?
6. Do you feel that the women in your team have these technical competencies required for team operational performance?
7. How do the technical skills of women within your team add value to the team's operational performance?

Interview questions on the technical competencies of women in the mining industry and team operational performance that aim to answer the third research question:

Research Question 3: How do the technical competencies of women in the core mining activities affect team operational performance?

8. How do the decision-making skills of the women in your team add to the team's operational performance?
9. How does the ability of women to transfer knowledge and instructions to subordinates (listening and communication skills) in your team contribute to the overall team operational performance?
10. How do the problem-solving skills of women in your team add to the results of your team's performance?
11. How does the delegation of tasks by women in your team ensure that the team's operational performance targets are effectively achieved?
12. How does the knowledge of risk and safety management of the women in your team contribute to the team's operational performance?
13. How do the innovative skills (ability to have creative ways of thinking) of women in your team add to the team's operational performance?
14. What technical competencies do you feel women have that are required for team operational performance in the South African mining industry?