Exploring the retainment of women engineers at a steel manufacturer in Gauteng, South Africa

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OPSOMMING

Verkenning van die behoud van vroulike ingenieurs by 'n staalvervaardiger in Gauteng, Suid-Afrika.

Sleutel woorde: Behoud, vroulike ingenieurs, behoud, omkeerbedoelings, staalbedryf.

Agtergrond: Wêreldwyd is daar 'n toenemende eis vir geslagsbalans in die werkplek. 'n Gebalanseerde omgewing bied nie net gelyke geleenthede vir loopbaanontwikkeling nie, maar verbeter ook organisatoriese prestasie. Tog is die ingenieursbedryf, insluitend die staalbedryf, ongebalanseer met slegs 35.9% vroue in geselekteerde Europese lande en 21% in die VSA. In Suid-Afrika is slegs 20% van ingenieurs vroue. Ten spyte van 'n toename in vroue in ingenieursprogramme, is daar 'n beduidende afname, met slegs 11% wat aktief as ingenieurs werk. Studies beklemtoon die uitdagings wat deur vroue in ingenieurswese in die gesig gestaar word, maar die uitvloei van vroulike ingenieurs uit die staalbedryf bly onverken.

Doel: Hierdie studie het ten doel om vas te stel of die behoud van vroulike ingenieurs binne die gekose staalorganisasie 'n rede tot kommer is, in lyn met wêreldwye tendense. Hierdie studie het verder die faktore ondersoek wat die behoud van vroulike ingenieurs in die organisasie beïnvloed, sowel as hul omkeerbedoelings.

Metode: Hierdie studie is uitgevoer deur 'n empiriese ondersoek wat gebaseer is op 'n interpretivistiese paradigma, 'n induktiewe benadering, 'n kwalitatiewe metode, 'n fenomenologiese strategie, en 'n deursnit-tydhorison-navorsingsontwerp.

Resultate: Die navorsing toon dat die behoud van vroue-ingenieurs in die geselekteerde staalvervaardigingsorganisasie kommerwekkend is. Hierdie studie het verder faktore geïdentifiseer wat vroue-ingenieurs se behoud- en omsetvoornemens beïnvloed. Die studie bied bestuursimplikasies en maak aanbevelings gebaseer op die bevindings. Laastens maak die studie aanbevelings vir toekomstige navorsing.

ABSTRACT

Background: Globally, there is a growing demand for gender balance in the workplace. A balanced environment provides equal opportunities for career advancement and enhances organisational performance. However, the engineering industry, including the steel industry, falls short of gender balance, with only 35.9% women in selected European countries and 21% in the USA. In South Africa, only 20% of engineers are women. Despite an increase in women in engineering programs, there's a significant attrition, with only 11% actively employed as engineers. Studies highlight challenges faced by women in engineering, yet the attrition of women engineers in the steel industry remains unexplored.

Aim: This study aims to determine whether the retention of women engineers within the selected steel organisation is a cause for concern, in line with global trends. This study will further explore the factors that influence the retention of women engineers in the organisation and their turnover intentions.

Method: This study used an empirical investigation with an interpretivist paradigm and inductive approach in applying qualitative research methodology. The study applied a phenomenological strategy with a cross-sectional time horizon data collection design.

Results: The research determined that the retention of women engineers in the selected steel manufacturing organisation is a cause of concern. This study further identified factors influencing women engineers' retention and turnover intentions. The study provides managerial implications and makes recommendations based on the findings. Finally, the study makes recommendations for future research.

Keywords: Retention, women engineers, retainment, turnover intentions, steel industry.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

AIST	Association for Iron and Steel Technology
APWEN	Association of Professional Women Engineers in Nigeria
CH	Children's Hospital of Philadelphia
ECSA	Engineering Council of South Africa
ECSA	Engineering Council of South Africa
ECT	Expectancy Confirmation Theory
HBR	Harvard Business Review
IEEM	Industrial engineering and engineering management
NSPE	National Society of Professional Engineers
POPI	Protection of Personal Information
SO	Secondary objective
STEM	Science, Technology, Engineering, and Mathematics
SWE	Society of Women Engineers
TOE	Theory of Organisational Equilibrium
TWAS	The World Academy of Science
USA	United States of America

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

A global trend of inclusion has incited programs that attract women to the workforce, particularly in science, technology, engineering, and mathematics (STEM) fields (World Wide Learning, 2021). Although focusing on including women in the workforce is partly societal (Fouad *et al*., 2020:446), studies have indicated that a gender-balanced workforce contributes to improved business performance (Naismith *et al*., 2017:227). Within this context, women's retention and turnover intentions in engineering are considered, specifically focusing on a selected steel manufacturer in Gauteng, South Africa.

This study aims to determine whether the retention of women engineers within the selected steel organisation is a cause for concern, in line with global trends. This study will further explore the factors that influence the retention of women engineers in the organisation and their turnover intentions. This was done through an empirical investigation based on an interpretivist paradigm, inductive approach, qualitative method, phenomenological strategy, and a cross-sectional time horizon research design.

This study comprises three chapters. Chapter 1 focuses on the background of the study, the study's significance, demarcation, definition of terms, study objectives, and research paradigm and methodology. Chapter 2 is in an article format with a literature review, findings, discussion, and recommendations. Chapter 3 provides the managerial implications, recommendations, conclusion, and areas for future research.

1.2 BACKGROUND TO THE STUDY

In 1970, STEM-orientated occupations in the United States of America (USA) had a female representation of 8% (United States Census Bureau, 2021). A similar low representation of women in STEM occupations can be seen globally during that time. Figure 1 indicates that in 1970, engineering had the lowest percentage of women in STEM (2%), while there were women 35% biological scientists (SWE, 2022a).

Therefore, statistics indicate that historically, male workers preferred STEM occupations. Furthermore, Figure 1 below shows that although there is an increase in women's representation in STEM-related careers from 1960 to 2021, women remain underrepresented (SWE, 2022a).

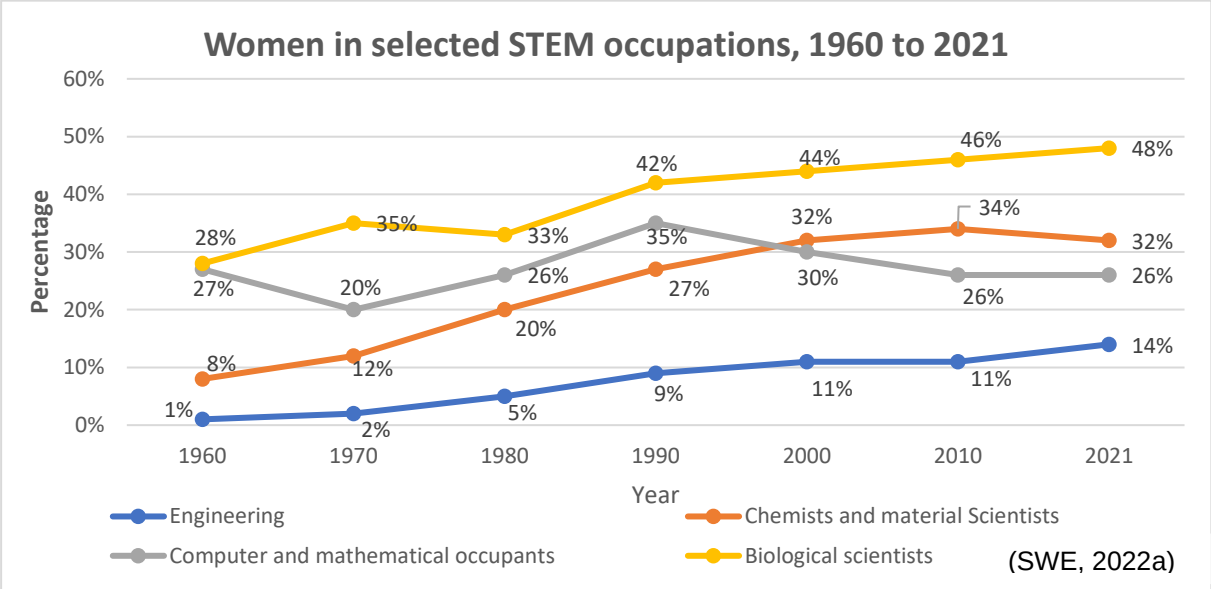

Figure 1: Women in selected STEM occupations, 1960 to 2021

Figure 1 above indicates a rise in women who occupy STEM-related careers. The increased representation of women in STEM concurs with the USA statistics, with women comprising 27% of the STEM workforce (United States Census Bureau, 2021). Similarly, statistics indicate that women's representation in STEM has increased marginally yearly in the United Kingdom from 2015 to 2019 (STEM Women, 2022).

Although there is an increase in women's representation in STEM, statistics indicate a slow growth rate, and therefore, the need to include and accommodate women in the different STEM-related fields should be a societal and organisational focus. From 2015 to 2019, the United Kingdom experienced a 3% increase in women's representation in physical science, a decline of 1% in mathematical fields, and a 1% increase in engineering, technology, and computer science fields (STEM Women, 2022). The percentage of women within STEM careers remains a function of the number of male counterparts that join these fields in the same period, and therefore, the underrepresentation of women in STEM cannot be considered in isolation.

The engineering field remains the STEM category with the lowest female representation, with statistics indicating that only 14% of engineers globally are women (SWE, 2022a). In South Africa, the global statistics concurred with 20% women representation in the engineering industry (ECSA, 2021:1). Therefore, considering South African women's inclusion in engineering can be considered against the same background as the global situation.

Organisations developed multiple programs and initiatives to attract women to pursue careers in STEM-orientated fields to address the underrepresentation of women. Programs and institutions such as the *Association for Women in Science, National Girls Collaborative Project, National Center for Women and Information Technology,* and *Million Women Mentors* aim to attract women to the STEM workforce and promote their career development (World Wide Learning, 2021). The steel manufacturing industry has a global drive to break down the entry barriers for women through Women in Steel programs (AIST, 2022). The South African steel industry has called for women's participation in 2019, stating that there are not enough women in the industry and emphasising women's unique contribution to the industry (Parker, 2019). Therefore, the drive to include women in engineering and the steel industry is evident in the global background. Thus, the retention of women engineers in the steel manufacturing industry must be explored considering the worldwide situation and organisational drives to include women.

1.3 PROBLEM STATEMENT

Globally, there is a societal demand for equality in all aspects. This trend is also associated with gender balance and equality in the workplace. A gender-balanced work environment can create equal opportunity for both men and women to thrive in their careers and contribute to better organisational performance. Gender-balanced organisations are more likely to outperform their industry median by 15% (Naismith *et al.,* 2017:227), and a gender-balanced workforce benefits benefits.

In contrast, statistics have shown that the engineering industry is not a gender-balanced industry, with a maximum of 35.9% women representation in selected European countries, and in the USA, this figure goes down to 21% (Catalyst 60, 2020).

In South Africa, only 20% of engineers are women (ECSA, 2020:81). Furthermore, studies have shown that although women's representation in undergraduate engineering programs is increasing, the number of active women engineers in the industry remains less than the number of women engineering graduates. According to Fouad *et al.* (2016:79), 20% of engineering graduates are women, with only 11% actively employed as engineers. This indicates that there is an attrition of women from engineering.

Several studies, such as those conducted by Singh *et al.* (2018), Fouad *et al.* (2020), and Naismith *et al.* (2017) focused on the attrition of women from engineering graduate programs and the engineering industry in general. These studies relate the attrition of women from engineering to the barriers and challenges women face in engineering. However, the attrition of women engineers from the steel industry is explored.

Considering the global trends in the steel industry, there is a gap to determine whether the retention of women in the engineering profession is a problem and to explore the factors that influence women's intent to leave or remain in the organisation. Considering that the selected steel organisation gives bursaries to both men and women to study engineering, it must be understood whether it can retain women engineers in the industry, considering the global statistics.

Retention remains a concern as retention strategies differ and largely pertain to eliminating the barriers women face in engineering and creating support systems for women in engineering. The question of effective retention strategies and the attrition of women engineers from the steel industry remains largely unanswered. Answering this question can enable the selected steel organisation to re-evaluate their women in engineering retention strategies against the backdrop of the motivating factors for women engineers to leave the organisation.

This study aims to understand whether the retention of women engineers is similar to global trends and the factors that influence the turnover intentions and retention of women engineers in the context of their intent to leave or remain within the organisation.

1.4 RATIONALE AND SIGNIFICANCE OF THE STUDY

- **Theoretical contribution**

The research study aims to understand and add value to the theoretical knowledge base related to the retention strategies of women in engineering, specifically focusing on the retention of women engineers in a selected steel manufacturing organisation in Gauteng, South Africa.

- **Practical contribution**

The steel organisation has various global and local steel initiatives like the *Women in Steel* initiative that focus on attracting women to the steel industry. These initiatives also create a social platform for women in the organisation. However, these platforms' contributions towards the retention of women in the organisation may improve as a result of the study.

- **Industry and organisational contribution**

The research study can shed light on the factors influencing women's intent to remain within the selected steel organisation and their possible intent to leave the steel manufacturing organisation. This can lead to potential changes in organisational policies, training, networking platforms, coaching strategies, and the working environment that can enable the steel manufacturer to retain women engineers in a positive working environment.

1.5 DEMARCATION OF THE STUDY

This study analyses the human resource management. Human resources management is a comprehensive approach to employing, managing, and developing people. From an organisational perspective, human resource management is concerned with improving organisational effectiveness and its people through an ethical dimension (Armstrong, 2014:1). Therefore, women engineers' attraction, retention, and turnover intentions can be associated with the human resource field in organisations.

The study explores the retention of women engineers in the steel manufacturing industry, specifically considering a manufacturing facility in the Southern region of Gauteng, South Africa. The selected steel organisation agreed to this study because its name remains undisclosed.

1.6 DEFINITION OF TERMS

The following definitions and concepts are essential to the study and are defined to ensure uniform interpretations.

- **Engineering**

Engineering is a result and solution-orientated practice that emphasises problem-solving. It is the act of looking into problematic situations or possible improvement opportunities through different perspectives and creating solutions to problems (Forbes *et al.*, 2022:2). Chou and Chen (cited by Pleasants & Olson, 2018:147) support and define engineering as the design and development of new solutions to meet people's needs through the implementation of science and technology. This study considers engineers as individuals who occupy an engineering position with engineering responsibilities that align with the definition of engineering. Furthermore, for this study, different engineering disciplines can include chemical, metallurgical, mechanical, electrical, instrumentation, industrial, process, and environmental engineering.

- **Gender balanced**

Broadly defined gender balance is the equal or near-equal representation of males and females (Law Insider, 2022). More specifically, gender balance is defined as equitable opportunities and access to employment with equal compensation and equal development opportunities for individuals, notwithstanding their gender (OECD, 2020:3). Therefore, this study considers gender balance as a near-equal representation of women in engineering with equitable opportunities, similar access to employment and development, and equal compensation.

- **Industry**

The Britannica Dictionary defines an industry as productive organisations producing or supplying goods or services (Britannica, 2022). In addition, it divides the term into

primary, secondary, and tertiary industry groups. This study considers the secondary industry that is conceptualised as the manufacturing industry. Therefore, in the context of this study, the term industry is defined as a manufacturing industry where raw materials are processed into products or consumer goods.

- **Retainment**

Retainment is defined as keeping in possession (Merriam-Webster Inc., 2022a); therefore, it refers to the act of keeping. Therefore, retaining women engineers is an organisation's ability to keep women engineers active in the industry with engineering responsibilities.

- **Retention**

Retention is “the act of retaining” (Merriam-Webster Inc., 2022b). This study refers to the retention of women in engineering as the act of retaining women engineers in industry, specifically, the steel industry. Furthermore, the retention of women engineers is considered engineers with engineering responsibilities who occupy an engineering designation.

- **Science, technology, engineering, and mathematics (STEM)**

STEM is an abbreviation for science, technology, engineering, and mathematics (White & Massiha, 2016:1). This study refers to STEM fields or industries as any work or research conducted in the science, technology, engineering, and mathematics industries. Furthermore, the reference to STEM fields considers individuals employed in the STEM industry and excludes those who left STEM-orientated industries.

- **Steel industry**

The steel industry is defined as one that manufactures steel and steel products (Definitions, 2022); thus, it is considered a secondary industry. Therefore, the steel industry is contextualised as manufacturing steel products.

- **Steel organisation**

The steel organisation term is derived from the definition of the steel industry and refers to a single organisation that manufactures steel products through secondary industrial processes.

- **Turnover intention**

Turnover intentions are an employee's consideration and willingness to seek employment outside of an organisation (Jaharuddin & Zainol, 2021:108).

1.7 PRIMARY AND SECONDARY OBJECTIVES

1.7.1 Primary objectives

The primary objective of this study is to explore the retention of women engineers in a selected steel manufacturing organisation in Gauteng, South Africa.

1.7.2 Secondary objectives

SO1: To determine if the retention of women engineers is problematic in the selected steel manufacturing organisation.

SO2: To determine what attracts women engineers to the steel industry and the selected organisation.

SO3: To explore the factors influencing women engineers' turnover intentions within the steel manufacturing organisation.

SO4: To determine what the selected steel organisation can do to retain women engineers.

SO5: To determine what women engineers in the selected steel organisation can do to retain themselves.

1.8 PRIMARY AND SECONDARY RESEARCH QUESTIONS

1.8.1 Primary research question

What factors influence the retention of women engineers in a selected steel manufacturer in Gauteng, South Africa?

1.8.2 Secondary research questions

SRQ1: Is the retention of women engineers problematic in the selected steel manufacturing organisation?

SRQ2: What attracts women engineers to the steel industry and the selected organisation?

SRQ3: What factors influence women engineers' turnover intentions within the steel manufacturing organisation?

SRQ4: What can the selected steel organisations do to retain women engineers?

SRQ5: What can women engineers in the selected steel organisation do to retain themselves?

1.9 RESEARCH PARADIGM, METHOD, AND DESIGN

1.9.1 Research paradigm

The broad perspective of a research paradigm refers to a system of assumptions and beliefs about knowledge development (Saunders, 2016:124). According to Maree (2016:34), the research paradigm refers to a way to view the world. Therefore, the research paradigm provides the framework to the researcher from which meaningful assumptions and systems are favoured.

Historically, the two mainstream research philosophies are interpretivism and positivism. However, more recently, the pragmatism and critical realism positions in research philosophies have been considered (Melnikovas, 2018:34). The interpretivism epistemology is based on the position that social sciences differ from natural sciences with specific reference to the subject matter. According to Saunders *et al.* (2019:124), an interpretivistic perspective on humans and their social environment cannot be like physical phenomena. The interpretivism philosophy is

based on the foundation that individuals can construct meaning (Nieuwenhuis, 2016:60). Furthermore, the interpretivism research philosophy requires a research logic that considers the disparateness of humans (Bryman *et al.,* 2019:14), as well as the interpretation and understanding of social worlds and the context thereof (Saunders *et al.*, 2019:149).

The objectives of this study were to explore the retainment and turnover intentions of women engineers, considering their experiences within a selected steel organisation. Therefore, a deeper understanding of the retention of women in the organisation was the focal point. An interpretivist research paradigm was adopted based on this study's nature and objectives.

1.9.2 Research method

The methodological choice pertains to the general orientation in which the research is conducted and the data is collected (Bryman *et al.,* 2014:3; Melnikovas, 2018:39). There are two distinctive methodological approaches to research, quantitative and qualitative research methodology (Bryman *et al.,* 2014:30). Bryman *et al.* (2014:31) distinct quantitative research as a research methodology that emphasise data collection and the analysis thereof. In contrast to this, qualitative research places emphasis on words and is primarily associated with an inductive research approach (Bryman *et al.,* 2014:31). Nieuwenhuis (2016:53) concurs and states that inductive research relies on linguistics in comparison to a statistical approach of quantitative data analysis.

Niewenhuis (2016:53) adds that qualitative research methodology is naturalistic in nature as it focuses on the natural setting in which interactions occur. Furthermore, qualitative research uses exploratory questions and emphasises understanding phenomena (Niewenhuis, 2016:53).

Due to the nature of this study, where the emphasis was placed on exploring the retention and turnover intentions of women in the selected steel organisation to understand the phenomena, a qualitative research methodology was followed. This

was emphasised through the vitality of understanding the retention of women engineers within the organisational context through exploratory questions.

1.9.3 Research design

1.9.3.1 Research strategy

Saunders' research onion model includes eight different strategies (Melnikovas, 2018:40). However, an additional phenomenological research strategy was considered for this study.

A phenomenological research strategy is based on the meaning and description of participants' life experiences. Based on the description of the participants' experiences, overall meanings are derived (Niewenhuis, 2016:77). Bryman *et al.* (2014:15), add that researchers should bracket their preconceptions to prevent them from influencing the research study. Furthermore, phenomenological studies are not limited to one individual's experience but rather aim to describe what all participants have in common (Niewenhuis, 2016:77). This strategy includes the identification of phenomena, collecting data from multiple individuals who experienced the phenomena, reducing the data to main themes, followed by a textural and structural description (Niewenhuis, 2016:78).

The research study was exploratory, focusing on understanding the participants' life experiences in the organisation that influenced the retention of the participants. Therefore, a phenomenological research strategy was followed.

1.9.3.2 Time horizon

The time horizon is the period over which a study is conducted (Melnikovas, 2018:34). According to Saunders *et al.* (2016:200), there are two main time horizons, the cross-sectional and the longitudinal time horizon. Longitudinal research studies are longer-term studies that map the change of mechanisms and contextualise them (Bryman *et al.,* 2014:109). In contrast, cross-sectional studies are a snapshot of phenomena at a particular time (Saunders *et al.,* 2016:200). Bryman *et al.* (2016:106) add that cross-

sectional studies involve studies that focus on more than one case. Therefore, cross-sectional studies are shorter than longitudinal studies.

This study utilised a cross-sectional time horizon as the focus of the study was to understand the retainment of women in the selected steel organisation as a snapshot of their experiences. Therefore, the study was short-term focused and thus cross-sectional.

1.10 RESEARCH PROCESS

1.10.1 Population

The study population is a representative sample (Bryman *et al.*, 2014:168) of the full set of cases the researcher wants to study (Saunders *et al.*, 2016:274). This study's target population was women engineers employed in the selected steel organisation and women engineers who moved into other positions but remained in the selected steel organisation based in Gauteng.

Listing all the population units from which a sample is selected is a sample frame (Bryman *et al.*, 2014:383). The sample frame for the participants guides the inclusive and exclusive criteria. The inclusion criteria included women engineers with two years of working experience as an engineer or engineering manager in the selected steel organisation. Women candidate engineers with less than two years of experience who report directly to the researcher were excluded from the study.

1.10.2 Sampling methodology

Non-probability sampling methods do not use random selection to represent a population; therefore, study conclusions drawn from studies must consider the study sample against the population (Maree & Pietersen, 2016:197). A purposive sampling method is used when research is executed with a specific study-related purpose in mind (Maree & Pietersen, 2016:198).

This study used a non-probability purposive sampling method to select samples that enabled the researcher to gain insight into the retention of women engineers in a

selected steel organisation. Furthermore, non-probability studies are preferred in time-limited studies (Maree & Pietersen, 2016:198). A purposive sampling method was used to ensure a strong focus is placed on women engineers or engineering managers with two years of engineering experience in the selected steel organisation. In addition, the short-term period in which this study was conducted favoured a non-probability sampling method.

A human resource management representative of the selected steel organisation acted as the gatekeeper to this study. The gatekeeper communicated the study details to all potential participants via an electronic bulletin notification. The participants responded electronically via a link to indicate participation in the study. A consent form was supplied via an electronic link after the electronic indication to participate in the study. This consent form gave participants an option of interview dates and timeslots, which they could select for convenience. Interview dates and timeslot options were available for a month.

Furthermore, the electronic response included a consent form where the participant consented that the required personal information and contact details may be used. The focus was to adhere to the Protection of Personal Information (POPI) Act, Act 4 of 2013. The participants' responses were sent to an independent person who anonymised the list of respondents.

The sample size of a study must be such that the sample is representative of the population (Maree & Pietersen, 2016:200). Saunders *et al.* (2016:297), state that the relationship of the sample selection must be logical in comparison to the focus of the study. In a qualitative research method, data must be collected until data saturation is reached (Saunders *et al.,* 2016:297). Saunders *et al.* (2016:297) explain that the data saturation point is reached when additional collected data provide minimum new information.

Consider the commonalities in this study’s organisational environment and the probable commonalities in the women who are employed in the selected steel organisation. Data saturation was reached with a sample size of eight participants.

This is supported by the Saunders *et al.* (2016:297) guideline that states that non-probable sample sizes for homogenous populations should vary between four and eight.

The researcher is an employee at the selected steel organisation. As such, no subordinate directly reporting to the researcher was considered to participate in the study.

1.10.3 Data collection instrument

The measurement instrument is used to collect data during the research process. Similar to the aim of this study, qualitative research is to see the world through the participants' eyes (Niewenhuis, 2016:93). Therefore, a semi-structured interview guide was designed to obtain the required experiences from participants.

Semi-structured interviews are based on a line of inquiry that is followed by probing and clarification questions (Niewenhuis, 2016:93). Although the researcher focused on the line of inquiry, it was anticipated that probing questions would be required, and therefore, a semi-structured interview guide was used.

The researcher designed a semi-structured interview guide based on the literature to relate questions to the selected steel organisation and the operational environment of participants. The measuring instrument included informed consent (Appendix F), introduction, follow-up, probing, and direct and indirect questions (Van der Merwe, 2022). The semi-structured interview guide questions answered the research objectives about the retention of women engineers in the selected steel organisation, the factors that attract women engineers to the steel industry, women engineers' turnover intentions, and women's contribution to their retainment within the selected steel organisation.

1.10.4 Data collection and fieldwork

The selected steel organisation has approved this study. The participants were recruited following the POPI Act and in alignment with the steel organisation's human

resource policies. The North-West University's Ethics Committee approved the study and issued the number NWU-00629-23-A4.

Participants were accessed through the selected steel organisation. The human management resources representative of the selected steel organisation acted as the gatekeeper. Study details were communicated to participants by the gatekeeper through an electronic bulletin notification. Participants responded electronically via a link that indicated their interest in participating in the study. In a second link, participants gave informed consent and selected interview dates and timeslots. The participants' responses were sent to an independent person who anonymised the list of respondents.

1.10.5 Data coding and analysis

A data analysis framework is the guidelines that structure the data analysis process (Bryman *et al.,* 2014:342). A literature review indicated that thematic data analysis will support the study's objectives. The thematical data analysis method is flexible and can identify, analyse, and describe themes across data sets (Bryman *et al*., 2014:350). Saunders *et al.* (2016:579) state that thematic analysis can be used in interpretivism studies that explore phenomena. The objective of this study was to explore the retention of women engineers in a steel organisation, and therefore, the focus will be on identifying themes. Therefore, thematic data analysis was adopted to analyse the data.

Braun and Clark (cited by Bryman *et al.*, 2014:351) proposed a six-step process to conduct thematical data analysis that was utilised in the data analysis phase of this research study. The researcher transcribed the data and noted general ideas. This process was followed by the initial data coding into a systematic pattern. Potential themes were identified, reviewed and categorised. Definitions and names were given to each theme, followed by the report (Bryman *et al.,* 2014:351).

A co-coder conducted an independent thematic analysis of the transcribed data to increase credibility. The researcher reached a consensus of themes and the co-coder before the data analysis process continued.

1.11 ETHICAL CONSIDERATIONS

Ethical considerations in research are vital to ensure that participants are safe from harm and protected from unnecessary stress. Therefore, it is important to plan and implement research design and methodology based on ethical standards (Cacciattolo, 2015:55). Ethical considerations ensured that the research study complied with ethical standards.

1.11.1 Research topic

The topic of the research study was designed to allow and guide a non-intrusive research study. Non-intrusive research is research with minimum intrusion and minimum impact on research participants (Emden & Smith, 2004:37). The structured literature review ensured credibility and finalised the research topic.

An ethical research study protects the life, dignity, integrity, and privacy of participants and treats personal information as confidential (Camille *et al.*, 2016:76). The researcher considered the legal authorisation of the study as the permission to conduct the study within the organisation, ethical permission to conduct the study from the NWU, and participant informed consent (see Appendix E).

A request letter to conduct the research study within the selected steel organisation was sent to the organisation's Human Resources Manager (HRM) (see Appendix A). The request stipulated a brief background on the study, including the research objectives, research question, and the study's contribution. A permission letter to conduct the study within the organisation has been obtained from the responsible HR personnel, and the study was approved to be completed within the selected steel organisation (see Appendix B). The NWU Ethics Committee Ethical cleared the study and issued an official ethics number (NWU-00629-23-A4).

Informed consent is a process where participants voluntarily confirm their willingness to participate in a study after being informed of the study aspects and details (Bryman *et al.,* 2014:124; Camille *et al.,* 2016:77). The researcher constructed an informed consent form that was administered through a trained independent person. The participants were informed as to what the interview would entail, the interview timeline, the proposed duration of the interview, that all questions were voluntary to answer, and that they could withdraw from the study at any given time.

1.11.2 The risk level of the study

The study’s risk level was determined using the NWU checklist to guide researchers and scientific committees during a full ethics review. Based on the checklist attached

in Appendix C and the NWU risk level descriptors for human participants, the researcher determined the study risk to be low-level. The risk level descriptor document for research studies with human participants is attached as Appendix D.

1.11.3 Risks and benefits

Risk is assessed by the probability of causing harm to a participant due to a monitoring or intervention experience. The magnitude of harm to the participant is considered a research risk (CH Research Institute, 2022). Risks and benefits must be appropriately balanced, the recruitment process must be voluntary and fair, and it must include informed consent (Bracken-Roche *et al.,* 2017:1).

The research study did not present the potential risk for harm as the study focused on the participant's experiences, and no harm came to the participants. Furthermore, the study was structured around an uncontroversial topic; therefore, the researcher did not dispute the participants' experiences. Based on the NWU checklist to guide researchers and scientific committees on recommendations for ethics review, this study will be a low-risk study (see Appendix C).

Confidentiality and anonymity guarded the participants if they made negative comments about the organisation's retention strategies.

The participants did not directly benefit from participating in the study; however, they might benefit indirectly from the study in the future.

1.11.4 Vulnerability of participants

A vulnerable participant is defined as a participant with an identifiable increased likelihood to incur additional harm or a greater wrong (Bracken-Roche, 2017:2). Participants' vulnerability is considered the balance between the risks and benefits of the study as stipulated in the risk and benefits section. Participants are working female adults within the organisation, and therefore, the sample was not perceived as those with an increased likelihood of incurring additional harm.

1.11.5 POPI Act considerations

The POPI Act, Act 4 (2013) aims to protect individuals' personal information by introducing certain conditions that establish a minimum requirement to process personal information (POPIA, 2021). The participant's personal information was protected through privacy, confidentiality, anonymity, and the use of different role players.

Strydom (2011:119) states that the principle of privacy in research safeguards the privacy and identity of research participants. Participants must be informed should there be any risk in a research study that will violate their privacy. In addition, the handling of participant information must be done confidentially. The anonymity of participants is conceptualised as a research study where the participant cannot be identified afterwards (Strydom, 2011:119).

The selected steel organisation's HR representative acted as the gatekeeper during the recruitment process. The gatekeeper gave consent for this study to be conducted. The gatekeeper provided an independent person with a list of possible participants. The gatekeeper person communicated the study details and the research methodology to the possible participants via an electronic link. The potential participants responded via an electronic link indicating whether they intended to participate in the study or not. This response was sent to the independent person who anonymised the list of respondents. From that list, eight participants were selected using a sequential method. The independent person obtained informed consent from these participants. This informed consent form indicated whether their personal information can be used to schedule interviews. The anonymity of respondents was protected in the recruitment process. During the interviews, the participants' anonymity could not be protected as the researcher and the independent person knew the participants' identities. Therefore, the researcher, HR representative, and independent person must treat participant information confidentially. Participants' basic personal information was asked to establish a demographic layout during the coding phase.

Personal details, such as participant names, were not used. Participant names were changed to a numeric participant number; therefore, participant anonymity was

protected after the interview. The gatekeeper, independent person, and researcher strictly adhered to the ethical research code about privacy, anonymity, and confidentiality.

1.11.6 Role players

The study utilised a researcher, the selected steel organisation's HR representative, as gatekeeper, an independent person, and a co-coder. The researcher conducted the study, the gatekeeper gave permission and provided a list of possible participants, the independent person anonymised the potential participant list and obtained participant consent, and the co-coder recoded the transcriptions for validity. All role players were trained to perform their duties and will sign a confidentiality agreement.

1.11.7 Participant experience

Qualitative research entails a critical outlook that supports the commitment to capture the voice of participants and to represent their experiences in a true form. Furthermore, qualitative research is conducted through direct interaction with the participant to understand the participant's social world through their voices (Aluwihare-Smaranayake, 2012:65). The researcher expected the participants to experience the semi-structured interview process as positively as they would have the opportunity to voice their experiences in a safe and semi-structured environment. Participants were fully informed about the details of the study and could engage in the interview as respected women, adults, and human beings.

1.11.8 Incentives

The participants did not receive incentives for participating in the study. The participants were involved in the study at no cost to the participants as the semi-structured interviews were conducted on the facilities of the selected steel organisation. The semi-structured interviews were conducted during the lunchtime of participants and after hours, as preferred by the participant and approved by the steel organisation.

1.11.9 Facilities

The research study's semi-structured interviews were conducted at the facility of the selected steel organisation as arranged by the gatekeeper and an independent person.

1.11.10 Invasion of privacy

According to Bryman *et al.* (2014:127), research participants can refuse to answer specific questions based on various justification factors. The researcher ensured that participants were informed that answering all questions was voluntary. Any refusion to answer a question by a participant was respected with no implication to the participant.

1.11.11 Ethical consideration during data analysis

The POPI Act, Act 4 of 2013, legislates the legal process for data handling as outlined in this study. With specific reference to research data management, the POPI Act outlines that information processing must be done fairly and lawfully and that information processing must be transparent to the participant. The participant must give formal consent that processed personal information may be used for the reasons specified and agreed to (Bryman *et al.,* 2016:128)*:*

The researcher adhered to confidentiality, anonymity, and privacy when processing data. No participant names were used in the data analysis. Participants are referred to as numerical participant numbers before the semi-structured interviews were conducted. This ensured that the semi-structured interviews remained anonymous. The co-coder did not receive the participants' names and only processed data from the numerical transcriptions. Furthermore, data anonymity was ensured through the coding process, where data was classified in themes rather than per participant’s response.

1.11.12 Storage and archiving of data

All hard copies are stored in the researcher's private office in a locked cabinet until the study's conclusion. After that, the data were sealed and handed to the NWU for

safekeeping. All recordings of the semi-structured interviews are stored on the researcher's personal password-protected computer. These recordings were deleted after analysing the data. All transcriptions, scanned documents, and data are password-protected.

1.11.13 Dissemination of results

The results obtained from the research study are documented in a mini-dissertation format and submitted to the NWU. In addition, the study results were presented to the HR department of the selected steel organisation. Findings and results are documented in a letter format and are available for participants should they require through the gatekeeper. The findings of this study might be published in academic journals or presented at conferences (the organisation's name will remain anonymous).

1.12 OUTLINE OF THE STUDY

The composition of the research report is structured in three chapters because this study employed the article format. Chapter 1 presents the study background, research objectives, significance, definition and terms, research design and methodology, and ethical considerations. Chapter 2 is a stand-alone independent scientific article and serves as the core of the study. Chapter 3 provides the conclusion, managerial implications, recommendations, and areas for future research. Some of the information used in Chapter 2 was re-used in Chapters 1 and 3 because of the article format.

CHAPTER 2: RESEARCH ARTICLE

EXPLORING THE RETAINMENT OF WOMEN ENGINEERS AT A STEEL MANUFACTURER IN GAUTENG, SOUTH AFRICA.

Keywords: Retention, women engineers, retainment, turnover intentions, steel industry.

Abstract: The global demand for gender balance in the workplace is growing, recognising its potential to provide equal career opportunities and enhance organisational performance. However, the engineering industry, particularly in steel, lacks gender balance, with limited representation in selected European countries (35.9%) and the USA (21%) and only 20% in South Africa. Significant attrition is observed despite an increase in women in engineering programs, with only 11% actively employed as engineers in South Africa. While existing studies highlight challenges faced by women in engineering, this research focuses on the unexplored attrition of women engineers from the steel industry.

This study aimed to assess the retention of women engineers within a selected steel organisation and explore the factors that influence their retention and turnover intentions. It used an empirical investigation with an interpretivist paradigm and inductive approach in applying qualitative research methodology. The study's phenomenological strategy with a cross-sectional time horizon data collection design revealed concerning trends in women engineers' retention. The identified factors influencing retention and turnover intentions have managerial implications, leading to recommendations for the organisation and suggestions for future research.

2.1 CHAPTER INTRODUCTION

The chapter is structured in an article format that outlines the study introduction, problem statement, research objectives, research questions, study significance, literature review, study findings, discussion of results, managerial implications, recommendations, and limitations. This section is written according to the selected journal's instructions; therefore, the format, technical aspects and referencing style differ.

2.2 INTRODUCTION

Worldwide emphasis has been placed on the underrepresentation of women in STEM disciplines due to observations made about it on a global scale. In addressing this concern, global initiatives were launched to attract women to and proportionally increase women in post-secondary education STEM (World Wide Learning, 2021; Zamora-Hernández *et al.,* 2020:653). Fine *et al.* (2022:55), provide evidence that gender diversity is positively associated with improved business innovation and societal justice. Fouad *et al.* (2020:446) concur and state that a gender-balanced workforce can improve business performance. Therefore, the attraction and retention of women engineers to businesses must be contextualised against the organisational and societal benefits. Within this context, the attraction, retention, and turnover intention of women engineers in a selected steel manufacturer in Gauteng, South Africa, is explored.

This study aims to ascertain whether the retention of women engineers in the selected steel organisation is a cause for concern following global trends. This study explored the factors influencing women engineers' retention and turnover intentions. An interpretivist paradigm with an inductive approach, a qualitative method, a phenomenological strategy, and a cross-sectional time horizon study design was used in the empirical investigation.

2.3 PROBLEM STATEMENT

The desire for equality in all spheres of life is a global trend that extends to workplace equality and gender balance. Equal opportunities for men and women to succeed in their professions can be created in a gender-balanced workplace that can improve organisational performance. Thus, a gender-balanced workforce benefits the individual and the organisation, as is evident by the 15% outperformance of gender-balanced organisations against the industry median (Naismith *et al.*, 2017:227). Mickeney and Company (cited by Bloyer, 2021:219) concur and add that gender diversity can contribute to a 25% improvement in an organisation's financial performance.

In contrast, statistics indicate that the engineering sector lacks gender parity. The Society of Women Engineers reports that only 24.2% of engineering bachelor's degrees in 2020 were earned by women (SWE, 2022b). European countries have a maximum of 35.9% female representation in engineering; in the USA, it is as low as 21% (Catalyst 60, 2020). Furthermore, research indicates that while the proportion of female students enrolled in undergraduate engineering programs is rising, there are still fewer women working as engineers in the field than there are women graduates. 20% of engineering graduates are women. However, only 11% of them are now working as engineers in the sector (Fouad *et al.,* 2016:79). Therefore, it is evident that women remain underrepresented in engineering.

South African statistics support the global trend. The country has 54% of women in undergraduate engineering programs, while only 23% enter the industry as engineering candidates (SWE, 2022c). A further reduction to merely 20% of the engineering workforce in South Africa is female (ECSA, 2020:81). This suggests that women are leaving the engineering field.

Studies, such as the work of Singh *et al.* (2018:446), Naismith *et al.* (2017), and Fouad *et al.* (2020), relate the attrition of women from engineering graduate programs and engineering to the entry barriers and challenges women face. However, specific factors associated with the attrition of women from the steel industry and the selected organisation are still to be explored.

Considering global trends and the low representation of women engineers in South Africa, there is a gap in determining whether the retention of women in engineering within the organisation is a cause for concern. Furthermore, the factors influencing women's turnover intentions within the selected steel organisation require exploration. Women's intent to leave or remain within the organisation must be considered against the background of the organisation's efforts to attract women to the industry and the selected steel organisation.

Retention of women engineers in the industry remains a concern as retention strategies differ and pertain mainly to eliminating the challenges and barriers women engineers face. The question as to the effectiveness of the steel industry's retention strategies and the attrition of women from the steel industry remains partially unanswered. By answering this question, the selected steel organisation can reassess its retention strategies for women in engineering.

The purpose of this study was to determine whether female engineers' retention in the organisation is similar to global trends and to identify the factors that influence the retention and turnover intentions of women engineers within the selected steel organisation.

2.4 PRIMARY AND SECONDARY OBJECTIVES

2.4.1 Primary objectives

The primary objective of this study is to explore the retainment of women engineers in a selected steel manufacturing organisation in Gauteng, South Africa.

2.4.2 Secondary objectives

SO1: To determine if the retention of women engineers is problematic in the selected steel manufacturing organisation.

SO2: To determine what attracts women engineers to the steel industry and the selected organisation.

SO3: To explore the factors influencing women engineers' turnover intentions within the steel manufacturing organisation.

SO4: To determine what the selected steel organisation can do to retain women engineers.

SO5: To determine what women engineers in the selected steel organisation can do to retain themselves.

2.5 PRIMARY AND SECONDARY RESEARCH QUESTIONS

2.5.1 Primary research question

What factors influence the retention of women engineers in a selected steel manufacturer in Gauteng, South Africa?

2.5.2 Secondary research questions

SRQ1: Is the retention of women engineers' problematic in the selected steel manufacturing organisation?

SRQ2: What attracts women engineers to the steel industry and the selected organisation?

SRQ3: What factors influence women engineers' turnover intentions within a steel manufacturing organisation?

SRQ4: What can the selected steel organisations do to retain women engineers?

SRQ5: What can female engineers in the selected steel organisation do to retain themselves?

2.6 SIGNIFICANCE OF THE STUDY

The research study seeks to make theoretical, practical, and industry-specific contributions to retain women engineers in a selected steel manufacturing organisation in Gauteng, South Africa.

- **Theoretical contribution**

The study aimed to understand and add value to the theoretical knowledge base related to the retention strategies of women in engineering, specifically focusing on the

retention of women engineers in a selected steel manufacturing organisation in Gauteng, South Africa.

- **Practical contribution**

The steel organisation has various global and local steel initiatives like the *Women in Steel* initiative that focus on attracting women to the steel industry. These initiatives also create a social platform for women in the organisation. This platform can contribute towards women's retention in the organisation.

- **Industry and organisational contribution**

The research study can shed light on the factors influencing women's intent to remain within the selected steel organisation and their possible intent to leave the steel manufacturing organisation. This can lead to possible changes in organisational policies, training, networking platforms, coaching strategies, and the working environment that can enable the steel manufacturer to retain women engineers in a positive working environment.

2.7 LITERATURE REVIEW

There is an increased need for organisations to recruit and retain a skilled workforce to be competitive in a globally competitive market. Employee talent development and retention is a strategic tool that organisations must utilise to achieve organisational outcomes (Arasanmi & Krishna, 2019:174). Singh (2019:245), concurs and adds that employees must be seen as valuable and productive assets contributing to organisational development, profitability, and sustainability. Therefore, employee retention should be contextualised against a competitive advantage background.

2.7.1 Women's representation in engineering

Recent studies indicate that women are underrepresented in the engineering and engineering technology industries across the globe. The SWE reported that globally, women obtained only 24.2% of bachelor's degrees in engineering in 2020 (SWE, 2022a). Statistics show that 17.2% of undergraduate Australian engineering students are women. In selected European countries, 23.7% to 35.9% of engineering bachelor's

degrees are obtained by women. Only 21% of women in the USA have engineering degrees (Catalyst 60, 2020). These international statistics corroborate South African engineering statistics. According to the Engineering Council of South Africa (ECSA) vice president Refilwe Buthelezi (ECSA 2021:1), only 20% of the South African engineering workforce are women. Furthermore, ECSA (ECSA, 2020:81) has reported that just 6% of professionally registered engineers in South Africa are women. These statistics indicate fewer women enter the engineering industry than their male counterparts.

Naismith *et al.* (2017:227) state that 62% of women remain in the engineering industry after completing their studies. Frehill (cited by Singh *et al.,* 2018:901) expands this study and indicates that half of female engineers leave the engineering industry by the time they reach 50 years of age. Fouad *et al.* (2017:2) add that some women complete the rigorous study curriculum and never enter the industry, while others leave after working there. The South African statistics echo the global statistics, with 30% of women leaving the engineering industry (WEF, 2020). This indicates that in an already underrepresented industry, women go to the engineering industry, contributing to a gender-imbalanced workforce.

Thus, in an underrepresented field, retaining women in the engineering industry is important to ensure that diverse opportunities, ideas, and skills are captured, as it can result in improved organisational performance (Naismith *et al.*, 2017:227). Dell and Verhoeven (2017:1) believe that increasing women's representation in engineering might enhance the science, technology, engineering, and mathematics (STEM) workforce. Fouad *et al.* (2020:446), consider the gender imbalance in the engineering industry in a societal context, with societal losses in the potential talent pool and social injustice in the profession. Despite these organisational and societal benefits, there is an attrition of women from the engineering field. Therefore, exploring women's retention and turnover intentions in engineering is vital.

2.7.2 Attracting women engineers to the industry

The women’s turnover intentions must be contextualised against the background of what drew women to engineering and the industry. A global trend to involve women in

all engineering sectors on the foundations of gender equality and economic and societal sustainability has led to various organisations and institutions creating policies and programs to attract women to engineering and the engineering industry (Bannikova *et al.,* 2018:1).

Organisations are sharing the successes of women engineers and focus on the personal and professional benefits of the occupation (Nel & Meyer, 2016:4). Policies such as the National Strategy for the Advancement of Women and Eurasian Women's Forum's STEM Committee are created with the specific focus to attract and retain women in technical positions (Bannikova *et al.*, 2018:1). Therefore, the global trend to attract women to the engineering industry is supported by global policies and programs. Furthermore, factors that influence the attraction of individuals to STEM and engineering are explored by scholars. Sithole *et al.* (2017:49) state that the engineering advisory body sparks students' interest in STEM. It also seems to relate to the success in STEM to an individual's analytical skills and mathematical proficiency. The influence of family members and acquaintances in engineering is emphasised as an attraction factor for women to engineering. Bannikova *et al.* (2018:2) concur that women are motivated to choose challenging programs that can propel their career opportunities. Thus, the practical ability to apply analytical skills, mathematical ability, the influence of family members, and the perceived challenge to study engineering as a foundation to propel an individual's career influence women's attraction to engineering.

Programs such as the Women in Steel emphasise removing entry barriers for women to enter the steel industry. A specific focus on promoting success stories of women in the steel industry is driven by the Association for Iron and Steel Technology (AIST) in their Progress and Perspectives – Women in Steel column (AIST, 2023). Therefore, the steel industry also attracts women through selected programs focusing on the success stories of women. Against the background of organisations' efforts to attract women to engineering and the steel industry, the focus should be to retain women and prevent their turnover.

2.7.3 Retention of women engineers in the industry

The attraction of women engineers to the industry is only beneficial to organisations and individuals when retaining women. As such, retention factors influencing women in engineering are important to organisations. Osta *et al.* (2020:9) find that supportive family, peer and group work, mentorship, career aspirations, and research opportunities are all positively associated with the retention of women in engineering. The opportunity to work in a team, understand the experiences of other women engineers, have a career path, and develop themselves through research and technical opportunities are factors that can contribute to the retention of women in engineering.

The retention of women engineers can also be related to the personal attributes of the individual with confidence, competence, relational orientation, and personal identity, emphasised by Fernando *et al.* (2018:4). The National Society of Professional Engineers (NSPE) concurs and states that women engineers must have a positive attitude, an engineering related self-efficacy, a STEM identity, and a solid supporting network (NSPE, 2020). Therefore, women must identify as engineers, be confident, have technical skills, be positive, and have a strong support network to remain in engineering. Organisational factors are part and parcel of retaining women because the industry requires engineers to work as part of a larger organisational community.

2.7.4 Organisational retention of women engineers

Like other engineering industries, the steel industry requires an improved gender balance to improve innovation and productivity (Salminen-Karlsson, 2020:66). Therefore, retaining women engineers in the steel industry and The intent of women engineers to leave or remain in the organisation must be explored against the driving factors of what attracted women to the steel industry and the challenges they face.

Organisational retainment strategies must effectively combat the challenges faced by women in engineering to ensure a more accommodative environment for women as engineers in the steel industry and within organisations. The working environment, social responsibilities, and women's career goals and career growth must be considered to create successful retainment strategies in the engineering and steel industry. Knowledge-sharing communities can assist in creating a supportive personal

network of resources that can support women's psychological needs in the industry (Dell & Verhoeven, 2017:1). A study on peer mentoring of women engineering students at Montana State University in the USA indicated that women engineering students' retainment improved through the implementation of peer mentoring programs (Clark *et al.,* 2015:2). Skvoretz *et al.* (2019:3) concur and add that a strong relationship between a mentor and the mentee can increase women engineers' connection with the occupation and their confidence. Therefore, mentorship programmes can be fundamental in retaining women engineers in industry.

Fernando *et al.* (2018:5) relate the retention of women engineers to an organisational culture that recognises and accepts employees. A working environment where male colleagues respect women engineers for their technical abilities shapes their sense of belonging. Thus, content-specific mentorship programs and social support can enhance a supportive working environment. Organisations must, therefore, consider their recognition and rewards strategies and corporate culture in retaining women engineers.

2.7.5 Turnover intentions of women engineers

It is essential to understand why women leave the engineering industry within the societal and organisational contexts and uncover the factors that can lead to their attrition from the engineering industry. Scholars such as Houston (2022:2), Fouad *et al.* (2016), Du Plessis and Barkhuizen (2015), and Naismith *et al.* (2017) equate the attrition of women from the engineering industry to various factors.

Houston (2022:2) attributes the attrition of women from the engineering industry to the perception of an unbalanced work-life and salary inequity. Further, Fouad *et al.* (2016:80) explain that a lack of self-confidence, stereotype vulnerability, and dissatisfaction with career opportunities motivate women to leave the engineering industry. Du Plessis and Barkhuizen (2015:39) concur with the statements of women's exposure to stereotyping, poor work-life balance, and limited career advancement opportunities but add harassment and a lack of mentorship opportunities as motivating factors for women to leave the engineering industry. Furthermore, Naismith *et al.* (2017:227) indicate that workplace stereotypes still exist regarding the balance

between long working hours and a work-life balance for women in the engineering industry, as concurred by Fernando *et al.* (2018:4). Therefore, the societal perception of the roles of women in households influence their engineering turnover intentions.

The findings of Mozahem *et al.* (2019:127) relate women's turnover intentions to verbal and psychological harassment, the lack of execution from colleagues when women engineers give instructions, job discrimination, and the perception that women are weak. Substantial cultural differences and a lack of self-confidence can be influential in the turnover intentions of women, according to White and Massiha (2016:2). The stereotypical masculine culture and masculinity associated with the characteristics of an engineer is a factor that gives engineering the perception of being a *man's world.* Women are often excluded from large-scale project allocations. A masculine-driven environment where women are excluded from bonding activities and masculine topics causes women engineers to feel isolated (Fernando *et al.,* 2018:4). Thus, women engineers can be exposed to different forms of harassment and a perception of being technically inferior to their male counterparts. In addition to these factors, the perceived cold and unreliable environment in the engineering industry is emphasised as an attrition factor by Arthur and Guy (2020:212). These factors can motivate women to leave the engineering industry and should be identified, defined, and addressed if women are to be retained within the engineering context.

Singh *et al.* (2013:282,283) argue that an individual's departure from an organisation is preceded by the consideration to leave the organisation. Women's turnover intentions in engineering must lead to determining intervention points to retain them for the engineering industry. The challenges women face in the engineering industry must be determined concordantly with their intention to leave or remain engineers.

There is a difference in the attrition of women from the engineering industry and women in engineering leaving an organisation (Singh *et al.*, 2018:902). Blau (2007:136), explains the difference between voluntary organisational turnover and voluntary occupational turnover as individuals leave their organisation and change their occupations. This indicates that the attrition of women from an organisation does not necessarily indicate that the individual is goining to leave the engineering industry. Although this is interlinked, due to the nature of this study, it will only focus on the

factors contributing to the turnover intentions of women engineers within an organisation.

2.7.6 Women's engineers drive to remain in an organisation

The retention and turnover intentions of women engineers in the industry cannot be limited to an organisational perspective but must consider what women can do to enhance their experiences and improve their retention. Various programs, such as the Association of Professional Women Engineers in Nigeria (APWEN), The World Academy of Science (TWAS), and the Society of Women Engineers (SWE), exist with a focus on supporting women in engineering. Women can join mentorship programs where women engineers can mentor others (Longe & Ouahada, 2019:5-6). Therefore, the retention of women in engineering should not only be left to the organisation as women can take strides to retain themselves.

The literature shows that the retention of engineering women in the steel industry must be considered against the backdrop of what attracted women to enter the engineering industry and the reality of their challenges. Retaining women in the industry is important to create a diverse and innovative workforce and ensure that a fair and gender-balanced engineering field is created where women can contribute and reach self-satisfaction and job satisfaction.

2.8 RESEARCH PARADIGM, METHOD, AND DESIGN

2.8.1 Research paradigm

The broad perspective of a research paradigm refers to a system of assumptions and beliefs about knowledge development (Saunders, 2016:124). According to Maree (2016:34), the research paradigm refers to a way to view the world. Therefore, the research paradigm provides the framework to the researcher from which meaningful assumptions and systems are favoured above others.

Historically, the two mainstream research philosophies are interpretivism and positivism. However, more recently, the pragmatism and critical realism positions in

research philosophies have been considered (Melnikovas, 2018:34). The interpretivism epistemology is based on the position that social sciences differ from natural sciences with specific reference to the subject matter. According to Saunders *et al.* (2019:124), an interpretivistic perspective on humans and their social environment cannot be similar to physical phenomena. The interpretivism philosophy is based on the foundation that individuals can construct meaning (Nieuwenhuis, 2016:60). Furthermore, the interpretivism research philosophy requires a research logic that considers the disparateness of humans (Bryman *et al.,* 2019:14), as well as the interpretation and understanding of social worlds and the context thereof (Saunders *et al.*, 2019:149).

The objectives of this study were to explore the retention and turnover intentions of women engineers, considering their experiences within a selected steel organisation. Therefore, a deeper understanding of the retention of women in the organisation was the focal point. Based on this study's nature and objectives, an interpretivist research paradigm was adopted.

2.8.2 Research method

The methodological choice pertains to the general orientation in which the research is conducted and the data is collected (Bryman *et al.,* 2014:3; Melnikovas, 2018:39). There are two distinctive methodological approaches to research, quantitative and qualitative research methodology (Bryman *et al.,* 2014:30). Bryman *et al.* (2014:31) distinct quantitative research as a research methodology that emphasise data collection and the analysis thereof. In contrast to this, qualitative research places emphasis on words and is associated mainly with an inductive research approach (Bryman *et al.,* 2014:31). Nieuwenhuis (2016:53) concurs and states that inductive research relies on linguistics in comparison to a statistical approach to quantitative data analysis.

Niewenhuis (2016:53) adds that qualitative research methodology is naturalistic, focusing on the natural setting in which interactions occur. Furthermore, qualitative research uses exploratory questions and emphasises understanding phenomena (Niewenhuis, 2016:53).

Due to the nature of this study, where the emphasis was placed on exploring the retention and turnover intentions of women in the selected steel organisation to understand the phenomena, a qualitative research methodology was followed. This was emphasised through the vitality of understanding the retention of women engineers within the organisational context through exploratory questions.

2.8.3 Research design

2.8.3.1 Research strategy

Saunders' research onion model includes eight different strategies (Melnikovas, 2018:40). However, adding the phenomenological research strategy was considered for this study.

A phenomenological research strategy is based on the meaning and description of participants' life experiences. Based on the description of the participants' experiences, overall meanings are derived (Niewenhuis, 2016:77). Bryman *et al.* (2014:15), add that researchers should bracket their preconceptions to prevent them from influencing the research study. Furthermore, phenomenological studies are not limited to one individual's experience but rather aim to describe what all participants have in common (Niewenhuis, 2016:77). This strategy includes the identification of phenomena, collecting data from multiple individuals who experienced the phenomena, reducing the data to central themes, followed by a textural and structural description (Niewenhuis, 2016:78).

The study was exploratory, focusing on understanding the participants' life experiences in the organisation that influenced their retention. Therefore, a phenomenological research strategy was followed.

2.8.3.2 Time horizon

The time horizon is the period over which a study is conducted (Melnikovas, 2018:34). According to Saunders *et al.* (2016:200), there are two main time horizons: the cross-sectional and the longitudinal time horizon. Longitudinal research studies are longer-

term studies that map the change of mechanisms and contextualise them (Bryman *et al.,* 2014:109). In contrast, cross-sectional studies are a snapshot of phenomena at a particular time (Saunders *et al.,* 2016:200). Bryman *et al.* (2016:106) add that cross-sectional studies involve studies that focus on more than one case. Therefore, cross-sectional studies can be seen as shorter-term than longitudinal studies.

This study utilised a cross-sectional time horizon as the focus of the study was to understand the retention of women in the selected steel organisation as a snapshot of their experiences. Therefore, the study was short-term focused and thus cross-sectional.

2.9 RESEARCH PROCESS

2.9.1 Population

The study population is a representative sample (Bryman *et al.*, 2014:168) of the full set of cases the researcher wants to study (Saunders *et al.*, 2016:274). This study's target population was women engineers employed in the selected steel organisation and women engineers who moved into other positions but remained in the steel organisation based in Gauteng.

Listing all the population units from which a sample is selected is a sample frame (Bryman *et al.*, 2014:383). The sample frame for the participants guides the inclusive and exclusive criteria. The inclusion criteria included women engineers with two years of working experience as an engineer or engineering manager in the selected steel organisation. Women candidate engineers with less than two years of experience who report directly to the researcher were excluded from the study.

2.9.2 Sampling methodology

Non-probability sampling methods do not use random selection to represent a population; therefore, study conclusions drawn from studies must consider the study sample against the population (Maree & Pietersen, 2016:197). A purposive sampling method is used when research has a specific study-related purpose (Maree & Pietersen, 2016:198).

This study used a non-probability purposive sampling method to select samples that enabled the researcher to gain insight into the retention of women engineers in the selected steel organisation. Furthermore, non-probability studies are preferred in time-limited studies (Maree & Pietersen, 2016:198). A purposive sampling method was used to ensure a strong focus is placed on women engineers or engineering managers with two years of engineering experience in the selected steel organisation. In addition, the short-term period in which this study was conducted favoured a non-probability sampling method.

A human resource management representative of the selected steel organisation acted as the gatekeeper to this study. The gatekeeper communicated the study details to all potential participants via an electronic bulletin notification. The participants responded electronically via a link to indicate participation in the study. A consent form was supplied via an electronic link after the electronic indication to participate in the study. This consent form gave participants an option of interview dates and timeslots, which they could select for convenience. Interview dates and timeslot options were available for a month.

Furthermore, the electronic response included a consent form where the participant consented that the required personal information and contact details may be used. The focus was to adhere to the Protection of Personal Information (POPI) Act, Act 4 of 2013. The participants' responses were sent to an independent person who anonymised the list of respondents.

The sample size of a study must be such that the sample is representative of the population (Maree & Pietersen, 2016:200). Saunders *et al.* (2016:297) state that the relationship of the sample selection must be logical in comparison to the focus of the study. In a qualitative research method, data must be collected until data saturation is reached (Saunders *et al.,* 2016:297). Saunders *et al.* (2016:297) explain that the data saturation point is reached when additional collected data provide minimum new information.

Consider the commonalities in this study's organisational environment and the probable commonalities in the women who are employed in the selected steel organisation. Data saturation was reached after eight participants. This is supported by the Saunders *et al.* (2016:297) guideline that states that non-probable sample sizes for homogenous populations should vary between four and eight.

The researcher is an employee at the selected steel organisation. Therefore, no participant directly reporting to the researcher was considered to participate in the study.

2.9.3 Data collection instrument

The measurement instrument is used to collect data during the research process. Similar to the aim of this study, qualitative research is to see the world through the participants' eyes (Niewenhuis, 2016:93). Therefore, a semi-structured interview guide was designed to obtain the required experiences from participants.

Semi-structured interviews are based on a line of inquiry that is followed by probing and clarification questions (Niewenhuis, 2016:93). Although the researcher focused on the line of inquiry, it was anticipated that probing questions would be required, and a semi-structured interview guide was used.

The researcher designed a semi-structured interview guide based on the literature to relate questions to the selected steel organisation and the operational environment of participants. The measuring instrument included informed consent (see Appendix F), introduction, follow-up, probing, and direct and indirect questions (Van der Merwe, 2022). The semi-structured interview guide questions answered the research objectives about the retention of women engineers in the selected steel organisation, the factors that attract women engineers to the steel industry, women engineers' turnover intentions, and women's contributions to their retainment within the selected steel organisation.

2.9.4 Data collection and fieldwork

The selected steel organisation has approved this study. The recruitment of participants followed the POPI Act and was conducted in alignment with the steel organisation's human resource policies. The North-West University's Ethics Committee approved the study and issued an ethical clearance number (NWU-00629-23-A4).

Participants were accessed through the selected steel organisation. The human management resources representative of the steel organisation acted as the gatekeeper. Study details were communicated to participants by the gatekeeper through an electronic bulletin notification. Participants responded electronically via a link that indicated their interest in participating in the study. In a second link, participants gave informed consent and selected interview dates and timeslots. The participants' responses were sent to an independent person who anonymised the list of respondents.

2.9.5 Data coding and analysis

A data analysis framework is a set of guidelines that structure the data analysis process (Bryman *et al.,* 2014:342). A literature review indicated that thematic data analysis will support the study's objectives. A thematical data analysis method is a flexible method aimed at identifying, analysing, and describing themes across data sets (Bryman *et al*., 2014:350). Saunders *et al.* (2016:579), states that thematic analysis can be used in interpretivism studies that explore phenomena. The objective of this study was to examine the retention of women engineers in a steel organisation, and the focus was on identifying themes, thus adopting thematical data analysis.

Braun and Clark (cited by Bryman *et al.*, 2014:351) proposed a six-step process to conduct thematical data analysis that was utilised in the data analysis phase of this res were noted. This process was followed by the initial data coding into a systematic pattern. Potential themes were identified, reviewed and categorised. Definitions and names were given to each theme, followed by the report (Bryman *et al.,* 2014:351).

A co-coder conducted an independent thematic analysis of the transcribed data to increase credibility. The researcher reached a consensus of themes and the co-coder before the data analysis process continued.

2.10 FINDINGS

This study sought to explore the factors that influence the retention of women engineers in a selected steel manufacturer based in Gauteng, South Africa. The following higher-order themes related to each research question emerged from the coded data. The findings are contextualised in several occurrences. Each theme occurred in the semi-structured interviews of the eight participants (N=8). The findings were grouped according to the research questions.

2.10.1 Participant demographics

The participants are all employees of the selected steel manufacturing organisation based in Gauteng, South Africa. The participants' age, length of service in the organisation, length of service in their specific position, job category, qualification, marital status, and number of children are displayed in Table 1.

Table 1: Participant demographics

Demographic category	Years	# Participants
Age	20 - 30	4
	31 - 40	3
	41 - 50	1
Organisational length of service	1 - 5	1
	6 - 10	4
	11 - 15	2
	16 -20	1
	21 - 25	0
Positional length of service	1 - 5	7
	6 - 10	0
	11 -20	1
	20+	0

Demographic category	Subheading	# Participants
Job category	Engineer	6
	Engineering manager	2
Qualification	Undergraduate	7
	Masters	1
	Doctorate	0
Marital status	Single	3
	Married	4
	Divorced	1
	Widow	0
Number of children	One	0
	Two	2
	Three	0
	Four	0

Participants are mainly engineers between 20 and 40 years of age, with 6 to 10 years of experience in the organisation. Most participants have less than five years of experience in their current position. Participants are primarily active in plant engineering, with only two in engineering management positions. Furthermore, participants' educational qualifications are skewed positively towards an undergraduate degree. Four participants are married, while only two participants have children.

2.10.2 The problematic retention of women engineers in the organisation

A Likert scale is a rating or a set of statements that requires participants to rate their level of agreement with each statement (Joshi *et al.,* 2015:397). Participants were asked two questions about their probability of remaining in or leaving the organisation. Furthermore, participants were asked if they would consider leaving the engineering occupation or if they would leave the organisation.

Participants rated their probability to leave the organisations as four out of five, with five indicating their intent to leave and one indicating that a participant will remain in the organisation. Seven participants indicated that they would consider leaving the organisation rather than the occupation, and one indicated that she would consider an alternative occupation.

2.10.3 Factors that attract women engineers to the industry

2.10.3.1 Factors that attract women engineers to engineering

Within this category, the following four themes emerged as motivating factors for women to study engineering: (1) an interest in STEM, (2) problem-solving opportunities, (3) practical application of theory, and (4) career guidance. Table 2 below outlines the number of occurrences of each theme.

Table 2: SRQ 2 – Factors that attracted women to engineering themes

Theme	Number of occurrences
Theme 1: Interest in STEM	5
Theme 2: Problem-solving opportunities	17
Theme 3: Practical application of theory	14
Theme 4: Career guidance	2

- **Theme 1: Interest in STEM**

School STEM subjects are biology, chemistry, physics, technology and mathematics (Lee & Perret, 2022:127). Five participants identified a love for a specific STEM-related subject, including mathematics, science in general, and chemistry, as a motivating factor to study engineering. Selected participants stated that they have a natural

aptitude for mathematics or science. Some of the participants' statements are as follows:

- *"I enjoyed chemistry. It was definitely a subject that was close to my heart, and everybody struggled to grasp it. I got it quicker, and that made me think perhaps I am suited for it."*
- *"I love mathematics."*
- *"I love mathematics and science, and I love to figure out how things work."*

- **Problem-solving opportunities**

Problem-solving is finding a solution to a problem (Merriam-Webster Inc., 2023a). During the interviews, participants stated that in 17 occurrences, problem-solving opportunities attracted them to engineering. This theme considers sub-themes of creative problem-solving opportunities and the ability to overcome a challenge. Some of the statements made by participants are as follows:

- *"I like the logic and the whole problem-solving aspect that goes into it, I think it just fits my personality."*
- *"Problem-solving was a good challenge for me. I enjoyed solving a problem."*
- *"I think it is more my personality because I'm driven by the challenge, I'm driven by the fact that if I set my mind on something, I know I'm going to get it. So the perception that engineering is difficult to attain was something that motivated me."*
- *"I was committed to overcoming the challenge, and I continued to be interested during the course."*

- **Practical application of theory**

Practical application is using theoretical knowledge to accomplish or perform work (Thomas, 2017:10). This study considers the practical application and understanding of how things work as sub-themes. Participants stated that the ability to apply theoretical knowledge in the industry and to understand how systems work 14 times. Some participant statements are as follows:

- *“So basically, you're understanding the theoretical background when you're in university, and then you have to couple it with an actual practical side of engineering, which takes you to a different realm in entirety.”*
- *“It is that moment in the plant when everybody's been telling you theory, and you've been studying this portion and that portion, and then just everything clicks together, and you can see that gap where you can apply theory and improve it.”*
- *“It's a level of respect you start getting for machinery, for how everything works, for the mind that created it in the first place.”*

- **Career guidance inputs**

Career guidance is advice or information about careers that helps individuals decide on a career (Collins Dictionary, 2023a). Two participants stated that their decision to study engineering was influenced by a family member or an acquaintance who motivated them. The two participants' statements are as follows:

- *“My dad, I think he's my role model, so he pushed me into the field because he is involved in engineering in specific, and he's still sort of a niche for me, and obviously he wants the best for me.*
- *“Two of my neighbours worked at the company and are in similar roles to what I do. That motivated me to try it.”*

Considering the differentiation between women leaving an organisation and women leaving the engineering occupation (Singh *et al.,* 2018:902), *a* follow-up question was asked to determine if engineering lived up to the participants’ expectations. Seven of the eight participants stated that the engineering occupation satisfied their expectations and that they wanted to remain in the occupation. Furthermore, five participants indicated that they did not initially understand what engineering entailed. However, they pursued the career despite this.

2.10.3.2 Factors that attracted women engineers to the steel organisation

Within this category, the following three themes emerged as factors that attracted women engineers to the selected steel organisation: (1) receiving a bursary from the organisation, (2) technical motivation, and (3) others that entail a combination of factors

that were mentioned in low frequencies. Table 3 below displays the themes and the number of occurrences of each theme per category mentioned by participants.

Table 3: SRQ 2: Factors that attracted women engineers to the selected steel organisation themes

Theme	Number of occurrences
Theme 1: Receiving a bursary from the organisation	6
Theme 2: Technical motivation	14
Theme 3: Others (Location, possible mentor figures, career guidance, and vacancies)	9

- **Receiving a bursary from the organisation**

A bursary is a financial provision awarded to an individual that enables them to study at an institution (Cambridge Dictionary, 2023a). Six participants received a bursary from the organisation to study engineering. Potgieter (2023) confirms that the organisation has nine active women engineer bursars in 2023, and varies year-on-year based on organisational and candidate variables. Some participants' statements are as follows:

- *"But what brought me to the steel organisation was the bursary, nothing else."*
- *"So my path was more chosen for me, but because I had the bursary, so I started working after the bursary."*
- *"I was offered a bursary by the steel organisation."*

- **Technical motivation**

Technical motivation encompasses specific technical details that attracted the participant to the selected steel organisation. Process intricacy and the opportunity to work at a globally recognised company are considered retention factors by participants. The organisation has a global technical team shares information, benchmarks data, and supports plant personnel. This serves as a technical motivation for participants to remain in the organisation. Participants stated 14 times that the decision to join the organisation was motivated by a technical factor. Selected participants' statements are as follows:

- *“But when I started studying metallurgical engineering and learned how steel works, and you know, the intricacy part, that's what I want to do and a lot of years later, I still want to learn every day. So it was the process intricacy that was a factor.”*
- *“I thought that it would be a good opportunity because it is a multinational company.”*
- *“To work at a blast furnace was what made my eyes, you know, shine. It was fully aligned to see the transformation that happens at the blast furnaces in the whole steel-making process.”*
- *“It's a global company, it's very prestigious.”*

- **Others (location, vacancies, and family motivation)**

Although not specific to a theme, the other category summarises the codes that occurred fewer times than more prominent codes. Five participants favourably considered the geographic location of the steel organisation (Collins, 2023b). Two participants were attracted to the organisation through vacancies (unoccupied positions). One participant stated that a family member motivated her to join the organisation, and another said she could identify possible mentor figures during the recruitment process. Selected participants' statements are as follows:

- *“So me being in the steel organisation, it was really about location. I looked at companies that were around Johannesburg.”*
- *“Geographics first because we stayed in the vicinity of the steel organisation.”*
- *“I had a family member who was working here, and she recommended applying here because she worked at HR, and she said that it was a good opportunity to learn.”*
- *“So it was actually one of my colleagues at my previous place of employment. He advised me that there was a vacancy.”*
- *“The one thing that attracted me was, honestly, it was the managers. He showed me the leadership qualities that I wanted to imitate in the interview.”*

A follow-up question was asked to determine if working at the selected steel organisation meets women engineers’ expectations. This is supported by the theory that there is a differentiation between intentions to leave an organisation and an

occupation (Singh *et al.,* 2018:902*).* Seven out of the eight participants stated that working at the selected steel organisation did not meet their expectations and that the initial factor that attracted them to the organisation was no longer considered important. Furthermore, one participant stated that she only remains in the organisation to make a difference, while another stipulates that she loves the occupation but not the organisation.

- *"I want to make a change, and that is why I remain in the organisation."*
- *"I love engineering, not the company."*

2.10.4 Factors that influence women engineers' turnover intentions

Within this category, the following five themes emerged as factors that influence women engineers' turnover intentions: (1) poor communication and a fear of speaking up**,** (2) micromanagement, (3) a lack of development opportunities, recognition, and rewards, (4) job conditions, demands, and company culture, and (5) workplace discrimination. Table 4 below indicates the theme and the number of occurrences for each theme as stated by participants.

Table 4: SRQ 3: Factors influencing women engineers' turnover intentions within the steel manufacturing organisation.

Theme	Number of occurrences
Theme 1: Poor communication and a fear of speaking up.	9
Theme 2: Micromanagement and lack of trust	37
Theme 3: Lack of development opportunities, recognition, and rewards.	20
Theme 4: Job conditions, demands, and company culture.	53
Theme 5: Workplace discrimination	7

- **Poor communication and a fear of speaking up**

Poor communication is withholding essential information or information not communicated clearly (Leaders, 2022). Within this study, participants referred to a lack of communication through codes, such as poor organisational communication, where participants felt a gap between staff and management and a lack of emotional intelligence. Participants stated that in their experience, there is a lack of emotional

intelligence as people in the organisation do not understand how to communicate and work with women in the industry. Two participants stated that they fear speaking the truth and that it is creating a communication gap between employees and management. Some participants' statements are as follows:

- *"I wouldn't call it verbal abuse, but emotional intelligence, the lack of emotional intelligence."*
- *"You have to have a high level of emotional intelligence to work with women in your area."*
- *"It's not communicated well, or it is not communicated at all."*
- *"It's like a fear to speak the truth."*
- *"Fear is creating a communication gap."*
- *"I think the recruitment quality is not always up to standard, and we are excluded from the process."*

- **Micromanagement and lack of trust**

Limon and Dilekçi (2021:124) define micromanagement as the control of every detail in an employee's task. Ndidi *et al.* (2022:752), characterise micro-managing behaviour as a lack of trust in the workplace (Ndidi *et al.,* 2022:752). Thirty-seven times, participants relate their workplace experience to a micromanaged environment with a lack of trust. Participants accentuated in 17 occurences the feeling that there is a lack of trust in a woman's opinion in the organisation. Furthermore, participants emphasise that their voice is silenced and that they experience an absence of a voice within the organisation. A lack of voice contextualised to the workplace comprises employees' inability to share their opinions, ideas, or concerns on workplace issues (Muller-Heyndyk, 2019). Participants state that their opinions are disregarded. Some participant statements are as follows:

- *"So micromanagement is one; it speaks to the lack of trusting people."*
- *"Micromanagement, it's all we do."*
- *"You're questioned all the time about how you approach situations, your decision-making and your voice is silenced in meetings, or your opinions are disregarded, either because you're young, or because you are a female, or because you seem as you're not technically there. "*

- *“Because some of the women, they don't trust that I can also do it you know.”*
- *“So your opinions are sort of toned down or filtered along the way, or your responses are filtered.”*
- *“I think that technically, women are generally seen as technically non-compliant in a lot of aspects and non-comparable to male counterparts.”*

- **Lack of development opportunities, recognition, and rewards**

The Harvard Business Review (HBR) defines the lack of development as growth opportunities (HBR, 2017). This study considers the lack of self-development and organisational development opportunities as a subtheme to this theme. Recognition is the continuous effort to acknowledge the efforts of an employee, while rewards can be financial or non-financial compensation (Asaari *et al.,* 2019:52-53). This study considered a lack of fair compensation, fair treatment, and poor recognition performance sub-themes to the specific theme.

Seven participants stated that they feel under-compensated for their work, and three emphasised the lack of fair treatment from their experiences. Participants relate their intention to leave to factors such as an imbalance between employee contribution towards the company and the organisation's contributions towards them and a lack of fair compensation in various statements. Four participants stated that the organisation has a lack of self-development opportunities and that they will leave the organisation for better opportunities. Some participants' statements are as follows:

- *“I am doing three people's work and am not being compensated for it.”*
- *“I would leave for better pay.”*
- *“So you have to give, give, give, but you don’t get anything in return.”*
- *“I feel like the organisation is benefiting too much and I'm not benefiting as much.”*
- *“For exposure. The company does not have development opportunities for me.”*

- **Job conditions, demands, and company culture**

Job demands refer to a job's physical, social, organisational, and physical characteristics (Sliter & Yuan, 2015:1). Participants relate their negative experiences to long working hours, work pressure, emotional drainage, and a lack of resources in 53 occurrences. Five participants said they feel taken for granted and expected to work

long hours. Furthermore, participants stated that they worked under negative pressure conditions 13 times and that the working environment lacked resources. One participant related her experience in the organisation as harming her health. In addition, participants refer to the company culture as a toxic environment that is non-constructive and masculine-driven. Participants refer to the poor company culture in 19 occurrences. Some participant statements are as follows:

- *"I've been taken for granted, as you can use your own time to do work. I would leave for better working hours."*
- *"I think it is the fact that we learn how to handle pressure, but it is the wrong type of pressure that is thrown upon us."*
- *"They expect the impossible of you."*
- *"There is no resources."*
- *"Then the third thing, I think, is the culture. It's a masculine-driven culture."*
- *"So our current culture on paper and also what is expressed through the engagement sessions that we have, sort of seems like it's in paired fashion. It's rehearsed."*

- **Workplace discrimination**

Discrimination, and specifically gender discrimination, is defined as the practice of letting an individual's gender unfairly become a factor when deciding on promotions, training opportunities, job assignment, compensation, and other employment benefits (Yu & Lee, 2021:274). Seven participants stated that they experienced discrimination through unfair job assignments. Some participant statements are as follows:

- *"There is a sense of discrimination towards women when allocating work."*
- *"Make use of her as a senior engineer. Make use of her brain. Don't make her handle all your contracts and your admin."*
- *"I am given the administration work."*

Three follow-up questions were asked, with seven of the eight participants stating that they had an intention to leave the organisation. Based on a Likert scale of one to five, where one indicates the participant's intent to stay within the organisation, and five indicates their intent to leave, participants rated their probability to leave the

organisation as a four. Only one participant indicated that she would consider leaving the engineering occupation, while two indicated that they would consider future management positions. Furthermore, all participants stated that they are experiencing an imbalance in their contribution towards the organisation and their contribution towards them. All participants stated that they give more than what the organisations do, influencing their turnover intentions.

2.10.5 Factors that influence women's retention within the organisation

The organisational retention factors were considered as factors currently positively contributing to the retention of women engineers in the selected steel organisation and factors that can contribute to retaining women engineers in the future.

2.10.5.1 Organisational factors that currently retain women engineers

The factors that are positively contributing to the retention of women engineers in the selected steel organisation are as follows: (1) organisational safety initiatives**,** (2) technical and developmental factors, (3) managerial recognition and rewards, (4) lack of outside opportunities, and (5) self – motivation. Table 5 below indicates the theme and the number of occurrences for each theme as stated by participants.

Table 5: SRQ 4: Factors currently influencing women engineers' retention within the steel manufacturing organisation.

Theme	Number of occurrences
Theme 1: Organisational safety initiatives	4
Theme 2: Technical development opportunities	3
Theme 3: Managerial recognition and rewards	1
Theme 4: Lack of other opportunities	1

- **Organisational safety initiatives**

Organisational safety initiatives refer to safety training, safety systems, and safety surveys within the organisation. Three participants relate the organisation's safety drives positively to retention factors. Some participant statements are as follows:

- *“I went to safety training and it was really good. We are doing a lot with regard to safety.”*
- *“The safety speak-up initiative we had.”*
- *“We have a very structured health and safety policy.”*

- **Technical development opportunities**

The organisation has a global chief technical officers’ group that provides technical support, benchmarking opportunities, technical mentorship, and training to plant personnel. This includes access to the global research and development facilities. Three participants stated that access to the knowledge capital this group provides positively contributes to their retention within the organisation. Some participant statements are as follows:

- *“The fact that we are a global company, we are able to send our lab samples to research and development.”*
- *Exposure to the international group. To the knowledge capital of the group.”*
- *I think it is good that we are getting sort of benchmarks from global, I think it is great.”*

- **Managerial recognition and rewards**

Employee recognition can be viewed as a sort of constructive criticism aimed at improving an employee's conduct or highlighting the accomplishment of an individual (El & Abubakr, 2019:29). Managers should recognise the efforts applied by individuals as it can lead to increased motivation and improved productivity (Giudici & Filimonau, 2019:25). One participant stated that her manager recognises her work in the organisation. The participant’s statement is as follows:

- *“My manager recognises my work.”*

- **Lack of other opportunities**

A lack of opportunities in the context of this study refers to the lack of engineering employment opportunities outside of the organisation. One participant relates her willingness to stay in the organisation to lacking other opportunities. The participant’s statement is as follows:

- *"The reason, I would say, is because it's difficult to get another job outside."*

2.10.5.2 Organisational factors that will retain women engineers in future

The factors that can positively contribute to the retention of women engineers in the selected steel organisation in future are as follow: (1) development opportunities, recognition, and rewards; (2) role models; (3) job condition and demands; and (4) trust in womens' opinion. Table 6 below indicates the theme and the number of occurrences for each theme as stated by participants.

Table 6: SRQ 4: Factors influencing women engineers' future retention within the steel manufacturing organisation.

Theme	Number of occurrences
Theme 1: Development opportunities, recognition, and rewards	38
Theme 2: Role models	11
Theme 3: Job conditions and demands	12
Theme 4: Voice and trust in a woman's opinion	36

- **Development opportunities, recognition, and rewards**

Development opportunities consider investment in the participant's career and knowledge base to foster growth opportunities (HBR, 2017). Furthermore, succession planning and the career opportunities of participants are included in the theme. Participants stated 15 times that personal development opportunities such as knowledge management platforms will contribute to retaining them in future. Four participants stated that a future career path within the organisation will positively contribute to their retention. In addition, participants mentioned fair compensation and performance recognition as factors that will retain them in future. Participants stated 19 times that financial incentives, monetary remuneration, and recognition of their work will positively influence their retention within the organisation. Some participants' statements are as follows:

- *"Invest in programs, developing programs, and leadership programs."*
- *"A career counsellor needs to have a roadmap. But on the roadmap, it tells me a from a candidate engineer or from an engineer, I can branch out into a specialist."*

- *“I would say investment in my career.”*
- *“So something that will definitely help me stay if I get fair pay for what I'm doing.”*
- *“Renumeration in terms of monetary value and benefits.”*
- *“Something that will motivate me is getting recognition for what I do.”*
- *Deliver the praise that they require when a job is well done.”*

- **Role models**

Role models are defined as a person whom someone admires and whose behaviour they want to imitate (Cambridge Dictionary, 2023b). Role models are contextualised to the organisation, and this study refers to the representation of women in engineering who have achieved success in the occupation and the organisation as perceived by the participants. Participants stated 11 times that they want to see representation of women role models in the organisation. One participant stated that she wants to see women engineers in management and understand her role model’s experiences. Some participants' statements are as follows:

- “*I want to see more representation of my role model, of my ideal.”*
- *“I want to see a woman there, and I want to understand how she experienced it in the organisation.”*
- *“I want to see more female representation.”*

- **Job conditions and demands**

Bakker and Demerouti (cited by Science Direct, 2019) define job demands as the physical, social, and psychological aspects that require an individual's physical or psychological efforts. In this study, job conditions consider the organisation’s resources, systems, and working conditions. Flexible working hours, improved management systems, sufficient resources, and a fair performance system are considered within this theme. Participants stated that improvements in these factors can positively contribute to their retention in 12 occurrences. Participants stated that sufficient resources and a fair performance system where individual performance is considered will contribute to their retention in future. Flexible working hours and work-from-home opportunities are emphasised as retention factors. Some participant statements are as follows:

- *“So something we need to improve on and that's the whole of the organisation, is how we do our financial control, so proper systems where everything speaks to each other.”*
- *“I would say manage your resources.*”
- *“You can perform at your best of your ability and it must be considered as an individual.”*
- *“Something that will motivate me is a sense of individualism.”*
- *“Flexibility in terms of times, giving you some work-from-home opportunities.”*

- **Voice and trust in a woman’s opinion**

To trust an opinion is to have confidence in the individual or to believe what a person is saying (Cambridge Dictionary, 2023c). To give a woman a voice in the organisation is to give them a speaking opportunity, trust their opinion, provide opportunities for them to lead initiatives, and challenge them professionally. It is to trust them to communicate the organisation's strategic outline and ensure they are included. Participants stated 36 times that they need a speaking opportunity and that trust in their opinion will influence their long-term retention. Improved communication and trust with organisational strategic outlines are mentioned as retention factors that will motivate participants to remain in the organisation in the long term. Some participants' statements are as follows:

- *“Give them a speaking opportunity.”*
- *“Let me lead initiatives for the group.”*
- *“Something else that will help me stay is in the long run, and I now trust is also earned, but trusting my opinion when it's given.”*
- *“I think firstly treat women with the respect in the sense to consider their inputs.”*
- *“Then there is a trust aspect, trust my opinion.”*
- *“So there's a large amount of work that's available and a lot of very challenging projects and investigations that can be done. Give it to women engineers to do.”*
- *“I feel like I would be a lot more impacted if I know what the direction of the strategy of the organisation is because I feel like we are running blind.”*

Participants rated their probability of staying in the organisation as a two out of five. Furthermore, six participants indicated that they do not know of any retention strategies

that focus specifically on women's retention in the organisation. Two participants stated that they know of a quota policy that includes women's representation in the organisation. Furthermore, seven participants stated they would consider an alternative occupation and move away from engineering within the organisational context.

2.10.6 Women engineers' self-retention factors in the organisation

Women's self-retention factors consider what women engineers in the organisation can do to retain themselves. Participants stated that the following factors can contribute to their retention within the organisation: (1) role models, (2) coaching and mentoring, and (3) social interaction platforms. Table 7 below indicates the theme and the number of occurrences for each theme as stated by participants.

Table 7: SRQ 5: Factors influencing women engineers' self-retention within the steel manufacturing organisation.

Theme	Number of occurrences
Theme 1: Role models	9
Theme 2: Coaching and mentoring	2
Theme 3: Social interaction platforms	6

- **Role models**

Role models are women who, by serving as behavioural role models and examples of what is feasible, can impact role aspirants' accomplishments, motivation, and objectives (Porter & Serra, 2020:227). Participants associated role models as women in leadership positions within the organisation in nine occurrences. Participants want to see how other women have reached a certain accomplishment and then learn from them. Some participants' statements are as follows:

- *"I want to see more female representation in that space to know that it's possible, to know that she is making it."*
- "I say, more women in management in management positions."
- "*The problem is that how are we being recognised as females in order to drive change, in order to get to high levels, where we are seeing a lack of female representation."*

- **Coaching and mentoring**

Coaching and mentoring are developmental methods centred on one-on-one conversations to improve and enhance a person's skill, knowledge, and work performance (Hilali *et al.,* 2020:42). Participants stated 12 times that coaching and mentoring would influence their organisational retention. Participants stated that stories from other women can be inspirational and that knowing how others overcame challenges might be beneficial. Some participants' statements are as follows:

- "*Ladies need a support structure on the plant. Sometimes It can even be a mentoring intervention*."
- "*Women in Engineering, I think it was, they have conferences, you go to things like that where you get to hear from other women who have been in the industry longer. Those stories are inspirational to know how did they overcame the challenges*."
- "*We can definitely coach each other in terms of how to handle certain situations."*

- **Social interaction platforms**

Social interaction is the process where people stimulate or respond to each other. It fosters social roles, rivalry, and engagement and develops interpersonal relationships (Psychology Dictionary, 2023). Six participants stated social interactions and events among women engineers as a platform that can positively relate to their retention. Participants convey that they need to share experiences. Some participants' statements are as follows:

- "*But just to point out grey areas or just have a nice chat, you know, just a coffee date every week or something like that."*
- "*I think if we can have, let's call it I'm going to call it a Friday coffee session so you force the women in the environment to get together and share experiences, good or bad, to see what solutions can there be to improve the working environment.*"
- "We are part of women in steel, but we do not really interact with each other."

2.10.7 Organisational welcoming environment retention of factors

Participants were asked if the organisation created a welcoming environment for women engineers and associated it with motivational factors to determine if they felt a welcoming environment was created. Participants stated the following differentiation factors: (1) lack of trust in a woman's opinion, (2) job demands and conditions, and (3) a male-dominant culture. Table 8 below indicates the theme and the number of occurrences for each theme as stated by participants.

Table 8: Steel organisation's environment for women engineers

Theme	Number of occurrences
Theme 1: A lack of facilities	3
Theme 2: Dirty plant environments	3
Theme 3: Harassment	2
Theme 4: Male-dominant culture	11

- **A lack of facilities**

A lack of facilities is the insufficient or absence of something required or desired (Reverso Dictionary, 2023). Bathroom facilities in the plants and in the offices are lacking. Participants stated three times that they do not have bathroom facilities on the plants for women. This requires women engineers to leave the plant and use facilities in the closest office building. Some participant statements are as follows:

- *"And there's not enough toilets. You have to walk a really long distance."*
- *"But as soon as you start going to the plant, which we typically as engineers need to be, there's no bathroom facilities."*
- *"They can improve the bathroom facilities on the plant because it is really not nice."*

- **Dirty plant environments**

The cleanliness of the plant considers how physically clean the plant is. This means it is free of dust, spare parts, and equipment. Participants stated three times that they wanted to work in a cleaner environment. Some participant statements are as follows:

- *"I think housekeeping of our plants, to invest in it."*

- *“They can give me a cleaner plant.”*
- *“Women tend to struggle in a very dirty environment.”*

- **Harassment**

Harassment, specifically sexual harassment, is the unwelcome and uninvited verbal or physical behaviour of a sexual nature towards a person (Merriam-Webster Inc., 2023b). Two participants briefly referred to harassment situations on the plants that prompted them to leave and seek alternative departments to work in. Participants statements are as follows:

- *“There are experiences of harassment and bullying.”*
- *“Harassment, you know, some whistling and some disrespectful situations by people at the plant.”*

- **Male-dominant culture**

A male-dominant culture is where men have the most influence or power (Collins Dictionary, 2023c). The feeling of being a misfit, not accepted, excluded, and a lack of women's protective equipment are considered under the male-dominant culture theme. Participants stated that they did not feel welcome on the plant on 11 occasions through factors such as their colleagues not seeming to know why they were on the plant and colleagues telling them they should not be there. Furthermore, one participant emphasised her experience to validate herself while her male counterpart was accepted immediately in the plant environment. Some participants' statements are as follows:

- *“You have to prove yourself to every person. Whereas you find with the male counterpart, he goes in there, and almost immediately he is accepted.”*
- *“The practical aspect on the field, I feel misfit, I feel that it's a misfit.”*
- *First of all, it looked like people didn't know what I was doing there, like what is she doing here?”*
- *“I worked night shifts and contractors or people inside would tell me that I shouldn't be there, I should be at the office. I should be at home and not working here.”*
- *“Even our PPE, we have to use the same PPE that men use”*

Participants rated the working environment for women engineers as two out of five on a Likert scale. Six participants stated that, in their experience, the organisation does not do much to retain women in the engineering environment. Furthermore, participants rate the plant facilities for women as two out of five. Six participants stated that the organisation has no specific policies that accommodate women, while one mentioned the organisation's maternity policy. The Women in Steel drive is identified by all eight participants, and all eight participants are part of the Women in Steel drive. This is a female-focused drive, but no participants related it to retention factors.

2.10.8 Organisational diversity retention factors

Participants were asked to emphasise factors that might differ between males and females in the organisation. To determine if participants feel that there is a distinction between male and female retention and turnover intention factors within the organisation, participants stated the following differentiation factors: (1) lack of trust in a woman's opinion, (2) job demands and conditions, and (3) a male-dominant culture. Table 9 below indicates the theme and the number of occurrences for each theme as stated by participants.

Table 9: Organisational retention factors differentiation factors

Theme	Number of occurrences
Theme 1: Lack of trust in women's opinion	16
Theme 2: Job demands and conditions	8
Theme 3: Male-dominant culture	21

- **Lack of trust in women's opinion**

Lack of trust is the lack of trust or confidence in a person (Merriam-Webster Inc., 2023c). Participants stated in 16 occurrences that a differentiation factor between males and females in the organisation is related to the lack of trust in a woman's opinion. In participants' experience, males are trusted while women engineers' opinions are not trusted. One participant stated that in her experience,, people take a male's opinion more seriously than a female counterpart's. Another stated that women

engineers' technical opinion is questioned until a male confirms it. Some participants' statements are as follows:

- *"It's again to me the trust, absolutely just trust them. Don't always question their technical opinion to a man. And then once he confirms it, then it's fine."*
- *"The experience I had, I think people will take more seriously what a man says than what a woman says."*
- *"We've got this firm belief that everything that comes out of the male's mouth is the truth."*

- **Job demands and conditions**

According to Sliter and Yuan (2015), job demands are a job's physical, social, organisational, and physical aspects. All participants stated that women face challenges in balancing family time, children, and maternity leave, which can be different for their male counterparts. One participant stated that she is too afraid to have children due to work requirements and that her male counterparts might not be facing the same concerns. Some participants' statements are as follows:

- *"Ladies have to look at the balance between family, time for children, and maternity leave, so the factors will be different than for males.*
- *Currently, one of my biggest fears at the moment whether I will be able to juggle the requirements for work with my household.*
- *I'm a young female that's actually too scared to have kids because I don't even know the timing and work requirements. I mean that's not something my male counterparts need to worry about.*

- **Male-dominant culture**

A male-dominant culture or patriarchal environment is one where males feel superior and hold power (IGI, 2023). Participants stated that they felt like a misfit and excluded and that cultural differences and the role of women in different cultures are affecting the retention of women more than that of men in the organisation. Participants stated that males are accepted and welcomed on the plant, while another stated that males form a *band of brothers.* Participants feel driven out and experience difficulties in

overcoming the role of women in different cultures in the working environment. Some participants' statements are as follows:

- *“Although new engineers also find it difficult at first, they are accepted. Because they are heard when they speak.” (Males).*
- *“They form a band of brothers.”*
- *“You do have specific cultures, specific races, that believe a woman does not have the correct opinion or enough whatever the case may be.”*
- *“I felt driven out.”*

2.11 DISCUSSION

The problem statement (Section 2.3) of this study emphasises that women are underrepresented in the engineering field and that there is an attrition of women from the engineering industry. The study aimed to explore the factors that influence the retention of women engineers at a selected steel manufacturing organisation in Gauteng, South Africa. The aim was to (1) determine whether the retention of women engineers is a cause for concern to the specific organisation, (2) determine what attracted women to engineering and the selected steel organisation, (3) determine the factors that influence women engineers’ turnover intentions, (4) determine what the organisation can do to retain women engineers, and (5) determine what women engineers in the selected steel organisation can do to retain themselves. Furthermore, the women’s perception of the organisation’s welcoming environment towards women and the differentiation factors that influence the retention of women engineers compared to their male counterparts were explored.

2.11.1 Women’s retention in the selected steel manufacturing organisation

The first study objective was to determine whether the retention of women engineers is problematic for the selected steel manufacturing organisation. Participants rated their probability of leaving on an average of four out of five. Furthermore, it is underpinned by the theory that there is a difference between individuals leaving an organisation and individuals leaving an occupation (Blau, 2007:136). Participants

indicated their intent to leave the organisation but to remain in engineering, with one exception. Therefore, the retention of women engineers in selected steel manufacturing organisations is problematic and is considered a cause for concern.

2.11.2 Factors that attracted women to engineering and the organisation

The second objective was determining what attracted women to engineering and the selected steel organisation. Four main themes emerged as the factors that attracted women to engineering: (1) women engineers showed an interest in STEM-related subjects, (2) enjoy problem-solving, (3) see engineering as an opportunity to apply theory practically, and (4) received career guidance to pursue the career or the organisation.

Women's interest or proficiency in STEM-related subjects such as mathematics, science, and chemistry became an attraction factor for women to study engineering. Participants emphasised the importance of applying theoretical knowledge in the industry and understanding how systems work, underscoring the significance of bridging the gap between academic learning and practical application. This concurs with the findings of Sithole *et al.* (2018:2), who states that women enjoy the opportunity to apply theory and solve problems practically. Family members and friends influence another member's career in many situations. As in the findings, career guidance by family members and friends influences women's decision to study engineering. Family members or acquaintances, such as fathers or neighbours working in similar roles, are motivational figures shaping career paths. Participants state that the engineering occupation is living up to their expectations.

In the determination of factors that attracted women to the selected steel manufacturing organisation, three themes emerged: (1) receiving a bursary from the organisation, (2) technical motivation, and (3) others. Bursaries are a prominent factor in attracting women engineers into a specific work field. This is a similar trend that emerged from the findings, as this was a prominent factor for many of the participants. The attraction of women in engineering through bursaries is outlined by Akpey-Mensah and Muchie (2021:1), where hard-working women are attracted to engineering through bursaries.

Technical motivation, defined as specific technical details that attract individuals to the organisation, emerges as a significant retention factor for women engineers. The complexity of plant processes and the opportunity to work for a globally recognised company are key technical motivators. The organisation's global technical team, which facilitates the sharing of technical knowledge, enables data benchmarking, and supports plant personnel, is highlighted as a compelling aspect contributing to participants' technical motivation and retention within the organisation. The global reach and prestige associated with working at a multinational organisation further strengthen women engineer's attraction towards the organisation.

The other category in the study encapsulates codes that, while not forming a specific theme, offer insights into factors influencing participants to a lesser extent. The organisation's geographical location, vacancies, and family connections were pivotal in attracting women engineers to the organisation. While these factors may not dominate the thematic analysis, they contribute nuanced perspectives to the multifaceted reasons shaping women engineers' decisions to join the organisation.

2.11.3 Factors that influence women engineers' turnover intentions

The third objective aimed to determine the factors influencing women engineers' turnover intentions within the steel manufacturing organisation. The following five main themes emerged from the study: (1) poor communication and a fear of speaking up, (2) micromanagement and a lack of trust, (3) lack of development opportunities, recognition, and rewards, (4) job conditions, demands, and company culture, and (5) workplace discrimination.

Poor organisational communication contributes to participants feeling excluded and uncertain, with the perception that people do not understand how to communicate with women in the industry. Studies by Vermeir *et al.* (2018:2), Abdien (2019:230), and Al-Tokhais (2016:2) have similar findings that indicate a lack of communication influences employees' turnover intentions. A communication gap between management and employees was identified. This creates an environment where women engineers have a fear of speaking up.

Micro-management in the organisation leads to participants feeling distrusted. Participants experience a lack of trust and feel that their voices are not heard or even silenced, which they associate with the perception that women engineers are technically inferior or disregarded to their male counterparts. Findings by Irani-Williams (2021:39), Oruh (2020:5), and Emelifeonwu and Valk (2018:228), have similar findings that relate micromanagement and the silencing of an employee's voice to turnover intentions. This gender dimension is accentuated by an expressed disregard for women's opinions on the organisation.

A lack of development opportunities, recognition, and rewards influences women engineers' turnover intentions. Participants attribute their intent to leave the organisation to an imbalance between their contribution and reciprocation, with a specific focus on compensation. The organisation's lack of self-developmental opportunities and unfair treatment motivate women engineers to seek opportunities outside the organisation. The influence of compensation on turnover intentions and lack of development is concurred by the studies of Asimah (2018:1) and Belete (2018:26).

Long working hours, work pressure, emotional drainage, and the shortage of resources are identified as job conditions and demand factors contributing to women engineers' intention to leave the organisation. Participants experience the company's culture as masculine-driven, toxic and non-constructive. Belete (2018:25) concurs that poor company culture contributes to employee turnover intention, while Arnoux-Nicolas *et al.* (2016:8) relate employees' turnover intentions to poor working conditions.

Workplace discrimination is associated with unfair job assignments, with women engineers being assigned administrative tasks that undermine their technical qualifications. This creates a sense of sense of job dejection. Furthermore, the underutilisation of women engineer's skills in positions of greater responsibility is evident. Norberg and Johansson (2020:1) emphasise women's discrimination in male-dominated industries.

Follow-up questions revealed a concerning trend among participants, with the majority expressing an intention to leave the organisation as indicated by a Likert scale rating. A noteworthy commonality among all participants is the perceived imbalance in their contributions compared to what the organisation provides, leading to heightened turnover intentions. The unanimous sentiment that participants give more than the organisation reciprocates underscores a critical issue in the work environment that warrants attention to mitigate the potential loss of women engineers.

2.11.4 Organisational factors that will retain women engineers

The fourth study objective aimed to determine what the steel organisation can do to retain women engineers. Two factors were considered: (1) what the organisation is currently doing to retain women engineers, and (2) what the organisation can do to retain women engineers. The first consideration in what the organisation is currently doing to retain women engineers emphasised five themes: (1) organisational safety initiatives, (2) technical and developmental factors, (3) managerial recognition and rewards, and (4) lack of outside opportunities.

The organisation's safety drive, supported by a structured health and safety policy, is a positive contribution towards the retention of women engineers. Participants experience technical support, technical mentorship, and technical training by the group's chief technical officers as factors that positively contribute towards their retention. Various forms of mentorship, including technical and friendship-based mentorship programs, are related to retention in the study of Nguyen (2018:1). Managerial recognition and rewards play a crucial role in fostering a positive work environment that enhances retention. Smith (2022:23) elaborates and states that there is often a lack of recognition of women engineers' work merely because they are female. Therefore, managerial recognition is emphasised as a positive retention factor. Furthermore, a participant who noted the difficulty of finding other work outside the organisation articulated the lack of alternative opportunities.

In the determination of what the organisation can do in the future, the following four main themes emerged from the study: (1) development opportunities, recognition, and

rewards; (2) role models; (3) job conditions and demands; and (4) trust in women's opinion.

The importance of developmental opportunities is emphasised by participants as a factor that will retain them in future. The significance of investing in participants' careers and knowledge development is evident, with participants emphasising the need for succession planning and a developed career path within the organisation. Personal development opportunities, particularly through knowledge management platforms, influence women engineers' retention in the organisation. Women engineers identify fair compensation in terms of monetary remuneration, financial incentives, and recognition of their work as pivotal to the organisation's retention of women engineers. These findings are concurred in the studies of Kossivi (2016:268) and Steil *et al.* (2020:147).

The participants expressed a strong desire for increased representation of women role models within the organisation and emphasised the importance of seeing women engineers in management roles. Women engineers seek to understand the experiences of their role models within the organisation. These remarks indicate the participants' need for visible role models in the organisation, demonstrating an understanding of the beneficial influence such representation can have on the retention of women engineers. The retention of women in engineering and STEM fields is associated with women role models by scholars such as Fogg-Rogers and Hobbs (2019:3) and Skvoretz *et al.* (2019:3).

Job conditions and demands related to the organisation's resources, systems and working conditions are identified as factors the organisation can improve to retain women engineers. Participants express a collective sentiment that factors such as flexible working hours, remote working opportunities, enhanced management systems, ample resources, and a fair performance evaluation system would positively contribute to their retention. Johennesse and Chou (2017:48) concur that employee retention is supported by a well-established and fair performance evaluation system, while Adebayo and Idowu (2020:24) agree that flexible working hours reduce employee stress and increase employee retention.

The participants focus on giving women engineers a voice inside the organisation and placing trust in their opinions to influence their retention. Women engineers desire to lead initiatives and understand the organisation's strategic outline. Women engineers in the organisation emphasise the importance of creating a welcoming environment where they are trusted and given technical opportunities.

There is a lack of awareness among participants related to specific women in steel retention initiatives and policies. Programmes such as the Women in Steel initiative are not positively associated with retention, while two participants only reflect on the quota system in achieving women's representation in the organisation. These findings suggest a perceived gap in awareness and effectiveness of existing retention strategies.

2.11.5 Women engineers' self-retention factors in the organisation

In the determination of factors that can contribute to the self-retention of women engineers in the organisation, three factors emerge (1) role models, (2) coaching and mentorship programs, and (3) social interaction platforms. Women engineers desire visible role models representing women engineers in managerial positions. These women engineers in management positions serve as an inspiration, proving that such accomplishments are attainable. Furthermore, participants identify coaching and mentorship programs as a retention factor that women can use to retain themselves in the organisation. Shared experiences are beneficial in providing insights for women engineers to overcome challenges. Acknowledging the potential for peer coaching within the organisation emphasises the importance of fostering a supportive network where women engineers can share experiences and collectively navigate professional challenges. The role of mentorship in retaining women engineers is concurred by Osta *et al.* (2020:9) and Jiménex *et al.* (2022:144).

Social interaction platforms among women engineers can positively contribute to the retention of women engineers in the organisation. These interactions can be formal or informal platforms. Participants desired regular informal gatherings to facilitate connections and discussions among women engineers in the organisation. Despite

being part of organisational groups like the *Women in Steel* initiative, the participants need more active and meaningful interactions within their specific organisational context. Social supporting platforms for women engineers are related to mentorship programs by Gatz *et al.* (2018:2) and Ball (2017:6). Thus, there is a relationship between social interactions and good mentorship programmes in the retention of women engineers in the organisation.

2.11.6 Steel organisation's environment for women engineers

In the determination that the organisation's environment is conducive to the retention of women engineers in plant environments, the following themes emerged: (1) a lack of facilities, (2) dirty plant environments, (3) harassment, and (4) a male-dominant culture. The steel organisation environment is explored through participants and found unwelcoming for women engineers. Inadequate and unhygienic women's bathroom facilities in the plants are practical considerations that make women engineers feel unwelcome in the organisation. Dirty plant conditions aggravate this. Furthermore, sexual harassment in the workplace by colleagues is driving participants from the plant environment towards other departments in the organisation.

The organisation's operational plant environment is experienced as a male-dominated culture, with participants describing the environment as a male-dominated culture. There is a constant need for women engineers to validate themselves while their male counterparts are readily accepted into the environment. Furthermore, women engineers feel like a misfit and are driven out of operational plant environments. Akinlolu and Haupt (2020:44) concur that most women in construction experience a masculine-gendered culture in the industry, while Gaines (2017:2) states that female engineers feel biases in male-dominant environments.

2.11.7 Organisational diversity retention factors

The following themes emerged To determine whether participants feel that there is a distinction between the factors that retain women engineers in the organisation and their male counterparts: (1) lack of trust in a woman's opinion, (2) job demands and conditions, and (3) a male-dominant culture. Women engineers perceive the retention

factors between males and females in the organisation as different. Women reiterate the lack of trust in a female engineer's opinion, while their male counterparts' technical opinion is accepted. This underpins this study's finding that women in the organisation experience a lack of trust in a woman's opinion.

Women engineers face challenges of balancing family responsibilities, children, and maternity leave, while male counterparts in the organisation might not be burdened with the same social responsibility. Gulotta *et al.* (2021:390) concur that female engineers are burdened as primary caregivers, forcing them to spread their time and energy between domestic and work responsibilities. Kahn and Ginter (2017:25), add that women are more likely to leave working environments where long hours leave less time for family responsibilities. There is a fear among female engineers in the organisation to expand their families due to a perceived inability to balance work and home responsibilities.

The environment is experienced as patriarch, where males hold superior power over that of women engineers. This male-dominant culture makes participants feel like a misfit, experiencing exclusion and difficulties in overcoming the cultural expectations regarding the role of women. Statements reflect a sense of male camaraderie, with participants noting that males are readily accepted and form a close-knit "band of brothers" on the plant. The challenge of overcoming cultural biases about women's roles is underscored, with participants expressing that acceptance and welcoming attitudes are extended more readily to male counterparts. Therefore, the organisation's environment is perceived as unwelcoming to women engineers.

2.12 CONCLUSION

This study aimed to determine whether the retention of women engineers in a selected steel manufacturing organisation in Gauteng, South Africa, is problematic with a specific focus on the factors that attracted them to engineering and the steel organisation, factors that influence their retention and turnover intentions, factors that contribute towards the self-retention of women engineers in the organisation, and the evaluation of whether the organisation creates a welcoming environment to retain women engineers. The study aimed to contribute in a theoretical, practical, and

industrial domain. In the theoretical construct, the study aimed to add to the knowledge base, while in the practical domain, the study aimed to enhance initiatives and platforms that aid in the retention of women engineers. From an organisational context, the study aimed to emphasise factors that can lead to possible changes in policies, training, networking platforms, and coaching strategies.

This study finds that the attraction to engineering and the selected steel organisation was rooted in women engineers' interest in STEM subjects, problem-solving, practical application of theory, and external influences such as career guidance. The study emphasised the role of bursaries and technical motivation as attraction factors to the selected steel organisation.

The study findings indicate that female engineers in the organisation have turnover intentions, so retaining women must be prioritised. Participants would leave the organisation instead of the engineering occupation, indicating contention with the career, not the organisation. Factors such as poor communication, micromanagement, a lack of trust in women engineer’s opinions, a perceived lack of development opportunities, recognition, and rewards, and a male-dominant culture emerged as significant contributors to turnover intentions. The gendered nature of the organisational environment is marked by a male-dominant culture that pushes women engineers from the organisation. The perceived discrimination in the male-dominant culture is emphasised by unfair job allocation that undermines the technical position of women engineers within the organisation.

Mentorship programs, social interaction platforms, increased role model visibility, safety initiatives, recognition and rewards, and developmental opportunities are retention factors that women engineers prioritise. Therefore, the organisation must create a platform where women engineers can interact with mentors, role models and other women engineers to understand their experiences.

Urgent attention is needed to address the unwelcoming features of the organisational environment, which include limited and unclean working conditions and bathrooms, harassment, and a male-dominant culture. In addition to actively fostering an inclusive and encouraging work environment, managers should try to demolish gender

stereotypes and advance gender equality. Furthermore, acknowledging the difficulties faced by women engineers in balancing work and family obligations, the research promotes flexible work schedules and family-friendly regulations.

In conclusion, by fostering a culture of diversity, equity, and inclusion, the organisation can harness the full potential of its women engineers, creating a workplace where every individual feels valued, supported, and empowered to contribute meaningfully to the organisation's success.

2.13 CHAPTER SUMMARY

This chapter structures the research study into a stand-alone article format. This study explored the retention of women engineers in a selected steel manufacturing organisation in Gauteng, South Africa. The research explored factors influencing retention and turnover intentions and women's attraction to engineering and the organisation. Furthermore, the factors influencing women engineers' self-retention within the organisation are explored. The organisation's environment is evaluated to determine if it creates a welcoming environment for women engineers. The study uses an interpretivist paradigm, employing qualitative methods and a phenomenological strategy.

The global context emphasises concerns about gender disparity in STEM fields, emphasising initiatives to increase women's representation. Research suggests that gender diversity positively impacts business innovation and societal justice. Despite these efforts, the engineering sector faces challenges with lower female representation. Although women constitute 54% of undergraduate engineering students in South Africa, only 23% enter the industry, and the workforce comprises a mere 20% of women.

The study's objectives include assessing the organisation's retention of women engineers, exploring attraction factors, and understanding turnover intentions. Primary findings indicate that the retention of women engineers in the selected steel organisation is problematic, with participants expressing a likelihood to leave the organisation while remaining in engineering. Attraction factors include an interest in

STEM subjects, problem-solving, practical application of theory, and external influences like career guidance and bursaries.

Factors influencing turnover intentions encompass poor communication, micromanagement, a lack of trust in women engineers' opinions, lack of development opportunities, job conditions, and workplace discrimination. Participants desired technical support, recognition, development opportunities, and improved retention. Suggestions for future improvement involve developmental opportunities, role models, better job conditions, and trust in women's opinions.

Women engineers seek self-retention through role models, coaching, mentorship programs, and social interaction platforms. The study emphasises challenges in the plant environment, including inadequate facilities, harassment, and a male-dominant culture. Differences in retention factors between male and female engineers, such as trust in their opinion and family responsibilities, are also noted.

In conclusion, the study recommends urgent attention to creating a more welcoming and inclusive environment, addressing issues like facilities, harassment, and gender stereotypes. By fostering a culture of diversity and equity, the organisation can maximise the potential of women engineers and contribute to a more inclusive and diverse workplace.

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CHAPTER 3 – CONCLUSION AND RESULTS

3.1 CHAPTER INTRODUCTION

This chapter serves as the concluding chapter for this study. It outlines the study questions and objectives and provides the managerial implications, recommendations, conclusion, and areas for future research. The managerial implications are considered within a societal and business context that outlines the implications of the findings on the selected steel organisation's management, while the recommendations propose solutions to concerning aspects in the findings outlined in Chapter 2 and the managerial implications. The conclusion contextualises the study findings in the context of the aim of the study.

3.2 PRIMARY AND SECONDARY OBJECTIVES

3.2.1 Primary objectives

The primary objective of this study is to explore the retention of women engineers in a selected steel manufacturing organisation in Gauteng, South Africa.

3.2.2 Secondary objectives

SO1: To determine if the retention of women engineers is problematic in the selected steel manufacturing organisation.

SO2: To determine what attracts women engineers to the steel industry and the selected organisation.

SO3: To explore the factors influencing women engineers' turnover intentions within the steel manufacturing organisation.

SO4: To determine what the selected steel organisation can do to retain women engineers.

SO5: To determine what women engineers in the selected steel organisation can do to retain themselves.

3.3 MANAGERIAL IMPLICATIONS

The managerial implications of women engineers leaving an organisation are multifaceted and necessitate careful consideration by organisational leaders. Their attrition from the organisation has financial and societal implications. The organisation attracts women engineers through bursaries and invests in the future of women engineers. The attrition of women engineers, or their increased intent to leave the organisation, results in financial losses. In addition, the emotional strain women experience influences their decision to leave. Furthermore, the organisation loses the competitive advantage that diversity brings.

The lack of organisational communication makes women engineers feel that there is a communication gap. Women engineers are further excluded from developing the organisation's strategy, making them feel unheard. This leaves them without strategic direction and with the perception that their opinion is not valued. The organisation must create an inclusive communication culture that prioritises clear communication to employees. The lack of trust in women engineer's opinions must be addressed at the plant and managerial level with mechanisms that empower women engineers, ensuring their voices are heard and valued. These women engineers must be encouraged to voice their opinions and lead initiatives.

Women engineers experience insufficient recognition and reward systems and lack managerial recognition. Managers must address potential biases and ensure that recognition is based on merit rather than gender. The participants experience an imbalance in their contribution towards the organisation and its reciprocal. Therefore, a lack of financial compensation for their contribution towards the organisation is perceived. Managers must be sensitised on the importance of recognising individual performances, while the organisation's compensation structure must be compared with industry standards. Women engineers express the desire to explore self-development opportunities, and therefore, the organisation should consider creating platforms that enable women engineers to grow in their careers.

The long working hours and pressured environment are key motivators for employees leaving the organisation. Therefore, the management team must consider the positive

impact sufficient resources will make on the retention of women engineers. Where practically possible, the organisation must offer the opportunity to work flexible hours and remotely to enhance retention. Discriminative job allocation towards women engineers undermines their technical skills and reduces the technical skills within the organisation. Managers must provide women with the opportunity to contribute towards the technical fields within the organisation, promoting diverse ideas and solutions while aiding in the retention of women engineers. This can strengthen diversity while creating an inclusive environment where women engineers feel valued and have equal opportunities for professional growth. Invest in continuous development opportunities for women engineers, including succession planning and well-defined career paths.

Women engineers state that role models, mentorship programs, improved job conditions, and trust in their opinion can positively contribute towards their retention in the organisation. Therefore, the organisation must expand its current mentorship program to include women engineers mentoring one another, and contemporary role models must be made visible. The organisation must facilitate social interactions between women engineers and their role models to allow women engineers to learn from the experiences of others. These platforms can be formal or informal but must focus on technical and friendship-based mentorship. Improved job conditions, such as sufficient resources and flexible working hours, can enhance the retention of women engineers and must be a managerial consideration.

To enhance the self-retention factors of women engineers within the organisation. The organisation must create platforms where women engineers can engage in social interactions and where informal mentorship is promoted. Although the organisation has a Women in Steel initiative, women engineers do not associate the program with retention.

To improve the unwelcoming environment for women engineers, the organisation must ensure adequate and clean bathroom facilities and ensure that women have a harassment-free working environment. There is a lack of women's bathrooms on the plants, with some plants without any bathrooms for women. Those with bathrooms became the storerooms for the cleaners as well. These factors contribute to the undervalued perception of female engineers. Management can create a harassment

reporting platform that is voluntarily anonymous. Furthermore, the male-dominant culture must be addressed by training programs that sensitise awareness about gender stereotypes. The organisation must actively work to dismantle patriarchal structures within the organization, promoting gender equality in decision-making processes and power dynamics. Implementing flexible working hours and remote working opportunities can address women's challenges in balancing their work and family responsibilities. Consider flexible working arrangements and advocate for family-friendly policies to attract and retain women engineers.

To foster a sense of belonging for women engineers, the organisation must promote a workplace culture that embraces diversity, celebrates differences, and ensures equal opportunities for career advancement.

3.4 RECOMMENDATIONS

A comprehensive set of recommendations has been formulated. Managers must address biases in the recognition and rewards system, prioritise merit over gender, and adjust remuneration structures to industry standards to address perceived disparities in the system to enhance the workplace environment for women engineers. There should be recognition of the perceived lack of compensation for women engineers and adjustments made to ensure a fair and transparent approach that values individual contributions above a generalised performance system. Actionable efforts to improve work-life balance are needed to address the negative effects of long hours and the high-pressure working environment. Typically, this includes allocating resources and implementing flexible working arrangements. Equal opportunities for women engineers in technical positions should be provided through work allocation without discrimination. It is imperative to actively encourage self-development by implementing platforms supporting ongoing education, succession planning, and clearly defined career pathways.

More role models and mentorship programs are needed to create a network that encourages and supports women engineers. Maintaining a favourable and encouraging work environment requires ongoing evaluation and improvement of working conditions. Ensuring adequate and maintaining facilities is required to create

a welcoming environment for women engineers. Using anonymous reporting systems to stop harassment can mitigate an unwelcoming environment towards women engineers. A dedication to gender equality in decision-making and awareness campaigns is essential to tearing down a male-dominant culture.

To attract and retain women engineers, family-friendly policies that support flexible work schedules and remote working options are necessary to manage work and family obligations. Cultivating a sense of belonging entails accepting diversity and endorsing programs that proactively support a welcoming and encouraging work environment. These recommendations aim to create an environment that retains women engineers and fosters professional development within the organisation.

3.5 LIMITATIONS

Although the literature review includes all women in the engineering industry, a limitation of the study is that it focuses on women in the selected steel organisation only. Therefore, the study's results may be specific to the organisation and not transferable to all women engineers or the wider industry. In addition, literature on the retention of women engineers is specifically focused on the global context and might omit the perspective of specific steel organisations. The South African context is motivated by South African statistics.

The study only focuses on the retention of females in the selected steel organisation and neglects their male counterparts. Therefore, the retention strategies of the organisation are generalised towards women’s experience, while the male counterparts may be exposed to the same experiences.

The study utilises a non-probability sampling method, and therefore, conclusions drawn from the study must be considered against the background of the population. Due to the study's cross-sectional design, the experiences of women engineers in the selected organisation may be different in the future.

3.6 CONCLUSION

This study aimed to determine whether the retention of women engineers in a selected steel manufacturing organisation in Gauteng, South Africa, is problematic with a specific focus on the factors that attracted them to engineering and the steel organisation, factors that influence their retention and turnover intentions, factors that contribute towards the self-retention of women engineers in the organisation, and the evaluation of whether the organisation creates a welcoming environment to retain women engineers. The study aimed to contribute in a theoretical, practical, and industrial domain. In the theoretical construct, the study aimed to add to the knowledge base, while in the practical domain, the study aimed to enhance initiatives and platforms that aid in the retention of women engineers. From an organisational context, the study aimed to emphasise factors that can lead to possible changes in policies, training, networking platforms, and coaching strategies.

This study finds that the attraction to engineering and the selected steel organisation was rooted in women engineers' interest in STEM subjects, problem-solving, practical application of theory, and external influences such as career guidance. The study emphasised the role of bursaries and technical motivation as attraction factors to the selected steel organisation.

The study findings indicate that female engineers in the organisation have turnover intentions. As a result, the retention of these women must be prioritised. Participants would rather leave the organisation than the engineering occupation, indicating contention with the career but not the organisation. Factors such as poor communication, micromanagement, a lack of trust in women engineer’s opinions, a perceived lack of development opportunities, recognition, and rewards, and a male-dominant culture emerged as significant contributors to turnover intentions. The gendered nature of the organisational environment is marked by a male-dominant culture that pushes women engineers from the organisation. The perceived discrimination in the male-dominant culture is emphasised by unfair job allocation that undermines the technical position of women engineers within the organisation.

Mentorship programs, social interaction platforms, increased role model visibility, safety initiatives, recognition and rewards, and developmental opportunities are retention factors that women engineers prioritise. Therefore, the organisation must create a platform where women engineers can interact with mentors, role models and other women engineers to understand their experiences.

Urgent attention is needed to address the unwelcoming features of the organisational environment, which include limited and unclean working conditions and bathrooms, harassment, and a male-dominant culture. In addition to actively fostering an inclusive and encouraging work environment, managers should try to demolish gender stereotypes and advance gender equality. Furthermore, acknowledging the difficulties faced by women engineers in balancing work and family obligations, the research promotes flexible work schedules and family-friendly regulations.

In conclusion, by fostering a culture of diversity, equity, and inclusion, the organisation can harness the full potential of its women engineers, creating a workplace where every individual feels valued, supported, and empowered to contribute meaningfully to the organisation's success.

3.7 AREAS FOR FUTURE RESEARCH

Future studies can consider the women in the steel industry rather than in a selected steel organisation. In addition, the differential retention factors between women engineers and their male counterparts are superficial. It is recommended that the retention factors between female engineers and male engineers be explored within the organisation. Future studies can also explore women engineers' retention and turnover intentions in different organisational departments.

3.8 CHAPTER SUMMARY

The primary objective of this study was to explore the retention of women engineers in a selected steel manufacturing organisation in Gauteng, South Africa. The secondary objectives included determining if retention is problematic for the selected steel

organisation, understanding factors attracting women engineers to engineering and the industry, exploring factors that influence women engineers' turnover intentions, assessing what the organisation can do to retain women engineers, and understanding factor that influence women engineers' self-retention.

Managerial implications emphasise the financial and societal consequences of women engineers leaving, urging the organisation's leaders to prioritise retention strategies. Prominent factors include communication gaps, exclusion from strategic development, insufficient recognition, long working hours, and an unwelcoming plant environment. Recommendations involve addressing biases in recognition systems, trusting a female engineer's opinion, promoting work-life balance, providing equal opportunities, and fostering a supportive workplace culture. The limitations of the study include that the study focuses on a specific organisation, potentially limiting generalisability. The research excludes male counterparts. Therefore, organisational retention factors might be similar for males as well. Future research could explore retention factors among male engineers and delve into variations across different departments.

The study concludes that attraction to engineering and the organization is rooted in STEM interests, problem-solving, and practical applications. Despite a positive outlook on the engineering profession, participants express high turnover intentions due to organisational factors. Recognition, mentorship, role models, safety initiatives, and developmental opportunities are crucial retention factors. Urgent attention is needed to address the factors that cause an unwelcoming environment and foster an inclusive work environment, promoting diversity, equity, and inclusion to harness the full potential of women engineers.

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APPENDIX A – REQUEST LETTER TO CONDUCT RESEARCH

MBA Research Study – Request and permission to conduct study in organisation

Attention: Marietjie Lotter – HR manager
From: Anika Steytler - Employee and MBA student at North-West University

This writing serves to request permission to do the following study related to the retention of female engineers within the organisation. Recent theory has indicated that gender-balanced workforce has competitive advantages within the industry. The organisation invests in the education of both male and female engineering students; however, this study aims to understand factors that influence the retention of female engineers only.

The primary and secondary research questions have been stated below with the research question. In addition, the contribution of the study is stipulated for organisational consideration. No direct reports to the student will be considered to participate in the study.

With this writing, the student and employee requests permission to conduct the study in 2023 in the organisation. As per discussion with the organisation's HR manager, the study will not mention the selected organisation's name.

1. PRIMARY AND SECONDARY OBJECTIVES

Primary objective

The primary objective of this study is to explore the retainment of women engineers in a selected steel manufacturing organisation in Gauteng, South Africa.

Secondary objectives

SO1: To determine if the retention of women engineers is problematic in the selected steel manufacturing organisation.
SO2: To determine what attracts women engineers to the steel industry and the selected organisation.

SO3: To explore the factors that influence women engineers' intent to remain in or leave the steel manufacturing organisation.

2. PRIMARY RESEARCH QUESTION

What factors influence the retainment of women engineers in a selected steel manufacturer in Gauteng, South Africa?

3. CONTRIBUTION OF THE STUDY

This study aims to contribute to understanding the retention strategies of women engineers in a selected steel manufacturing organisation. It can shed light on the factors that influence women's intent to remain within the organisation and their possible intent to leave the steel manufacturing organisation. This can lead to possible changes in organisational policies, training, networking platforms, and the working environment that can enable the steel manufacturer to retain women engineers in a positive working environment.

Should this be in order, the student requests that this request letter is signed and that a permission letter is provided to the student.

Anika Steytler

2022/10/14
Date

Plant Manager
Designation

Marietjie Lottering

2022/10/18
Date

Learning & Development
Designation

APPENDIX B – PERMISSION LETTER

From: Kleynhans, Deon DJ <Deon.Kleynhans@arcelormittal.com>
Sent: Tuesday, October 18, 2022 1:29:18 PM
To: Steytler, Anika A <anika.steytler@arcelormittal.com>
Cc: marietjie Lotter <lottermarietjie@gmail.com>
Subject: Signed permission letter

Dear Anika,

Attached please find the signed permission letter for you to conduct your research study at ArcelorMittal as part of your MBA studies. We want to which you all of the best with your study and trust that all will go according to plan.

PS. Please use this e-mail as conformation of our consent for you to conduct your study at AMSA.

Kind regards

Dr Deon Kleynhans | Resourcing, Learning, Development & Org Management
ArcelorMittal South Africa
Human Resources | Corporate Office
PO Box 2, PP 53801, Vanderbijlpark, 1900
T+27 16 889 2090 M+27 83 304 0790

APPENDIX C – NWU CHECKLIST FOR ETHICS REVIEW

Checklist to guide researchers and scientific committees on recommendations for full ethics review**.**

Economic and Management Sciences Research Ethics Committee (EMS-REC)

Application for ethics approval: New application

DOCUMENTATION INCLUDED (Please indicate the documentation included, where applicable)					
RESEARCH WITH PARTICIPANTS (Complete sections A, B and C)	**YES**	**NO**	**RESEARCH WITH NO PARTICIPANTS*** (Complete sections A, B and D)	**YES**	**NO**
Application form	◉	○	Application form	○	○
Scientific committee ethics recommendation form (SCERF)	◉	○	Scientific committee ethics recommendation form (SCERF)	○	○
Code of conduct	◉	○	Code of conduct	○	○
Approved research proposal (or similar)	◉	○	Approved research proposal (or similar)	○	○
Consent form	◉	○	Communication documents (if applicable)	○	○
Data collection tool	◉	○	Other (please elaborate below):	○	○
Communication documents (if applicable)	◉	○			
Other (please elaborate below):	○	◉			

* Research that does not involve contact with human participants, including literature reviews, publicly available data, etc.

SECTION A: RESEARCHERS' DETAILS

PROJECT HEAD/PRINCIPAL INVESTIGATOR/SUPERVISOR DETAILS					
Surname	Jackson	Name	Leon	Title	Prof.
University no.		E-mail	Leon.jackson@nwu.ac.za		
Research entity	NWU BUSINESS SCHOOL	Contact no.			
Project/study title	Exploring the retainment of women engineers at a steel manufacturer in Gauteng, South Africa.				
STUDENT DETAILS (IF APPLICABLE)					
Surname	Steytler	Name	Anika	Student no.	21710309
Contact no.	0719146317	E-mail	anika.steytler@gmail.com		

SECTION B: APPLICATION DETAILS

1. Is this research part of a project that already has ethics approval (i.e. phased research)? If yes, (a) provide a brief description of the progress to date, and (b) indicate the aspects of this application that are new to the project.	**YES**	○
	NO	◉

2. Has the data already been collected? If yes, please provide details.	YES	○
	NO	●
	N/A	○

SECTION C: RESEARCH WITH PARTICIPANTS

PARTICIPANTS		
3. Does the study involve participants who are considered vulnerable or unable to give informed consent? If yes, please elaborate.	YES	○
	NO	●
4. Will the study require permission from a gatekeeper/entity/organisation for access to the participants? If yes, please explain the nature of the access required.	YES	●
	NO	○
The study has been approved by the selected steel organistaion. The selected steel organisation will allocate a human resources gatekeeper to communicate study details to the participants and will post an electronic notification of the study on the bulliten board. (See Appendix A & B)		
5. Describe the characteristics of the participants to be included in the study by explaining: (a) who the participants are; (b) the inclusion and exclusion criteria (i.e. the characteristics that the prospective subjects must have and the characteristics that disqualify prospective subjects from inclusion in the study); (c) the recruitment and sampling strategy; and (d) the sample size.		
The participants of the study will be women engineers in the selected steel organisation and women who left the engineering occupation, but remains within the organisation. Inclusion criteria is that women engineers must have completed the candidate engineering program, and must have 2 years or more experience. Exclusing criteria is		
6. Describe the relationship between the researcher(s) and the participants and declare any conflicts of interest by the researcher(s) that might increase the risk level of the research (e.g. employee of the organisation where the study is planned, or a hierarchal relationship with participants, etc.), and the measures that will be taken to minimise the conflict of interest.		
The researcher is an employee of the selected steel organisation. A hierachal relationship with the participants is a possibility and therefore is included in the exclusion criteria. No direct employee of the researcher will be considered for the study.		
7. Please describe the nature of all contact with participants (e.g. who will have contact with the participants, what will be communicated, how will this be communicated, how will data be collected, what will the role of the researcher(s) and participants be, etc.)		
The gatekeeper will have electronic communication with the participants. This communication will be to communicate the details of the study, and to create the participation and consent form link. An independant person will anonymise the list of respondents. Interviews will be conducted by the student and through a semi-structured interview guide.		
8. What will the expected direct and/or indirect benefits and risks of this study be for participants?		
The study will focus on participants' own experience and therefore no harm towards participants are expected. The research questions are based on an uncontroversial topic, and therefore the participant's own experience will not be disputed. The risk of particpant's negative statements towards the organisation will be protected through		

17. Will the study require permission from a gatekeeper/entity/organisation for access to the data/information? If yes, please explain the nature of the access required.	YES	◯
	NO	◯
	N/A	◯
18. In the case of using secondary data, describe how data/information will be obtained from the source.		

SIGNATURE			
By signing this document, I certify that the information provided is accurate and complete.			
Principal investigator		**Date**	

APPENDIX D – NWU RISK LEVEL DESCRIPTORS

Risk level descriptors for human participants for use at the NWU (classification only).

RISK LEVEL DESCRIPTORS FOR HUMAN PARTICIPANTS FOR USE AT THE NORTH-WEST UNIVERSITY

1. INTRODUCTION

The risk level descriptors (RLDs) have been adopted from those utilised by the Faculty of Health Sciences based on the DoH 2015 guidelines. This document is not only concerned with harm to the participants themselves, but also to the researchers, community or societal interests. This document provides guidelines that are applicable across disciplines. The RECs may add specific examples applicable to their respective contexts.

2. DEFINITION OF KEY TERMS

Below terms have been extracted from DoH 2015 guidelines[1]

2.1. *Risk* is the possibility that research may cause different types of harm to any participant. For the purpose of this document a *risk* is seen as the *potential of harm occurring to a participant as a result of participation in research.*

2.2. *Harm* could be anything that has a negative effect on participant's welfare. Any research with humans must be preceded by an assessment of potential harm or inconvenience and possible benefits of the potential participant. A basic prerequisite for conducting the risk-benefit ratio analysis is a critical reflection on and deliberation about the risks and the benefits by both the researcher and the ethics committee.

2.3. *Benefits* are *direct* if it positively affects the interest or welfare of the participant, e.g. learning a new skill or service received; or *indirect* if it is to the benefit of the researcher, scientific field of knowledge or the community, e.g. improvement in policy or community programme.

2.4. Vulnerability refers to the diminished ability to fully safeguard one's own interests in the context of a specific research project. This may be caused by limited capacity or limited access to social goods like rights, opportunities and power; limited freedom to make choices; or relatively incapable of protecting own interest. Vulnerability is not an absolute condition but rather occurs on a sliding scale depending on personal or environmental circumstances

2.5. *Adverse event* refers to any undesirable or unintended response or occurrence in a research participant during research (related or not related to the research)

[1] (Department of Health. Second edition. Ethics in Health Research. Principles, Processes and Structures, 2015).

2.6. Researchers with a conflict of interest (declared) increase the risk level of the research. Conflict of interest is where a person's individual interests or responsibilities have the potential to influence the carrying out of his or her institutional role or professional obligations in research.

2.7. They have an obligation to ensure that the risks inherent in the proposed research have been reduced to the minimum necessary to achieve the research objective.

2.8. Clear measures and precautions should be in place to mitigate or avoid the potential identified risks.

3. RISK LEVELS for RESEARCH WITH ADULT PARTICIPANTS

Adjusted from: "Getting Ethics Approval for Your Research Project. Research Ethics Committee: Humanities. March 2015" University of Stellenbosch and guidance from the Department of Health. Second edition. Ethics in Health Research. Principles, Processes and Structures, 2015.

Risk Category	Definition	Explanation and/or examples
No risk	No contact with human participants, animals or environment	• Systematic reviews • Literature Review • Document analysis (e.g. in public domain)
Minimal, low or negligible risk	The potential of harm or discomfort anticipated in the research are not greater in and of themselves, than those ordinarily encountered in daily life. Research in which the only foreseeable risk is one of minimal discomfort or inconvenience. The research will collect information that would generally not be regarded as sensitive, such as opinions rather than personal information.	• There is a very small possibility of risk, if any • Market research surveys • Research on an uncontroversial topic • The study may be conducted through interviews, surveys and participant observation. • Research that focuses on opinions and/or perceptions. • Research not having any sensitive matters • This may involve interviews and surveys •
Medium risk (above minimal risk)	Research in which there is a potential risk of unexpected negative consequences, harm or discomfort, eg physical, psychological, social and environmental harm; but where appropriate steps can be taken to mitigate or reduce overall risk. Remedial actions can be undertaken should harm occur. to	The risk of harm is considered reasonable relative to the envisaged benefit of the study, e.g. new knowledge • anticipated knowledge gained. - It involves personal sensitive information rather than opinions or attitudes or a combination of these. • The information needs to be collected with personal identifiers (name, student number, etc.).

		• It involves a vulnerable or marginalized group, e.g. people living with HIV, disabled individuals, etc. It uses patient records in existing health systems • It uses laboratory test results of patients in existing health systems
High Risk	Research in which there is a real and foreseeable risk of unexpected negative consequences, harm and discomfort, and which may lead to serious adverse consequences if not managed in a responsible manner.	There is a higher possibility of various types of harm and adverse consequences. This may involve Pharmaceutical drug research. • **Research involving highly sensitive topic** • **Research involving vulnerable and marginalized communities e.g. people with multiple vulnerabilities.** • **Research investigating illegal activities among participants** • **Research involving drawing of bloods, dry blood spots, etc.** • **Research with** minors • **Research with adults** with mental incapacity • • Research that has impact on animal wellbeing • Research that has impact on the environment

APPENDIX E – INFORMED CONSENT

INFORMED CONSENT DOCUMENTATION FOR WOMEN ENGINEERS IN A SELECTED STEEL ORGANISATION

TITLE OF THE RESEARCH STUDY: Exploring the retainment of women engineers at a steel manufacturer in Gauteng, South Africa.

ETHICS REFERENCE NUMBERS: TBD,

PRINCIPAL INVESTIGATOR: Prof. L. Jackson

POST GRADUATE STUDENT: A. Steytler

CONTACT NUMBER: 082 840 1135

You are being identified to take part in a research study that aims to explore the retention of women engineers within the selected steel organisation. Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about and how you might be involved. Also, your participation is entirely voluntary and you are free to say no to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part now.

This study has been approved by the North-West University Ethics Committee of the Faculty of Economic Sciences and will be conducted according to the ethical guidelines and principles of ethical guidelines applicable to this study. It might be necessary for the research ethics committee members or other relevant people to inspect the research records.

What is this research study all about?

- This study will be conducted in a Southern Gauteng region and will involve women engineers with experience in the selected steel organisation, 12 participants will be included in this study.
- We plan to determine if the retention of women engineers in the selected steel organisation is problematic. In addition, we plan to understand the factors that attracts women engineers to the selected steel organisation and to understand the factors that influence women engineer's retention within the selected organisation.

Why have you been invited to participate?

- You have been invited to be part of this research because you are a women engineer working in the selected steel organisation.
- You also fit the research because the research focus on women that is actively working in the selected steel organisation.
- You will not be able to take part in this research if you are a direct report to the researcher and/or student.

What will be expected of you?

- You will be expected to share your retention related experiences in the selected steel organisation through a semi-structured interview.

Will you gain anything from taking part in this research?

- The gains for you, if you take part in this study, will be the opportunity to voice your opinion on the retention related experiences within the selected steel organisation.
- The other gains of the study are for the organisation and women working in the organisation to benefit from possible changes in the organisational policies.

Are there risks involved in you taking part in this research and what will be done to prevent them?

- The risks to you in this study are the fear of stating true experiences but will be limited by confidentiality and anonymity.

How will we protect your confidentiality and who will see your findings?

- The anonymity of your findings will be protected by removing your name and replace it with a number. Your privacy will be respected by not sharing any personal information and the interviews will be conducted one-on-one. The researchers will be able to look at your findings. Findings will be kept safe by locking hard copies in locked cupboards in the researcher's office and for electronic data it will be password-protected. (As soon as data has been transcribed it will be deleted from the recorders.) Data will be stored for five years.

What will happen with the findings or samples?

- The findings of this study will only be used for this study and will be reported in a mini-dissertation format that will be submitted to the NWU and the organisation. The organisation will also receive a presentation of the findings. The findings might also be published in peer reviewed journals.

How will you know about the results of this research?

- On request, we will give you the results of this research when the study has been concluded by the researcher.
- You will be informed of any new relevant findings by the researcher.

Will you be paid to take part in this study and are there any costs for you?

- This study is not funded. You will not be compensated for taking part in the study because participation is voluntarily.
- There will be no costs involved for you, if you do take part in this study.

Is there anything else that you should know or do?

- You can contact Anika Steytler at 071 914 6317 if you have any further questions or have any problems.
- You can also contact the study leader, Prof Leon Jackson at Leon.Jackson@nwu.ac.za, if you have any concerns that were not answered about the research or if you have complaints about the research.
- You will receive a copy of this information and consent form for your record.

Declaration by participant

By signing below, I the undersigned agree to take part in the research study titled: **Exploring the retainment of women engineers at a steel manufacturer in Gauteng, South Africa**.

I declare that:

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be handled in a negative way if I do so.
- I may be asked to leave the study before it has finished, if the researcher feels it is in the best interest, or if I do not follow the study plan, as agreed to.

Signed at (*place*).....…….. on (*date*) ……..…….. 20....

.....

Signature of participant

Declaration by person obtaining consent

I *(name)* ……..…… declare that:

- I clearly and in detail explained the information in this document to the participant.

- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above.
- I gave him/her time to discuss it with others if he/she wished to do so.

Signed at (*place*) ….....……...…….. on (*date*) ……..…….. 20….

.....
Signature of person obtaining consent

Declaration by researcher

I *(name)* ……..…… declare that:

- I explained the information in this document to the participant or I had it explained by …… who I trained for this purpose.
- I did/did not use an interpreter.
- I encouraged her to ask questions and took adequate time to answer them.
- or I was available should she want to ask any further questions.
- The informed consent was obtained by an independent person.
- I am satisfied that she adequately understands all aspects of the research, as described above.
- I am satisfied that she had time to discuss it with others if she wished to do so.

Signed at (*place*).....….....…….. on (*date*) ……...…….. 20....

.....
Signature of researcher

APPENDIX F – SEMI-STRUCTURED INTERVIEW QUESTIONNAIRE

Exploring the retainment of women engineers at a steel manufacturer in Gauteng, South Africa. Semi-structured interview.

Thank you for the willingness to take part in the research study. The purpose of this research study and the questionnaire is to explore the factors that influence the retention of women engineers in the selected steel organisation.
The results of this study will be formalized in a mini-dissertation that will be submitted to the NWU and to the selected steel organisation. This study will comply to the right of privacy, confidentiality and anonymity.

Participants have the right to not answering all the questions with no impact to the participant.

All data will be processed and then stored on the researcher's computer with password protection. Hardcopies will be sealed and locked in a cupboard.

On request, the participants may request a summary of the findings of this study.
All details pertaining to the study is shared in the consent form (for proposal purposes – Appendix E).

Participant number: _____ **Date:**_____

Time of interview:_____ **Duration:** _____

1. Participant demographics	**Categories**	**For office use (mark applicable)**
1.1. Participant age	20 – 30	
	31 – 40	
	41 – 50	
	51 – 60	
	60+	
1.2. Length of service in the selected steel organisation	1 – 5 years	
	6 – 10 years	
	11 – 15 years	

	16 – 20 years	
	21 – 25 years	
	26 – 30 years	
	30+ years	
1.3. Length of service in the position	1 – 5 years	
	5 – 10 years	
	10 – 20 years	
	20+ years	
1.4. Job category	Engineering	
	Management	
1.5. Qualification	Undergraduate	
	Masters degree	
	Doctoral	
1.6. Marital status	Single	
	Married	
	Divorce	
	Widow	
1.7. Number of children		

Factors that attracts women to engineering and the selected steel organisation

2. Factors that attract women to engineering
2.1. Why did you decide to study engineering?
2.2. What motivated you to study engineering?

3. Factors that attract women to the selected steel organisation
3.1. Why did you decide to work at the organisation?
3.2. What was the most attractive factor that motivated you to join this organisation?
3.3. Is that attractive motivating factor still the highest motivating factor?

3.3.1. How is that most attractive factor still motivating you to remain in the organisation?

Women engineers retention factors

4. Factors that motivate women to stay in the organisation:				
4.1. What is the probability of you staying in the organisation for the foreseeable future?				
(leave) 1	2	3	4	5 (stay)
4.2. Motivate the rating above.				
4.3. List the top 5 factors that motivate you currently to stay in the organisation.				
4.4. List the top 5 factors that will motivate you to stay in the organisation.				

Factors that influence turnover intentions

5. **Factors that motivate women to leave the organisation**:				
5.1. Do you have any intention to leave the organisation?				
Yes			No	
5.2. If yes to the question above, rate your probability to leave the organisation.				
(stay) 1	2	3	4	5 (leave)
5.3. Motivate the rating above.				
5.4. List the top 5 factors that will contribute towards you leaving the organisation.				
5.5. If you do have any intent to leave, will it be….				
out of engineering?	out of the organisation only?	out of engineering and into management		

6. Does the organisation create a welcoming environment for women?				
6.1. In your opinion does the organisation create a welcoming environment for women engineers?				
(no) 1	2	3	4	5 (yes)
6.2. Motivate the rating above.				

6.3. How does the organisation accommodate women engineers in the working environment?				
6.4. How do you rate the facilities for women engineers in the organisation?				
(poor) 1	2	3	4	5 (good)
6.5. Are you aware of any policies within the organisation that has specific reference to women? In case of yes, motivate your answer.				
6.6. Are you aware of any women in engineering related drives in the organisation? If yes, motivate your answer.				
6.7. Is there anything that the organisation can do to retain women engineers in the organisation?				

Organisational retention factors

7. What can the organisation do to retain women engineers?.	
7.1. In your opinion what can the organisation do to retain women?	
7.2. In your opinion what can the organisation do to retain women in engineering positions?	
If you had the opportunity would you stay within the engineering occupation in the organisation or would you consider alternative occupation within the organisation?	
Yes	No
What will be the reason for your answer above?	

Women engineer's own retention contribution

8. Women engineers' knowledge on current retention strategies in the organisation.
8.1. What is your opinion of the organisations current strategies to retain women engineers?
8.2. Is there anything that the organisation can do to retain women engineers in the organisation?

9. What can women do to retain themselves in the organisation.
9.1. In your opinion what can women do to improve the chances of them staying within the organisation?
9.2. What can women engineers to do improve the changes of them staying in the organisation in a engineering occupation?

Thank you for participating

APPENDIX G - DECLARATION OF LANGUAGE EDITOR

Dynamic Language & Translation Specialists

Antoinette Bisschoff
71 Esselen Street,
Potchefstroom
Tel: 018 293 3046
Cell: 082 878 5183
Language@dlts.co.za
CC No: 1995/017704/23

Friday, 24 November 2023

To whom it may concern

Re: Confirmation of language edit, typography and technical precision

The MBA mini-dissertation **"Exploring the retainment of women engineers at a steel manufacturer in Gauteng, South Africa"** by **A Steytler** (21710309) was edited for language and technical precision. Direct interview quotations from participants were spell-checked only. Referencing and sources were checked to comply with the Harvard guidelines specified by the 2020 NWU Reference Guide.

Final, last-minute corrections remain the responsibility of the author.

Antoinette Bisschoff

BA Languages (UPE – now NMU); MBA (PU for CHE – now NWU); Translation and Linguistic Studies (NWU)

Officially approved language editor of the NWU since 1998
Member of SA Translators Institute (no. 100181)

Precision ... to the last letter

APPENDIX H - DECLARATION BY RESEARCHER

NWU Business School
North-West University
Private Bag x6001
Potchefstroom, 2520
http://commerce.nwu.ac.za/business-school

SOLEMN DECLARATION – INDIVIDUAL ASSIGNMENT

Solemn declaration by the student

Module: Mini-Dissertation
Module Code: MBAC 873
Assignment No: Mini-Dissertation
Assignment due date: 27 November 2023

I, Anika Steytler, hereby declare that the thesis entitled *"Exploring the retainment of women engineers at a steel manufacturer in Gauteng, South Africa"* is my own original work and that I have not previously, in its entirety or in part submitted it at any university for a qualification.

Signature of student
Student number: 21710309
Student initials and surname: A. Steytler
Date signed: 27 November 2023