

Factors affecting the attraction of women to technical mining positions in South Africa



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Orientation: Since the advent of democracy, various laws and policies have been enacted to redress past inequalities concerning women's inclusion in mining.

Research purpose: The study aimed to investigate factors influencing women's attraction to technical positions in the South African mining industry and to also uncover what could be done to encourage their successful participation in the industry.

Motivation for the study: Despite the availability of opportunities in the mining industry, women's occupancy of technical positions is moving at a snail's pace.

Research approach/design and method: The research was conducted using a convergent parallel mixed-methods research design, with a sample consisting of women in technical mining positions and employer representatives.

Main findings: The exploratory factor analysis identified four factors as important for attracting women to technical mining positions. These were application and development value, interest value, economic value and social value. The qualitative findings revealed that the following barriers affect the inclusion of women in mining: the lack of career awareness of mining-related qualifications; the notion that mining jobs are physically demanding for women; work-life balance issues and a workplace culture in mining that is perceived as unwelcoming to women.

Practical/managerial implications: This research is significant in that it provides employers and human resource managers with information about factors affecting the attraction of women to technical positions in South Africa's mining industry and globally.

Contribution/value-add: This study contributes to the body of knowledge on women in mining, generally, and the factors attracting women to technical mining positions, specifically.

Keywords: attraction; barriers; mining industry; South Africa; technical positions; women.

Introduction

During apartheid, South Africa's law barred women from working in underground mining, as they were deemed unfit for minework (Commission for Gender Equality, 2017; Heine, 2008). Women who were employed in this industry were involved in support functions such as administration, cleaning and office assistance (Heine, 2008). Since the introduction of democracy, transformative laws and policies have been introduced to promote women's inclusion in mining. The expectation was that these laws and policies would help improve their numbers in a male-dominated industry. Despite these reforms, the mining industry experiences challenges attracting women to mining, particularly technical positions (Botha, 2014; Ledwaba, 2017).

Apart from their underrepresentation, there is a perception that women have little knowledge about existing occupations available to them in the industry, and as a result, they perceive the industry to provide more interesting and diverse occupational opportunities for men than women (Mining Industry Human Resources Council [MIHR], 2016). Women's challenges in mining are often unique to the industry and not commonly encountered by women working in gender-balanced occupations and industries (Martin, 2013). Consequently, prospective women seeking employment in mining tend to have negative perceptions of the industry's efforts to promote gender inclusivity (MIHR).

Challenges such as skills shortages, competition for talent and the lack of qualified and experienced applicants, particularly in specialised technical positions, are cited by mining organisations as other reasons attributed to the low rate of women entering the mining industry

(Hutchings et al., 2011; Moraka & Jansen Van Rensburg, 2015). This is despite the industry's reputation for high salaries, particularly mines located in remote areas (Hutchings et al., 2011; Moraka & Jansen Van Rensburg, 2015). It is against this background that the study sought to investigate factors influencing the attraction of women to technical mining positions in South Africa.

Purpose of the study

The study aimed to determine the factors that influence the attraction of women employed in technical mining positions in South Africa. The article starts with a discussion of the theoretical framework of employee attraction and factors affecting women's attraction to the mining industry. The research methodology, empirical results, findings and analysis are then presented, along with a discussion of the research results and findings. The article concludes with key conclusions and practical recommendations.

Literature review

A theoretical framework of employee attraction

The study's definition of attraction considers both individual and organisational outlooks. Attraction is defined using Berthon et al.'s (2005) and Rynes' (1989) definitions, which refer to attraction as an organisation's ability to successfully persuade prospective employees into viewing it and the work as appealing and suitable enough to cater to their needs, leading to the initiation of a work relationship.

Employee attraction can be explained using three metatheories. The first metatheory (environment processing) consists of two sets of theories: one that differentiates between the actual environment (i.e. the objective characteristics of the organisation) and the other addressing the perceived environment (i.e. individuals' subjective perceptions of the organisation based on available information) (Ehrhart & Ziegert, 2005). Interpretations of the actual environment include the heuristic-systematic model (HSM), image and signalling theories, whereas those related to the perceived environment involve the expectancy theory, the generalisable decision processing model and the exposure-attitude hypothesis. All these theories share a notion that the method in which information on a work environment is processed influences attraction (Ehrhart & Ziegert, 2005). According to the metatheory, individuals process and organise information about their knowledge of the actual environment when they are confronted with uncertainty, creating a unique perception of the environment, which leads to attraction (Ehrhart & Ziegert, 2005).

The second metatheory (interactionist processing theory) includes the interactional psychology, need-press, attraction-selection-attrition, work adjustment and employer attractiveness theories. These theories believe that attraction is a result of interaction (Åteg & Hedlund, 2011; Ehrhart & Ziegert, 2005; Rogelberg, 2016). According to interactionists, attraction results from an individual's assessment of how well they would fit into an organisation by comparing their personal traits, such

as needs and values, to those of their potential employer (Rogelberg, 2016).

The third metatheory, self-processing theory, views attraction as a function of self-perception (Åteg & Hedlund, 2011; Ehrhart & Ziegert, 2005; Rogelberg, 2016) and comprises consistency, social learning and social identity theories (Åteg & Hedlund, 2011). They consider how people's perceptions of themselves and personal traits influence the relationship between aptness and attraction (Ehrhart & Ziegert, 2005; Rogelberg, 2016).

From these theories, employer attractiveness theory was selected to provide insights into factors influencing the attraction of women employed in technical mining positions in South Africa (Mashaba, 2022). This theory was developed by Berthon et al. in 2005 and is one of the most popular theories used to explain the concept of employee attraction. According to Berthon et al. (2005), understanding the factors that contribute to employer attractiveness is critical for organisations seeking to attract employees. The factors contributing to employer attractiveness were established through their employer attractiveness scale (EmpAt). Berthon et al. derived five dimensions of employer attractiveness from the EmpAt, namely application, development, interest, economic and social values. Application value encompasses the provision of platforms that enable the application of what one would have learned at tertiary educational levels and the ability to teach that to others, as well as acceptance in and belonging to an organisation. Development value assesses the extent to which an individual considers an organisation that supports opportunities for career development and training. Interest value assesses the extent to which an individual considers an organisation that values innovation, high quality products and services and having an appreciation of innovation. Economic value is the value placed on attractive compensations and job security. Social value assesses the extent to which an individual regards a fun and exciting work environment with good collegial atmosphere as important (Arrehag & Persson, 2014; Berthon et al. 2005).

A contextualisation of women employed in technical mining positions in South Africa

The 2022 South African mining statistics reveal that women make up 18% of the mining workforce (Mining Qualifications Authority [MQA], 2022a). Most of them are employed in semi-skilled and discretionary decision-makers, followed by unskilled and defined decision-makers (26%). Skilled technical and academically qualified workers, junior management, supervisors, foremen and superintendents make up 24% of the female workforce, while professionally qualified and experienced specialists and middle management represent 7%. Senior and top management are the least represented at 1% (MQA, 2022a). These statistics show that women continue to be underrepresented in core mining positions. This is despite efforts implemented by the Mining Charter to improve women's representation in mining, not only in general but also in management positions (Republic of South Africa [RSA], 2018).

Compared to males, there are comparatively fewer females graduating with mining-related qualifications. In 2022, the Department of Higher Education and Training (DHET) reported that 9 438 students graduated with qualifications related to mining. Of these graduates, 68% (6447) were males and 32% (2991) females. Except for Geology, as shown in Figure 1, male graduates dominate five of the six listed mining-related qualifications (DHET, 2022).

Antecedents and consequences of employee attraction

Remuneration and fringe benefits

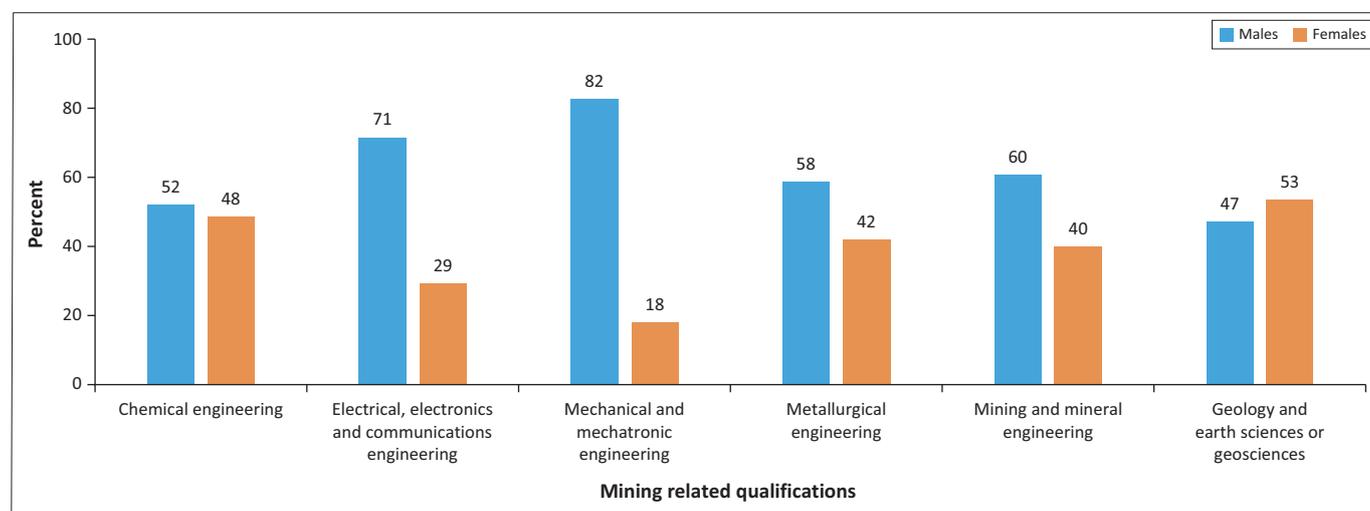
The mining industry is renowned for above-average remunerations relative to other industries (Pactwa, 2019). According to Ellix et al. (2021), one of the reasons women enter the mining industry is because of competitive remuneration offered by mining companies. Hutchings et al. (2011) state that competitive salaries, such as compensation for overtime work, bonuses, annual anniversary allowances, profit sharing, leave encashments, subsidised rent and living away from home allowances, among others, are some of the contributing sources of attraction. Mining has always been known as a high-paying industry. Previously, Rothmann and Baumann (2014) found that the perception that the mining industry offers competitive salaries and fringe benefits attracted individuals to mining. Similarly, Nyabeze et al. (2010) discovered that women's attraction to employment in mining was in part because of the industry's ability to offer competitive remuneration in the form of salaries, pensions and fringe benefits that contribute to a high quality of life. In a recent study, Ledwaba and Nkomo's (2021) study revealed that increased earning potential was a major factor leading women to seek employment in the mining industry. Research participants in the study stated that in addition to providing them with permanent employment, mining provided them with the opportunity to earn wages that enabled a high quality life.

It should be noted that while competitive remuneration and fringe benefits to some extent attract women to mining, the gender pay gap can be a deterrent to attraction. According to Ellix et al. (2021), the mining industry in South Africa has one of the highest median gender pay gaps compared to other industries. Cooper et al. (2022) in their research – titled *A Gendered Analysis of Employment and Skills in the Large-Scale Mining Sector: South Africa* – corroborated that men in mining earn more than twice as much as women. This challenge is not only unique to South Africa. Similarly, research conducted by Mining Technology (2022) and Stockholm Precision Tools (2023) revealed that on average, the United Kingdom has a gender pay gap of 17.3%, Spain 19.5% and Estonia 22.7%, indicating that generally, women in the mining industry earn less than men.

Career development opportunities

The availability of career development opportunities plays an imperative role in attracting employees (Aguenza & Som, 2012; Guest, 2014; Khabir, 2014; Ledwaba, 2017). The MQA's (2020) study on women in mining in South Africa revealed that women ventured into mining careers because of the possibility of learning new skills and the opportunity for career development. Similarly, Ellix et al. (2021) discovered that most women are drawn to the industry because of the opportunities for professional growth and career advancement. The pertinence of the provision of career development has also been emphasised by the Australasian Institute of Mining and Metallurgy (AusIMM [2009]), the Centre for Social Responsibility in Mining (CSRSM) (2006), Gibson and Scoble (2004) and Nyabeze et al. (2010), who view it as a key factor affecting the attraction of women in mining.

Furthermore, the provision of career growth and/or development opportunities may indicate an organisation's concern for the well-being of its employees, which may result in potential employees developing positive and favourable perceptions of it, thereby increasing attraction (Kumari & Saini,



Source: Department of Higher Education and Training (DHET). (2022). Directorate: Higher education management information systems: HEMIS Data Reports (Data Set[graduates]). Retrieved from <https://www.dhet.gov.za/HEMIS/Graduates/Graduates%202021/2021%20Table%202.13%20for%20all%20institutions.zip>

FIGURE 1: Percentage of graduates in mining-related qualifications by gender.

2018). In addition to career development, not only do women want to be trained or developed; they also want to pass on those skills to others. Carvalho (2018) found that women place a high value on the ability to apply what they have learned and teach it to others. Value is also placed on having a sense of belonging and concern for humanity (Carvalho, 2018). Hence, Hutchings et al. (2011) emphasise that enhancing career development opportunities particularly tertiary education and other government-related training initiatives should be one of the primary strategies for employee attraction.

Work-life balance

A work-balanced workplace is one that allows employees to balance their work responsibilities with their personal lives that is, their responsibilities and interests outside work (Almaaitah et al., 2017). Work-life balance is one of the factors affecting the attraction of women to mining. Generally, employment in mining is associated with shift work and working after hours, as mining is a continuous process and operates on a 24-hour cycle, which is divided into three 8-h shifts – morning, afternoon and night (Botha, 2017). Research conducted by Botha (2014, 2017) revealed that most women in mining (married and unmarried) are affected by shift work and working after hours. According to Lord and Eastham (2011), Mining Dot Com (2014) and Nyabeze et al. (2010), women in mining face challenges in maintaining a healthy work-life balance because of unfavourable work shifts and expectations to work overtime. In addition to the working arrangements, the locations of mines, which are commonly remote, have an impact on family-friendly work environments (Hutchings et al., 2011). The International Labour Organization (ILO) (2021) conducted research with 149 000 women in mining across 142 countries that confirmed that work-life balance and a lack of affordable care for children were among the significant challenges affecting women globally. These challenges affect how the industry is viewed from the outside, which, in turn, influences the perceptions of those who aspire to be employed in it, thereby influencing their participation rate in the industry (Fernandez-Stark et al., 2019; MIHR, 2016).

Negative gender stereotypes and workplace culture

According to the United Nations (2014, p. 1), a gender stereotype is a 'generalised view or preconception about attributes that are or ought to be possessed by women and men or the roles that are or should be performed by men and women'. Women employed in mining are subjected to negative gender stereotypes. The ILO (2021) notes that gender stereotypes accompanied by workplace cultures and structures that favour men's traditional roles and lifestyles are major challenges plaguing the mining industry. The male dominance of the industry often results in men occupying positions that reflect masculine stereotypes associated with power and authority, which exacerbate their superiority over women (Botha, 2014; Ledwaba, 2017; PwC, 2013). Because the industry is male dominated, women are perceived as lazy and lacking the capabilities and strength to perform mining jobs. As a result of this perception, there is a notion that men

make better miners than women (Benya, 2009; Khoza, 2015; Kilu et al., 2017). A male-dominated workplace culture creates biases in attracting women in mining and leads to different forms of discrimination against their employment (Ozkan & Beckton, 2012).

Previously, research conducted by Benya (2009) showed that organisational culture in mining was largely impacted by gender stereotypes that influenced perceptions of which occupations and behaviours were deemed suitable and acceptable for men and women. Women are said to be judged on their gender rather than their merit. To be taken seriously, women must work harder than men and sacrifice their femininity (Phoshoko, 2022). This assertion is corroborated by Valadares et al. (2022), who state that women must work much harder than men to demonstrate their competence in the workplace. Recent research conducted by the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) (2023) revealed that sexist biases in large-scale mining may be preventing women from entering the mining industry. In Latin American countries, for example, the existence of sexist biases is reported as an impediment to women's entry into the industry. The prevalence of macho attitudes and gendered division of labour both at work and at home are gender biases facing women in the workplace (IGF, 2022).

In addition to the aforementioned stereotypes, men's resistance to women affects their integration into the industry (Salinas, 2013). For example, Matshingane (2017) reported that men treat women unequally, with some women saying that they felt unwelcome to work underground and were not taken seriously by supervisors. These perceptions perpetuate women's exclusion and alienation and threatens their successful inclusion into the industry (Benya, 2009; Khoza, 2015; Ozkan & Beckton, 2012). As a result, the workplace cultures of the industry are viewed as barriers to the full integration of women, which diminishes the industry's attraction and discourages women from pursuing a career in mining (Botha, 2014; Ledwaba, 2017; PwC, 2013).

Hazardous working conditions and safety risks

Mine work is often viewed as physically demanding and may be jeopardised by adverse risks that can endanger employees' health and safety (Botha & Cronjé, 2015). To eliminate such risks, the *Mine Health and Safety Act (No. 29 of 1996)* establishes the responsibility for protecting the health and safety of mining employees in South Africa. In addition, the Act also regulates the elimination or minimisation of risks associated with health and safety (RSA, 1996). Although health and safety are a concern for all employees in mining, women, particularly in core mining occupations such as those working underground, face additional health and safety risks compared to men (Botha & Cronjé). The health and safety issues that primarily affect women are attributed to their physical limitations, inappropriate personal protective equipment (PPE), sexual harassment and sexual violence.

Women are built differently from men anatomically, physiologically and biochemically (Mining Safety, 2021; Zungu, 2011). For example, women have smaller body masses, different fat compositions and hormonal processes than men (Mining Safety, 2021). Therefore, they tend to experience challenges different from men (Nkomo & Balfour, 2022). According to Botha and Cronjé (2015), women working in core mining positions are disadvantaged because of their inability to work long, strenuous and physically demanding work (specifically those requiring stamina and strength) associated with these positions, resulting in physiological strain.

Furthermore, several countries with mining economic activities have policies in place to address issues of sexual harassment in mines. Because of the toxic masculine and male-dominated culture of mining, physical and sexual harassment are still prevalent risks for women, despite the existence of policies (Nkomo & Balfour, 2022). According to Mining Safety (2021), sexual harassment is a common practice in South African mines. The harassment can be direct, such as the expression of crude or explicit jokes or refusal to accept authority from women. This observation is supported by Cooper et al. (2022), who discovered in their research that women in mining are still subjected to acts of gender-based violence and sexual harassment. In Canada, Pauktuutit Inuit Women of Canada (2021) found that half of the women they had surveyed who worked in mining experienced multiple occasions of sexual harassment and violence in the workplace. Like South Africa, the most common of these harassments were in the form of 'so-called jokes, unwanted touching and emotional abuse' (Pauktuutit Inuit Women of Canada, 2021, p. 4). Moreover, the Australian Resources & Energy Group (2021) reported that Australia's mining industry had a prevalence of 40% sexual harassment compared to the national prevalence of 33%. They stated that women were more likely to have been sexually harassed than men, with an estimated 74% of women experiencing workplace sexual harassment in the past 5 years compared to 32% for men.

The aforementioned challenges have created a negative image of the industry, leading to few women pursuing careers in it (Letlape, 2014; Sohn & Lee, 2008). Given that mining is a production-driven industry, these challenges can also have psychological effects on women, leading them to perceive themselves as incompetent and lacking the necessary skills to perform their work (Matshingane, 2017). Overall, these challenges are believed to play a significant role in hindering women from entering the mining industry (Botha, 2014).

Research methodology

The research was conducted from the perspective of relational epistemology, a plural ontology, mixed-methods research design and a value-laden axiology. Relational epistemology contends that relationships in research are determined by what the researcher considers appropriate to a study. Plural ontology is based on the premise that there is no single reality, as people have different interpretations of reality. A

mixed-methods research design combines quantitative and qualitative methods in various stages of the research. Value-laden axiology seeks to conduct research that benefits people (Kivunja & Kuyini, 2017; Teddlie & Tashakkori, 2009).

A convergent parallel mixed-methods research design was employed for this study. Such a research design uses qualitative and quantitative methods concurrently. It ensures that both methodologies are equally prioritised, analysed independently, and their results and findings are combined for a unified interpretation (Creswell & Plano Clark, 2011). The use of this research design for the study provided an advantage of addressing holistic insights of the research problem and objectives. Through this approach, the researcher was able to gain a deep and comprehensive understanding of the research topic under investigation and compensate for the limitations of a single research methodology (McKim, 2017). In addition, this research design aimed to provide distinct, yet complementary data on factors affecting the attraction, engagement and retention of women in technical mining positions.

Population

A population is the total number of cases from which a sample is drawn (Taherdoost, 2016). The quantitative population comprised women employed in technical mining positions working in South African mines, while the qualitative population consisted of mining company representatives who were knowledgeable about matters related to the attraction, engagement and retention of women in technical mining positions.

Sampling

A nonprobability convenience sampling (availability sampling) technique was used for both quantitative and qualitative aspects of the study. Convenience sampling is a nonprobability sampling technique that involves selecting a sample based on their availability or attainability (Bryman, 2012; Waterfield, 2018).

Education and the position occupied by respondents were the two inclusion criteria used for the quantitative sampling. Regarding education, women were required to have a qualification in mining or a field closely related to mining that was higher than a matric (Grade 12). However, provision was made for respondents who had recognition of prior learning (RPL). Some women did not have a qualification in mining but had work experience in technical positions. Respondents with those traits were included in the study. The occupational inclusion criteria included women employed in technical positions such as geology, mining engineering, metallurgical engineering, chemical engineering, electrical engineering, analytical chemistry, mine surveying and jewellery design and manufacturing. However, women who were not employed in technical positions at the time of data collection but had prior work experience in those roles could participate in the study. These women might have transitioned to less

technical positions because of reasons such as pregnancy, injuries or other health-related issues. Women who held nontechnical positions or lacked prior work experience in technical positions or a post-matric or mining-related qualification were excluded from the study.

In addition to convenience sampling, the qualitative sampling also included purposive sampling. Purposive sampling targets participants with specific characteristics for a research study (Turner, 2019). Employer representatives knowledgeable about handling matters related to attraction within organisations were included in the qualitative sample. The researcher determined that human resource personnel were the most appropriate individuals to engage with regarding this topic, given that their work responsibilities typically include components of attraction. Employer representatives not dealing with these matters were excluded from the study.

Considering that a nonprobability sampling technique was used, the sample size could not be determined beforehand. Therefore, a total of 282 women in technical mining positions participated in the survey. Also, seeing that the questionnaire had been distributed using various channels, it could not be determined how many women, particularly those in technical positions, had received the questionnaire. Therefore, the response rate could not be determined. It can, however, be noted that the achieved sample size of 282 is comparable to previous studies that focussed on women in mining. Examples of such studies include Botha's (2014) study on 'Women in mining: a conceptual framework for gender issues in the South African mining sector', in which 156 participants were sampled. De Klerk (2012) conducted a study on 'The perceptions of the work environment of women in core mining activities', which had a sample of 100. Mangaroo-Pillay (2018) reached a sample of 165 responses in her study on 'The perceptions of women in the workplace in the South African mining industry'. For the qualitative research, a total of 11 company representatives participated in the semi-structured interviews.

Instrumentation and data collection

The quantitative research was conducted using a survey, and the qualitative research using semi-structured interviews. Two types of research instruments were used to collect data. A questionnaire was used to collect quantitative data; an interview schedule was used for qualitative data collection. Specifically, a web-based structured questionnaire employing an adapted EmpAt scale with a five-point Likert scale, ranging from 'not at all important' (1) to 'extremely important' (5), was used. The EmpAt scale is one of the most commonly used scales for measuring employee attraction (Andreasen & Reinholt, 2019; Eger et al., 2019; Reis & Braga, 2016), and the scale is considered reliable, according to Berthon et al. (2005), as the Cronbach's alpha coefficient measured 0.96. The scale consists of 25 items, of which 23 were used in the study, with the researcher incorporating two different items informed by

literature. The two additional items were added to the statements pertaining to interest value ('the location of the workplace') and social value ('an environment that enables me to balance my work and home life easily') (Mashaba, 2022).

On the other hand, semi-structured interviews were conducted using an interview schedule developed by the researcher. The interviews were conducted to elucidate the researcher's understanding of factors influencing the attraction of women to technical positions in mining from employers' perspectives. Without a preexisting database of a population of women in mining, the questionnaire was distributed using different channels through the help of various entities. Among these channels was WiMSA, which distributed the link to the questionnaire to women in technical mining positions in South Africa via their LinkedIn page; the MQA distributed it to various mines registered with them and the Minerals Council of South Africa and the National Union of Mineworkers distributed it to their members. Research participants were interviewed face to face, some through online video meeting platforms, while others opted to provide written responses. Interviews that were conducted face to face and using online video meeting platforms were audio-recorded and transcribed. In addition to the recordings, the researcher also made notes during the interviews. The interviews were conducted over a period of 1 month.

Data analysis and reporting

To give meaning to the data, quantitative data analysis involved descriptive statistics in the form of frequency distributions, means and standard deviations, multivariate analysis in the form of exploratory factor analysis and comparison tests (sample t-tests, analysis of variance [ANOVA], effect sizes and Pearson product-moment correlations). Qualitative analysis, on the other hand, was conducted through thematic content analysis. Thematic content analysis involves the identification and analysis of patterns of themes within a dataset (Wilson & MacLean, 2011).

Approaches to ensuring reliability and validity

To ensure reliability of the quantitative data, the internal consistency of the EmpAt scale was calculated using Cronbach's alpha coefficient. Cronbach's alpha coefficient should be equal to or higher than 0.70 to be considered satisfactory, as suggested by Field (2009). Factor analysis was used to determine the construct validity of the EmpAt scale, as recommended by Bryman (2012). Factor loadings with a value of more than 0.3 are considered meaningful, as suggested by Field (2009).

To establish the trustworthiness of the qualitative data, the researcher considered the criteria credibility, transferability and dependability, as suggested by Bryman (2012, p. 49) and Lincoln and Guba (1985). Different data sources were triangulated to corroborate the findings (credibility); the research findings were communicated using detailed and

thick descriptions (transferability) and the research process was clearly documented (dependability).

Ethical considerations

The Basic Social Sciences Research Ethics Committee of the Faculty of Humanities at North-West University granted permission to conduct the research (ethics number: NWU-01007-20-A7). The researcher adhered to the following ethical standards: voluntary participation, informed consent, anonymity, confidentiality, privacy, respect, no harm and protection from undue risks (Wilson & MacLean, 2011). Face-to-face data were collected following all the necessary coronavirus disease 2019 (COVID-19) protocols (e.g. permission to access the location, wearing masks, sanitising, physical distancing, safety toolkit for fieldwork, clean and disinfected equipment and self-monitoring for symptoms).

Results

A quantitative analysis

Sociodemographic information

Table 1 shows the sociodemographic results of the respondents. Although 282 respondents completed the questionnaire, some sections in the questionnaire were not entirely completed. Questionnaires containing sections that were uncomplete were not discarded but formed part of the dataset; only sections containing complete and useful information were retained.

The women who participated in the survey were employed in every province of South Africa, except the Eastern Cape. More than three-thirds of them (38.7%, $n = 109$) were working in the North-West province, and the least (1.4%; $n = 4$) were equally employed in the Free State and Western Cape, respectively. Their employment subsectors included cement, lime, aggregates and sand (CLAS), coal, diamond, gold and platinum group metals (PGMs) mining, diamond processing, jewellery manufacturing and other mining (mining of iron ore, chrome, manganese, copper, phosphates and salt). The PGM subsector had the highest employment representation (42.2%; $n = 119$), while diamond processing had the lowest (0.4%; $n = 1$).

Most of the respondents (45%; $n = 127$) were middle aged (30–39), followed by those between 20 and 29 years (32.3%; $n = 91$). About 80.1% ($n = 220$) collectively had a qualification higher than Grade 12. Most of them (20.9%; $n = 59$) had an honour's degree, followed by an advanced diploma (16.3%; $n = 46$).

Most of the respondents (64.2%; $n = 181$) indicated that they had children, were not required to work night shifts (69.9%; $n = 197$) and worked on the surface (54.6%; $n = 154$). More than half of the respondents (51.4%; $n = 145$) reported that they were single. About a third (30.5%; $n = 86$) had worked for their organisations for the past 1–3 years, while a quarter (25.9%; $n = 72$) of them were involved in a work committee.

TABLE 1: Sociodemographic information.

Item	Category	<i>n</i>	%
Province currently employed	Free State	4	1.4
	Gauteng	51	18.1
	KwaZulu-Natal	6	2.1
	Limpopo	29	10.3
	Mpumalanga	46	16.3
	North-West	109	38.7
	Northern Cape	29	10.3
	Western Cape	4	1.4
Mining subsector employed	Cement, lime, aggregates and sand	6	2.1
	Coal mining	49	17.4
	Diamond mining	13	4.6
	Diamond processing	1	0.4
	Gold mining	23	8.2
	Jewellery manufacturing	2	0.7
	Other mining (includes the mining of iron ore, chrome, manganese, copper, phosphates and salt)	65	2.0
	Platinum group metals (PGMs) mining	119	42.2
Age	20–29	91	32.3
	30–39	127	45.0
	40–49	47	16.7
	50–59	14	5.0
	60 and older	1	0.4
Highest qualification	No schooling	3	1.1
	Less than high (secondary) school	1	0.4
	Completed some high (secondary) school	4	1.4
	Standard 10 or Grade 12, NATED 3 or NCV Level 3	48	17.0
	National or Higher Certificate	16	5.7
	Advanced Certificate	8	2.8
	Diploma	25	8.9
	Advanced diploma	46	16.3
	Bachelor's degree	32	11.3
	Honour's degree	59	20.9
Duration of employment in present position (years)	Less than a year	43	15.2
	1–3	125	44.3
	4–6	41	14.5
	7–9	31	11.0
	10 or more	37	13.1
Duration of employment in the mining organisation (years)	Less than a year	32	11.3
	1–3	86	30.5
	4–6	61	21.6
	7–9	28	9.9
	10 or more	55	19.5
Duration of employment in the mining industry	Less than a year	32	11.3
	1–3	86	30.5
	4–6	61	21.6
	7–9	28	9.9
	10 or more	55	19.5
Employment at the mine	Underground	54	19.1
	On the surface	154	54.6
	Underground and on the surface	69	24.5
Requirement to work night shifts	No	197	69.9
	Yes	84	29.8
Marital status	Married	87	30.9
	Cohabiting or living together	31	11.0
	Single	145	51.4
	Separated or divorced?	18	6.4
Having children	No	100	35.5
	Yes	181	64.2

Table 1 continues on the next page →

TABLE 1 (Continues...): Sociodemographic information.

Item	Category	<i>n</i>	%
Involvement in a work committee	No	209	74.1
	Yes	72	25.5

Source: Mashaba, N. (2022). *An investigation into the attraction, engagement and retention of women employed in technical mining positions, South Africa*. Masters dissertation. North-West University, Potchefstroom

Validity and reliability of a data collection tool

As mentioned in the instrumentation section, a modified EmpAt scale was used to establish factors associated with employee attraction. This was established using an exploratory factor analysis on 25 five-point Likert-scale items measuring employee attraction.

The sampling adequacy was confirmed by the Kaiser-Meyer-Olkin (KMO) test, which yielded a measure of 0.930, which is greater than the recommended threshold of 0.7 (Child, 2006; Hair et al., 2010; Kaiser, 1974). Bartlett's test of sphericity had a *p*-value below 0.05, signifying statistical significance. This showed sufficient correlation between statements for an exploratory factor analysis (Field, 2009).

Using Kaiser's criteria, four factors were extracted (application and development value, interest value, economic value and social value), explaining 64.98% of the total variance (see Table 2).

All the statements on the four extracted factors loaded above 0.4. This exceeded the acceptable factor loading of above 0.30 (Field, 2009). According to Yong and Pearce (2013), the greater the factor, the more the variable contributes to the factor. All Cronbach alpha values for all four factors (0.827) were greater than the required threshold value of 0.7, demonstrating high levels of reliability and internal consistency.

The application and development value factor loaded nine items, with a factor mean of 4.174. The interest value factor loaded four items, with a factor mean of 4.179. The economic value factor loaded five items, with a factor mean of 4.173. With a factor mean of 4.180, the social value factor loaded seven items. These mean scores indicate that application and development, interest, economic and social values are all critical factors for attracting women to technical positions in mining.

Association between biographical variables and attracting women to technical positions in mining

Independent samples *t*-tests were conducted to ascertain the association between the requirement to work night shifts and having children and attraction. The research results are depicted in Table 3.

The results for the requirement to work night shifts showed statistically significant differences between the mean scores of the 'yes' and 'no' categories for two factors: social value ($p = 0.00$) and interest value ($p = 0.02$). Respondents who did not work night shifts scored higher on social value ($M = 4.28$) and interest value ($M = 4.26$) than those working night shifts ($M = 3.98$ and $M = 3.93$, respectively). The effect sizes ($d = 0.36$; 0.50) showed medium effects. This suggests that on average,

respondents whose jobs did not require them to work night shifts regarded social and interest values as more imperative factors affecting the attraction of women to technical mining positions than those who had to work night shifts.

In addition, interest value showed statistically significant differences between the mean scores of respondents with and without children ($p = 0.01$). Respondents without children scored slightly higher ($M = 4.34$) on interest value than those with children ($M = 4.09$), showing a small effect size ($d = 0.32$). This shows that while both cohorts (those with and without children) scored a mean above 4, those without children regarded interest value as a slightly more important factor for attracting women to technical positions in mining than those with children.

Furthermore, an ANOVA test was conducted to determine the association between marital status and attraction. The results are shown in Table 4.

The ANOVA test revealed statistically significant results for application and development value ($p = 0.02$) and interest value ($p = 0.01$). The post hoc test using Tukey B revealed that none of the group means for marital status differed significantly from one another, as all groups fell within the same homogeneous subset. Furthermore, the omega-squared effect sizes were small. Therefore, it can be deduced that the marital status of women in technical mining positions did not affect their perceptions of attraction when considering a potential employer.

The Pearson product-moment correlation coefficient was used to establish the linear association between attraction and age, highest level of education and length of employment in respondents' positions within their organisations and in mining in general (Table 5).

The Pearson product-moment correlation coefficient showed a small negative correlation between age and interest value (p -value = 0.013; $r = -0.149$), indicating that younger respondents placed greater importance on interest value than their older counterparts.

There were small positive correlations between highest qualification and application and development value (p -value = 0.02; $r = 0.143$), economic value (p -value = 0.02; $r = 0.139$) and interest value (p -value = 0.00; $r = 0.251$). It can be inferred that respondents with higher levels of education placed a greater value on application and development value, interest value and economic value as important employee attraction factors.

Small negative correlations were clear between the duration of employment in an employee's organisation and application and development value (p -value = 0.003; $r = -0.183$), interest value (p -value = 0.002; $r = -0.195$) and economic value (p -value = 0.026; $r = -0.138$). This shows that the longer a respondent had been employed by their organisation, the less likely they were to view application and development

TABLE 2: Validity, reliability and descriptive statistics of attraction.

Number	Items	Employee attraction			
		Factor 1: Application and development value †	Factor 2: Interest value ‡	Factor 3: Economic value §	Factor 4: Social value ¶
Q24	Opportunity to teach others what I have learned	0.810	-	-	-
Q23	Opportunity to apply what was learned, be it through previous training, short courses or at a tertiary institution	0.773	-	-	-
Q25	Being hands-on (active participation) in other interdepartmental work (work outside my department)	0.722	-	-	-
Q20	Gaining career-enhancing experiences	0.681	-	-	-
Q19	Feeling more self-confident as a result of working for a particular organisation	0.643	-	-	-
Q22	Humanitarian organisation – the organisation gives back to the community	0.589	-	-	-
Q21	A springboard for future employment	0.571	0.264	-	-
Q18	Feeling good about myself as a result of working for a particular organisation	0.523	-	-	-0.265
Q17	Recognition and/or appreciation from management	0.452	-	0.301	-
Q2	Innovative employer – new and forward-thinking work practices are continually introduced by the organisation	-	0.881	-	-
Q3	The organisation values and makes use of my creativity	-	0.783	-	-
Q1	Working in an exciting environment	-	0.776	-	-
Q4	The organisation produces high-quality products and services	-	0.638	0.263	-
Q16	An attractive overall compensation package, including benefits	0.320	-	0.706	-
Q15	An above-average basic salary	0.349	-	0.663	-
Q14	Job security within the organisation	-	-	0.630	-
Q5*	The location of the workplace	-0.341	-	0.607	-
Q13	Good promotion opportunities within the organisation	0.334	0.351	0.441	-
Q9	Having a good relationship with my colleagues	-	-	-	0.877
Q10	Supportive and encouraging colleagues	-	-	-	0.814
Q8	Having a good relationship with my superiors	-	-	-	0.757
Q7	A happy work environment	-	0.408	-	0.594
Q12	Acceptance and belonging	-	-	-	0.563
Q6	A fun work environment	-	0.329	-	0.420
Q11	An environment that enables me to balance my work and home life easily	-	-	0.360	0.390

Source: Mashaba, N. (2022). *An investigation into the attraction, engagement and retention of women employed in technical mining positions, South Africa*. Masters dissertation. North-West University, Potchefstroom

Extraction method: Principal component analysis.

*B2Q5 was reversed when reliability was calculated.

†, Cronbach's alpha coefficient = 0.915, Factor mean = 4.174 and Factor standard deviation = 0.723; ‡, Cronbach's alpha coefficient = 0.852, Factor mean = 4.179 and Factor standard deviation = 0.793; §, Cronbach's alpha coefficient = 0.827, Factor mean = 4.173 and Factor standard deviation = 0.789; ¶, Cronbach's alpha coefficient = 0.877, Factor mean = 4.180 and Factor standard deviation = 0.719.

value, interest value and economic value as important factors of employee attraction.

Correlations between application and development, interest, economic and social values

The Pearson product-moment correlation coefficient was also used to determine the linear association between the four factors of attraction. The results are presented in Table 6.

The results of the Pearson's product-moment correlation coefficient revealed large correlations, ranging between 0.559 and 0.719 (p -value = 0.000) between all four factors of attraction. This implies that the more respondents valued application and development value, the greater they valued interest, economic and social values as important and vice versa.

A qualitative analysis

As mentioned previously, semi-structured interviews were conducted to provide comprehensive and in-depth data on

the factors affecting the attraction of women to technical mining positions from employers' perspective.

Qualitative research participant profile

Table 7 shows the profile of employer representatives that participated in the study. Their profile is presented by the subsector in which they were employed and their occupation at the time of the study.

As stated previously, 11 employer representatives participated in the semi-structured interviews. Most of them (10) were human resources personnel and the other a rock engineer superintendent. Seven were employed in the PGMs subsector, three in other mining subsectors and one in the gold subsector.

Approaches to ensuring reliability and validity

According to Masenya (2018), the methodology used to establish validity and reliability in quantitative studies cannot be applied to qualitative studies. Rather, the quality

TABLE 3: Association between the requirement to work night shifts and having children and attraction.

Factor	Independent sample t-test				
	<i>n</i>	Mean	SD	<i>p</i> -value	Effect size
Requirement to work night shifts					
Application and development value					
Yes	81	4.07	0.82	0.17	0.20
No	197	4.22	0.67	-	-
Interest value					
Yes	82	3.98	0.99	0.02	0.36
No	197	4.26	0.68	-	-
Economic value					
Yes	81	4.09	0.91	0.33	0.14
No	197	4.21	0.73	-	-
Social value					
Yes	81	3.93	0.85	0.00	0.50
No	197	4.28	0.63	-	-
Having children					
Application and development value					
Yes	179	4.15	0.73	0.47	0.09
No	99	4.22	0.70	-	-
Interest value					
Yes	179	4.09	0.85	0.01	0.32
No	100	4.34	0.66	-	-
Economic value					
Yes	179	4.15	0.85	0.55	0.07
No	99	4.21	0.66	-	-
Social value					
Yes	179	4.15	0.73	0.31	0.13
No	99	4.24	0.70	-	-

Source: Mashaba, N. (2022). *An investigation into the attraction, engagement and retention of women employed in technical mining positions, South Africa*. Masters dissertation. North-West University, Potchefstroom

SD, standard deviation.

Cohen's *d*-values: small effect: $d = 0.2$; medium effect: $d = 0.5$; large effect: $d = 0.8$.

of a qualitative study can be established through the implementation of a trustworthiness criterion consisting of three dimensions. The first dimension of this criterion is credibility (similar to internal validity), which relates to the extent to which research findings are credible. The second dimension is transferability (similar to external validity), which seeks to establish whether findings are applicable to other contexts. The third dimension is dependability (equivalent to reliability), that is, the likelihood that the research findings will apply in other situations (Lincoln & Guba, 1985, in Bryman, 2012). These dimensions of trustworthiness were taken into consideration when conducting qualitative research.

Moreover, to ensure reliability, as stated previously, all face-to-face and online interviews were audio-recorded with each participant's consent. The recordings were supplemented by field notes that were taken during the interviews. The field notes were imperative, as they captured the researcher's thoughts and interpretations while listening to the recordings. The recordings also helped reduce bias in data analysis by allowing the researcher to reflect on conversations held during the interviews, ensuring that accurate information was captured (Halcomb & Davidson, 2006). In addition, Santos et al. (2020) highlight the importance of triangulating data sources to develop an understandable justification of themes

TABLE 4: Effect of marital status on attraction.

Factor	<i>n</i>	Mean	SD	ANOVA	Omega-squared
				<i>p</i> -value	effect size
Application and development value					
Married	86	4.10	0.64	-	-
Cohabiting and/or living together	31	3.93	1.03	-	-
Single	143	4.29	0.69	-	-
Separated	18	4.00	0.57	-	-
Total	278	4.17	0.72	-	-
Interest value					
Married	87	3.96	0.91	-	-
Cohabiting and/or living together	31	4.13	0.84	-	-
Single	143	4.33	0.70	-	-
Separated	18	4.08	0.60	-	-
Total	279	4.18	0.79	-	-
Economic value					
Married	87	4.06	0.88	-	-
Cohabiting and/or living together	31	4.10	0.96	-	-
Single	142	4.29	0.66	-	-
Separated	18	3.93	0.84	-	-
Total	278	4.17	0.79	-	-
Social value					
Married	87	4.12	0.80	-	-
Cohabiting and/or living together	31	3.97	0.96	-	-
Single	142	4.28	0.59	-	-
Separated	18	3.99	0.69	-	-
Total	278	4.18	0.72	-	-

Source: Mashaba, N. (2022). *An investigation into the attraction, engagement and retention of women employed in technical mining positions, South Africa*. Masters dissertation. North-West University, Potchefstroom

SD, standard deviation.

Omega-squared values: 0.01 = small effect; 0.06 = medium effect; 0.14 = large effect.

to further ensure reliability. In this study, qualitative data were triangulated with literature to provide more substantial support for recurring themes that emerged from the data.

The main themes derived from the qualitative data were as follows: (1) barriers to attraction; (2) measures implemented by mining organisations to ensure gender equality and (3) recommendations to attract women to technical positions. The research findings are supported by verbatim quotations from the research participants. For ethical purposes, verbatim quotes are presented with alpha numerals and subsectors (e.g., P1, PGMs [referring to participant 1, employed in PGMs]).

Barriers to attraction

According to the majority of respondents (7 of 11), a lack of career awareness about occupations and qualifications in mining is the main barrier to attracting women to mining, particularly technical positions. It was highlighted that there are not enough career awareness initiatives exposing pupils (especially those at basic education level) to and educating them about careers in mining. Owing to limited career awareness, girls are typically unaware that they can infiltrate mining professions. Below are some comments illustrating these points:

'There is a lack of knowledge at school level regarding mining occupations.' (P2, PGMs, HR assistant)

'Not sufficient mining career expos that will encourage girls to understand mining.' (P4, PMGs, HR manager)

TABLE 5: Correlations between age, highest qualification and duration of employment in mining and attraction.

Factor	Age	Highest qualification	Duration of employment in current position	Duration of employment in organisation	Duration of employment in mining industry
Application and development value					
Pearson correlation	-0.053	0.143*	-0.04	-0.183**	-0.121
Sig. (two-tailed)	0.379	0.018	0.519	0.003	0.051
N	277	273.00	274.00	259	261
Interest value					
Pearson correlation	-0.149*	0.251**	-0.11	-0.195**	-0.098
Sig. (two-tailed)	0.013	0.000	0.058	0.002	0.112
N	278	274.00	275.00	261	263
Economic value					
Pearson correlation	-0.046	0.139*	-0.06	-0.138*	-0.044
Sig. (two-tailed)	0.446	0.021	0.316	0.026	0.474
N	277	273.00	274.00	260	262
Social value					
Pearson correlation	-0.060	0.11	0.01	-0.107	-0.031
Sig. (two-tailed)	0.316	0.059	0.810	0.085	0.617
N	277	273.00	274.00	260	262

Source: Mashaba, N. (2022). *An investigation into the attraction, engagement and retention of women employed in technical mining positions, South Africa*. Masters dissertation. North-West University, Potchefstroom

Note: Small effect: $r = 0.1$; medium effect: $r = 0.3$; large effect: $r > 0.5$.

*, Correlation is significant at the 0.05 level (two-tailed); **, Correlation is significant at the 0.01 level (two-tailed);

TABLE 6: Correlations between application and development value, interest value, economic value and social value.

Factor	Application and development value	Interest value	Economic value	Social value
Application and development value				
Pearson correlation	1	0.633**	0.646**	0.719**
Sig. (two-tailed)	-	0.000	0.000	0.000
N	278	277	277	277
Interest value				
Pearson correlation	0.633**	1	0.559**	0.639**
Sig. (two-tailed)	0.000	-	0.000	0.000
N	277	279	278	278
Economic value				
Pearson correlation	0.646**	0.559**	1	0.664**
Sig. (two-tailed)	0.000	0.000	-	0.000
N	277	278	278	278
Social value				
Pearson correlation	0.719**	0.639**	0.664**	1
Sig. (two-tailed)	0.000-	0.000	0.000	-
N	277	278	278	278

Source: Mashaba, N. (2022). *An investigation into the attraction, engagement and retention of women employed in technical mining positions, South Africa*. Masters dissertation. North-West University, Potchefstroom

Note: Small effect: $r = 0.1$; medium effect: $r = 0.3$; large effect: $r > 0.5$.

*, Correlation is significant at the 0.05 level (two-tailed); **, Correlation is significant at the 0.01 level (two-tailed).

The perception that minework is labour-intensive is an additional barrier to attracting women to technical mining positions. Mining jobs are perceived as 'dirty jobs for women'. According to the research participants, women are apprehensive about performing strenuous labour. The image of mining externally, equipment and the actual work undertaken by miners can discourage individuals from pursuing careers in

TABLE 7: Qualitative research participant profile.

Research participant	Subsector representing	Occupation
Participant 1	PGMs	HR manager, senior accountant
Participant 2	PGMs	HR assistant, COVID clerk
Participant 3	Other mining and coal	Rock engineer superintendent
Participant 4	PGMs	HR manager
Participant 5	Other mining	HR officer
Participant 6	Gold	HR assistant
Participant 7	PGMs	HR assistant
Participant 8	PGMs	HR assistant
Participant 9	PGMs	HR assistant
Participant 10	PGMs	HR assistant
Participant 11	Other mining	HR officer

Source: Mashaba, N. (2022). *An investigation into the attraction, engagement and retention of women employed in technical mining positions, South Africa*. Masters dissertation. North-West University, Potchefstroom

mining. Research participants described mining working conditions as generally unfavourable, especially for women who are not accustomed to working under such conditions. The following responses demonstrate these points:

'Underground conditions which are not conducive [to] all, but women find them difficult, as they are not used to such [an] environment.' (P4, PGMs, HR manager)

'Women are scared of hard labour. So, when they look at mining, they see machinery, lifting, underground, this and that. So, it's kind of like, you can say a dirty job for a woman.' (P11. other mining, HR officer)

Women's attraction to technical mining positions is also affected by work-life balance. With mines operating 24 hours 7 days a week, with various work shifts, in addition to their work commitment, women are also burdened with domestic responsibilities, such as managing marital responsibilities or caring for their families. As a result of working shifts and 'unfriendly working hours', some women may reconsider working in the industry, as expressed below:

'The different shifts ... because we are a 24 [hours per] 7 [days we week] operation; it's something that can make a female employee to think twice before she can take up employment at the mine.' (P1, PGMs, HR manager)

'Marital responsibilities. I have to often choose between career and my family.' (P3, other mining, Rock engineer)

The research participants also mentioned that stereotypes about women's inability to perform minework affect their attraction to mining. Men in the mining industry are reportedly sceptical of women's abilities to adequately perform minework. To avoid jeopardising their own work, men are said to prefer assisting women with their work. This sentiment is expressed below:

'There's a stigma that women cannot do this job. If a lady decided to go do some jobs for that workplace, a guy would rather say, "Let me come and assist you". They are already afraid that she is not going to deliver. That's the stigma. Men don't have confidence in women to carry out work activities allocated to them.' (P2, PGMs, HR assistant)

Moreover, there are certain jobs – particularly those in underground mining – that can only be performed after

passing medical tests, as they require medical fitness. This, too, is considered a barrier to attraction, as some women fail the medical tests. This point is illustrated below:

'Certain positions, for example, you need to be medically fit to work in the mine, especially if you are going to work underground. For example, a senior rock engineer is a person that is going to work underground, and women, for example, are child-bearers; due to their DNA [*deoxyribonucleic acid*] after giving birth, it becomes difficult for women to pass a medical test. That's a critical occupation – a senior rock engineer. She started; she did her first medical in January this year. She gave it second try; now a day before yesterday [02 March 2021], she made it, but there are certain tests that must be done. So, it took me almost two months and it is going for the third month now to get that person just to pass a medical.' (P1, PGMs, HR manager)

Measures implemented by mining organisations to ensure gender equality

Most of the participants stated that their organisations had a Women in Mining Forum or a Gender Equality Forum in place. Such forums provide women with a channel to discuss matters affecting them. These matters are subsequently brought to the attention of management for remediation. Despite their positive role in the industry, the facilitation of forums in mines was criticised. The forums were criticised for their lack of visibility and sporadic meeting scheduling. However, forums were not completely responsible for this issue. One participant mentioned that the varying work shifts in mines affected the frequency of meetings, with most of them held during day shifts, excluding night shift employees by default. Taking these challenges into account, participants believed that it was necessary for women involved in these forums to develop solutions to address this issue. Furthermore, employer representatives stated that gender equality within their organisations was promoted through gender-inclusive recruitment processes. Recruitment processes are customised to attract more women to apply for listed job opportunities in the mining industry. The following comments demonstrate these points:

'You know, there's a higher-level Women in Mining Forum that is regional and national. It should, however, be taken into consideration that when the Women in Mining Forum wants to conduct a meeting, it must not be counterproductive, as this is a shift cycle. We've got morning, afternoon and night shift. So, sometimes the night shift women cannot be in the meeting because the meeting happens in the morning shift. But still, I would expect that there should be a representation from that shift so that they can take the feedback back to the underground.' (P1, PGMs, HR manager)

'Our recruitment strategy is tweaked to provide for us to bring in more females. So, for example, if I need to go and recruit a 100 equipping helpers, we make a rule to say 50% of them must be women. There is no negotiation about it. We need to go and get 50% equipping helpers which are women.' (P1, PGMs, HR manager)

Recommendations to attract women to technical positions

The employer representatives were asked to make recommendations regarding what they thought would attract women to technical positions in mining. Most of them

recommended that given that there is low awareness of professions in mining, more career awareness initiatives should be implemented at early stages of learners' schooling years to create awareness of careers in mining. Existing career awareness programmes were said to be limiting, as they mostly focus on conventional occupations, such as being a doctor, nurse, lawyer, etc. Because of this, girls are less exposed to careers in mining and unaware of opportunities available to them.

Participants also proposed that because of women's low representation in the industry, more career growth opportunities should be provided to women who are already employed in the industry. They contended that more representation of women who resembled them would motivate even more women to pursue careers in technical fields. Prospects for career advancement should be discussed with and provided to women when they first enter the industry.

One participant stressed the value of providing competitive compensation packages, implementing nongender discriminatory job requirements and making it compulsory for mining organisations to recruit women into the industry. Mining companies should examine their recruitment policies to ensure that they do not discriminate against women and ensure that they are designed to attract more women to the industry. Women's recruitment should be measured as a critical performance indicator for the organisation. Some of these recommendations were as follows:

'They need to provide more career awareness initiatives at basic education level so that learners can have more options to choose from other than the conventional occupations that they are exposed to.' (P11, other mining, HR office)

'School programmes which put emphasis on mining careers, especially from the local communities, should be in place so as to introduce mining careers to female learners.' (P11, other mining, HR office)

'Support women's career development and growth.' (P1, PGMs, HR manager)

'You need to make the recruitment of women in mining a KPI at executive level, of a mine manager, of an HOD. That must be a KPI and must be measured every year.' (P1, PGMs, HR manager)

Discussion

A mixed-methods research design was used to investigate factors affecting the attraction of women to technical positions in South Africa's mining industry. The quantitative biographical data revealed that the majority of respondents were employed in the North-West province, in the PGMs subsector. This reflects the South African mining workforce population. The PGMs subsector is the country's largest employer, with most of its ore located in the North-West. Minimal mining activities takes place in the Eastern Cape and Western Cape (MQA, 2022b).

Four factors of attraction were extracted using the EmpAt scale: application and development value, interest value, economic

value and social value. These factors confirm those of Berthon et al.'s (2005) theory. According to Berthon et al.'s (2005) theory, five factors are associated with employee attraction, namely application value, development value, interest value, economic value and social value. In this study, however, application value and development value were treated as a single factor, as respondents regarded them as complementary factors. For all factors, Cronbach's alpha coefficients showed high levels of reliability and internal consistency. All four factors scored means greater than 4, suggesting that respondents viewed all factors of attraction as important for attracting women to technical positions in mining.

The qualitative research findings confirmed the importance of development value and economic value, further emphasising the importance of having these factors in place to attract women to the industry. The provision of attractive remuneration packages, according to employer representatives, can motivate more women to infiltrate the industry. In addition, supporting women who are already employed in the industry by providing them with career growth opportunities would be advantageous, as it may inspire others outside the industry to pursue it, given that they would identify with people who resemble them.

The study's research results are in line with those of earlier studies. A recent study conducted by McKinsey and Company (Ellix et al., 2021, p. 3) among 52 countries found that women are mostly 'attracted to the mining sector by the type and variety of work it offers, the opportunities for professional growth and advancement, and the competitive remuneration'. Over a decade ago, Nyabeze et al. (2010) identified attractive salaries and benefits as one of the main factors that influenced women's decision to choose employment in mining. Eleven years later, the same factors were still perceived as relevant. Ledwaba and Nkomo (2021) discovered that prospective income was one of the major factors influencing women to seek employment in the mining industry. They stated that mines provided their employees with the opportunity to earn sufficient wages to support a high standard of living.

In addition to competitive remuneration, literature highlights the importance of the provision of career growth opportunities to enhance employee attractiveness. In their research, the MQA (2020) found that career advancement opportunities were viewed as critical factors in determining an employer's attractiveness, highlighting that the primary reason why women chose careers in mining was the possibility of learning new skills and having opportunities for growth once employed. Similar findings were highlighted by studies conducted by AusIMM (2009), CSRM (2006), Gibson and Scoble (2004), Guest (2014), Hutchings et al. (2011), Ledwaba (2017) and Nyabeze et al. (2010), who pointed out the importance of career development opportunities for women in mining to attract them into the industry.

The results of the independent samples t-tests, ANOVA and Pearson product-moment correlations revealed that night

shift work, having children, age, qualification and duration of employment in an organisation influence the attraction of women to technical positions in mining.

Furthermore, the qualitative findings revealed the following as barriers affecting the attraction of women to technical positions in mining: lack of career awareness of mining-related qualifications, perceptions of mine work as labour-intensive and physically demanding, lack of work-life balance, perceptions of mining as a male-dominated environment, male employees' reluctance to accommodate women and the requirement of medical fitness. These barriers were also widely documented in previous research conducted among women in the mining sector at a global level (Botha, 2014, 2017; Botha & Cronjé, 2015; Campbell, 2007; Letlape, 2014; Mangaroo-Pillay & Botha, 2020; Matshingane, 2017; Nyabeze et al., 2010; Women in Mining Canada, 2010).

It was enlightening to hear employer representatives assert that their organisations were making efforts to attract more women to technical roles. With the existence of Women in Mining or Gender Equality forums in mines, female employees have a platform to address workplace concerns affecting them while also networking. It is also positive that management was informed of any issues raised in these forums to devise solutions to address them. In addition to the forums, employer representatives also mentioned that they implemented gender-inclusive recruitment practices that included recruitment processes that were specifically designed to attract more women to mining and encourage them to apply for advertised positions.

Conclusion and recommendations

This research is significant in that it provides employers and human resource managers with information regarding factors influencing the attraction of women to technical positions in the South African mining industry as well as globally. From the quantitative results, it was established that application and development, interest, economic and social values are all important factors for attracting women to technical positions in mining. According to the qualitative findings, the main factors affecting the attraction of women to mining are centred around career awareness of mining as possible fields of study or employment; negative perceptions of mine work as dirty, labour-intensive and physically demanding; organisational factors such as working hours and shift work that interfere with work-life balance; perceptions of mining as a male-dominated and hostile environment and the requirement of medical fitness. Given the aforementioned, the following recommendations are made:

- Given the low awareness of mining qualifications and occupations, mining organisations are advised to develop and implement career awareness programmes in schools located both within and outside mining communities to educate people about qualifications in mining and to provide occupational opportunities to those who pursue

them. In these career programmes, it should also be communicated that the mining industry is gender-inclusive and has policies protecting women. Therefore, women should not fear to permeate the industry, as their presence may change the perception that the industry is male-dominated. This, in turn, should aid in attracting more women to mining, particularly technical roles.

- The factors that were identified as important by this research should be considered during recruitment stages and also implemented once employees are recruited.
- Human resource practitioners should construct monitoring and evaluation indicators to assess their accomplishments, shortcomings and gaps of initiatives implemented to attract women to technical mining positions.
- Mining organisations can collaborate with the academic community specialising in research on women in mining to investigate methods adopted in other countries to attract women to technical roles in mining to learn best practices that can be implemented in South Africa.

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The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

N.M. conducted the literature review as well as the empirical study and wrote the article. D.B. acted as the supervisor of the research project, assisted with the literature review and the empirical research and contributed to writing up the article.

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Data availability

The data that support the findings of this study are available on request from the author, D.B.

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