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Integrated electronic human resource management systems for front- line employees and mine safety performance

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Integrated electronic human resource management systems for front-line employees and mine safety performance

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Research Report

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ABSTRACT

The South African mining industry heavily relies on manual labour, resulting in significant risks to lives and production. Competency gaps, human behaviour, and violations are major contributors to frequent accidents. Despite the implementation of human resource management (HRM) systems, safety and productivity challenges persist, with base metals productivity declining annually by 0.3% from 2013 to 2017. Investing in competencies can enhance overall firm performance, as individual improvements lead to better team and organizational performance.

This study examined the impact of integrated electronic HRM (e-HRM) systems on safety performance in mining. It explored the relationship between e-HRM practices, employee roles, and mine safety. The research utilized SPSS and PLS-SEM tools to validate and analyze data, testing eight hypotheses within a theoretical framework that included performance management, HRM systems, and technological development. The findings showed that ability, opportunity, and motivation significantly and positively influence e-HRM practices, which in turn enhance employee roles, mine safety performance, and sustainable e-HRM systems.

Sustainable e-HRM systems were identified as mediators that enhance e-HRM practices and mine safety performance. However, the study could not substantiate the effects of employee level, firm age, and industry experience on safety performance. Limitations included the cross-sectional study design and the omission of factors like leadership and organizational culture. Despite these limitations, the study concluded that sustainable e-HRM systems improve business success by integrating sustainability plans, ethical data management, and effective technology use, fostering employee autonomy and safety.

The study suggests further longitudinal and qualitative research to evaluate the long-term sustainability of e-HRM improvements and their impact on safety performance. Comparative studies could also explore different system types and cultural variations, while investigating e-HRM's role in crisis management to reveal strategies for organizational resilience.

KEYWORDS: electronic human resource management system; competency; sustainability; operational performance; regulatory instructions; front-line employees.

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LIST OF ABBREVIATIONS AND ACRONYMS

AEHRM	Ability-enhancing e-HRM practices
AI	Artificial intelligence
AVE	Average variance extracted
B/S	Browser/server
CMV	Common method variance
CR	Composite reliability
e-HRM	Electronic human resource management
EU	European Union
FP	Firm performance
HR	Human resource
HRM	Human resource management
KMO	Kaiser-Meyer-Olkin
KPI	Key performance indicator
MD	Mahalanobis distance
MEHRM	Motivation-enhancing e-HRM practices
MHSA	Mine Health and Safety Act
NRM	Natural resource management
OEHRM	Opportunity-enhancing e-HRM practices
OLS	Ordinal least squares
PLS	Partial least squares
PLS-SEM	Partial least squares structural equation modelling
PMM	Performance measurement and management
PMMS	Performance measurement and management system
PMS	Performance management system
RBV	Resource-based view
ROI	Return on investment
SEHRM	Sustainable e-HRM systems
SEM	Structural equation model
SME	Small and medium-sized enterprises
TQM	Total quality management
VIF	Variance inflation factor
Z-MESOT	Measuring and Evaluation of Strategic and Operational Targets

1 INTRODUCTION

1.1 Background of the Study

South African mining is still reliant on manual labour and this presents a significant risk of loss of lives and loss of production resulting from production stoppages related to legal instructions issued in terms of the Mine Health and Safety Act (MHSA) (Mine Health and Safety Council, 2018) and compromised safety incidents. The number of fatalities in the South African mining sector increased from 60 in 2020 to 74 in 2021, a 23% increase from 2020 (Minerals Council of South Africa, 2022).

Most of the deaths in the mining environment are experienced by front-line employees. Investigations into most of the incidents, injuries, deaths and issued instructions in the mining industry reveal competency to be the main deficiency in front-line employees. A study on the causes of fatalities in the South African mining industry has shown that human behaviours, especially violations, are the main reasons for accidents (Bonsu et al., 2017).

Furthermore, the productivity index shows that the productivity of the South African mining industry in base metals declined by 0.3% per year from 2013 to 2017 as compared to other mining industries on other continents such as Asia, North America and Oceania; these continents increased productivity by 5% in the same period (Goodman, 2019).

Competency in mining is critical in ensuring that employees are skilled to perform tasks safely and the MHSA instructs that employers should provide employees with training to ensure they can conduct their activities safely (Mine Health and Safety Council, 2018). In addition, competency in conducting work improves the productivity of the employees. Using the regression model, Korenková and Lis (2019) found that when the competency rate of an employee is higher than that of other employees, an employee with higher competency performs from 7 to 12.5% higher.

Competency is not a once-off event in which, once employees are onboarded, management can assume that the employees will remain competent throughout the lifecycle period of their employment. Mining organisations have allocated the responsibility of ensuring competency to human resources (HR) to manage

recruitment, onboarding, training and refresher training during the employment period. When a department expected to manage this function exists, one needs to question why there are still employees either not competent or with expired licences in the organisation; such issues result in organisational losses and reputational damage.

Understanding how the HR department oversees the competency process amid other HR activities throughout the employee's lifetime in the company is crucial to answering the question. Lepak and Snell (2009) The following HR practices should be defined: performance management, job security, employee voice, teams, incentives, remuneration, training and development, recruitment, selection, job analysis, and career development procedures (Boon et al., 2019). To manage the above practices and their interactions with one another, Darwish et al. (2013) have identified different systems for examining them. One of the systems focuses on the interactions between different HR practices to form a system (Boon et al., 2019).

The need to enhance and encourage e-HRM practices and assist with the construction of a sustainable e-HRM (SEHRM) system was stated by Chowdhury et al. (2021). Additionally, they claimed that e-HRM solutions enhance business performance. The study's shortcomings included its narrow focus on the manufacturing industry which meant that it could not be generalised for the mining industry which is highly regulated and faces complexities in competency for conducting safe productive operations.

The study's conclusions by Chowdhury et al. (2021) about the relationship between competency and performance showed that when competency levels rise, company performance rises as well (Korenková & Lis, 2019). However, the study did not focus on competencies within the different hierarchical levels of organisations. Their study recommended further research on competency and performance as they argued that investing in competencies improves firm performance (FP) (Korenková & Lis, 2019).

1.2 Research Problem

Korenková and Lis (2019) indicate that as the competency of individuals improves, the performance of the individual also improves. Individual performance improvements lead to overall team performance improvements and in turn the organisation’s performance. Chowdhury et al. (2021) demonstrated through their study in manufacturing that SEHRM improves organisation performance. However, the above

theoretical knowledge available has not been explored in the mining industry where the regulations are much stricter, hence, mining organisations are still experiencing a high number of fatalities and loss in production either from low productivity, incidents caused by stoppages and related regulatory instructions due to gaps in the competency of front-line employees.

A study on the number of work related deaths in South African mining has shown that human behaviours, especially violations, are the main reasons for accidents (Bonsu et al., 2017). Mining organisations have implemented human resource management (HRM) systems for recruitment, upskilling of employees, motivation etc. However, safety is still a challenge in mining and productivity has dropped when compared to other mining industries.

1.3 Research Questions

The primary aim of the study was to identify the impact of integrated e-HRM systems on the safety performance of front-line employees.

The following secondary questions were posed to answer the primary question of the study:

1. What is the relationship between ability-enhancing e-HRM (AEHRM), opportunity-enhancing e-HRM (OEHRM) and motivation-enhancing e-HRM (MEHRM) practices on SEHRM systems?
2. What is the relationship between AEHRM, OEHRM and MEHRM practices and employee role or level?
3. What is the relationship between SEHRM systems and mine safety performance?
4. What is the relationship between SEHRM systems and employee roles or levels?

The study looks into how integrated e-HRM systems affect front-line employees' performance in terms of safety, with the goal of addressing safety issues and boosting productivity in the mining sector. The goal of the research was to obtain knowledge that will help develop tactics for raising productivity, boosting safety, and maximising organisational performance. The secondary research questions contribute to the body

of knowledge on HRM procedures and safety management in the mining industry by offering a thorough grasp of the dynamics at work and producing practical recommendations.

1.4 Research Purpose

The purpose of this study was to comprehend the effects of integrated e-HRM systems on the safety performance of front-line employees. This was achieved by answering the four secondary questions on how e-HRM operational, relational (competency) and transformational (performance management and development) categories impact mine safety performance. Mine safety performance in this context is measured in the safety of employees, legal compliance with safety regulations on employee competency and safety incidents.

Keywords in the research include digitisation, HRM system, competency, sustainability, operational performance, regulations and regulatory instructions and front-line employees.

1.5 Rationale

South African mining sector fatalities increased from 60 in 2020 to 74 in 2021, a 23% incline from 2020 (Minerals Council of South Africa, 2022). Safety incidents impact a mine's productivity and have a reputational impact on mining organisations. Chowdhury et al. (2021) demonstrated through their study in manufacturing that the relational, operational and transformational e-HRM categories of SEHRM improve FP.

Korenková and Lis (2019) indicated that performance improves when employee competency levels improve. Their study was conducted in the manufacturing sector, hence, the need for this study to focus on mining's front-line employees where most safety incidents occur. A study on the causes of fatality has shown that human behaviours (violations) are the main reason for accidents in South African mining (Bonsu et al., 2017).

Furthermore, the productivity index in South African mining has been declining (Goodman et al., 2019). This study will help mining managers and HR practitioners either through validation of the criticality of integrated systems or through recommendations for improvements on systems to improve mine safety performance.

The outcome of the research can be utilised by policymakers to improve mining industry safety performance and by HR practitioners to roll out HRM systems.

1.6 Delimitations of the Study

The scope of this research was on SEHRM systems. Even if artificial intelligence (AI) is developing in the mining industry, the majority of mining organisations are not yet developed enough to transition. Many topics are covered in e-HRM systems, however, the emphasis of this study was on the relational and transformational aspects of e-HRM systems, expressly on competencies, with a specific focus on recruitment, training, licensing and refresher training – aspects often emphasised by mining regulators and performance management evaluators. The study also focused on front-line employee management and excluded other levels in the hierarchy of mining organisations as it is mostly these employees who are involved in most safety incidents.

1.7 Definition of Terms

The following terms are defined in this section:

Competency: The sufficient training or knowledge, experience and skills which qualify a person to conduct an activity.

e-HRM: Al-Harazneh and Sila (2021) define e-HRM as the use of technological systems to achieve HR functions.

Front-line employees: Employees dealing with production, e.g. operators and artisans, and their immediate supervisors.

Operational performance: This refers to the safety performance of the mine.

Regulatory instruction: Any notification, judgement or order made or granted according to the MHSA (Mine Health and Safety Council, 2018).

1.8 Assumptions

The research focused on responses from the employees of mining organisations and contractors. Participation in the research was voluntary and the sample size was small due to time and resource constraints.

1.9 Conclusion

Mining organisations suffer major losses as a result of safety issues and production stoppages at mines. Analysis conducted on the causes of incidents indicates that they are mainly behaviour-related. In addition, the productivity index for mining has regressed compared to similar sectors on other continents. The above problems indicate deficiencies in HR management.

A study conducted in the manufacturing sector indicated that performance increased when competency was improved. The implementation of e-HRM systems has seen performance improvement in organisations in Europe. This study aimed to determine the impact of the e-HRM system in the mining industry with a specific focus on front-line employees.

2 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

In this section, the literature was reviewed with a focus on comprehending data regarding how HR systems affect business performance. The intention was to establish an understanding of findings made by researchers on the topic, in similar and or different industries and to establish gaps related to the study topic. Determining the effect of integrated e-HRM systems on the mine safety performance of front-line staff is the purpose of the study.

The literature was also reviewed to create a conceptual framework that was used to develop secondary questions to help the study answer the primary question of the research. In finding available literature on the topic, the Google Scholar search engine and Science Direct database were utilised with search words including HRM systems, HR integrated systems and the impact of HR systems on mine safety performance.

2.2 Background and Definitions

The assertion that human resources (HR) are pivotal to operational performance is well-founded, especially in industries with high safety risks like mining. Zeng and Qi, (2021) argue that effective HR management can significantly enhance operational performance by integrating HR information. However, many organizations continue to rely on traditional, manual methods for HR management, which can hinder their ability to fully leverage their workforce's potential.

In South Africa's mining sector, the reliance on manual methods for both HR management and operational activities, such as mineral extraction, underscores a critical gap. Modernising HR practices in this sector is essential to meet strategic objectives and improve efficiency. The integration of HR information systems (HRIS) could streamline processes, improve data accuracy, and enhance decision-making capabilities.

The importance of HR in safety performance is highlighted by Zhang et al. (2020) and Zujovic et al. (2021). Zhang et al. (2020) study on coal mine accidents in China identifies human error, non-compliance with safety regulations, and inadequate safety education as primary causes of incidents. These findings emphasize the need for

rigorous safety training and adherence to safety protocols, which are crucial areas for HR intervention.

Zujovic et al. (2021) further emphasize the role of training, specifically for equipment operators, in enhancing safety and reducing accidents. They argue that well-trained operators who understand how to safely handle equipment are vital for maintaining a safe working environment. This responsibility falls on HR professionals and management to ensure that training programs are comprehensive, up-to-date, and regularly refreshed to prevent complacency among workers.

Somarathna (2020), delves into the complexity of HR management, noting that the interaction between various HR practices is nonlinear and dynamic. This complexity can make it challenging for managers to understand and optimize these interactions without the aid of sophisticated HRM systems. Such systems can integrate various metrics from HR practices, aiding in more informed decision-making.

The synthesis of these studies suggests a clear connection between effective HR management and improved safety performance in mining operations. The recruitment and continuous training of employees, particularly in safety procedures and equipment operation, should be a priority for HR professionals. This not only ensures a safer working environment but also enhances overall operational efficiency

In summary the above literature reveals that the integration of modern HR practices and systems is essential for improving safety and operational performance in the mining sector. By leveraging HRIS and focusing on comprehensive training programs, mining organizations can better meet their strategic objectives and reduce the incidence of accidents. This holistic approach to HR management can transform traditional practices, leading to a more efficient and safer mining industry.

2.3 Empirical Review of Literature

Emerging themes within the study's framework were found. This section goes over these themes. HRM and its integration through systems and the impact of a well-implemented management system on mine safety performance were reviewed in the literature. In addition, how organisations utilise performance management and

available technologies to manage HR was reviewed. The literature considered in this study was grouped into themes as shown in Table 1.

Table 1: Literature Matrix

Theme	**#**	**References**	**Research Gaps**
HR Performance Management	4	Carden et al., 2021; Garengo et al., 2022; Ho & Kuvaas, 2020; Korenková & Lis, 2019	• Frameworks have not been tested in practice and their impact has not been measured. • The relationship between HRM systems and firm-based performance has been demonstrated based on a cross-sectional analysis; however, a longitudinal investigation may show a causal relationship.
HR Management Systems	11	Arifin et al., 2022; Boon et al., 2019; Chen & Cui, 2022; Chowdhury et al., 2021; Hu et al., 2022; Somarathna, 2020; Wang, 2022; Xie, 2022; Zeng & Qi, 2021	• Most studies focused on the theoretical application and missed an opportunity for practical confirmation or validation by the HR professional. • The majority of the research papers addressed the application of the developed models, however, not much focus was given to the impact of firm performance and business case for the implementation. • Gaps in the literature include understanding why HR systems impact the outcomes of a firm and an understanding of the systems of different types of firm's outcomes.
Technology and AI in HR Management	3	Chowdhury et al., 2023; da Silva et al., 2022; Votto et al., 2021	• The study excluded sustainability, which has a potentially negative impact in contexts such as mining where there is high disruption and connectivity is still in the infancy stage.

Theme	#	References	Research Gaps
			• The study did not confirm why other organisations failed to get the anticipated benefits from the implementation of the HRM system and missed an opportunity to validate findings by HR professionals.

2.3.1 Human resource performance management

Carden et al. (2021) identified an approach for the classification of HRs at the beginning of their project, using augmented change requests to support organizations in managing HRs to improve the success rate of completing projects. This approach aimed to enable project managers to identify teams who should be part of projects. However, they found shortcomings in their study, including insufficient testing of the research and measuring the impact on project success. This highlights a critical gap in empirical validation, suggesting that while the theoretical framework may be sound, its practical effectiveness remains uncertain.

Furthermore, Carden et al. (2021) stressed the need to determine HR practices critical for the successful completion of projects. Projects are often short-lived with clear performance metrics concerning quality, time, and cost. In their research, which leaned heavily on the successful completion of projects, insights were provided on how to onboard and train employees quickly to develop the necessary competencies for project completion. However, some projects do not face the sustainability challenges that other operational firms do, indicating a potential misalignment when applying these insights to industries with different operational dynamics, such as mining.

In contrast, the performance measurement and management system (PMMS) of an organization, as defined by Darwish et al. (2013),integrates performance indicators for both tangible and intangible assets. Such a system provides feedback on employee activities and their progress toward firm objectives. Marr and Adams (2004) and Neely et al. (2001) argue that HRM, considered an intangible asset, is crucial for management to enhance a firm's competitiveness. This perspective emphasizes the

strategic value of HRM in fostering organizational performance, aligning more closely with sustainable operational goals.

Garengo et al. (2022) highlight a gap in studies on organizational PMM models, confirming the importance of HRM in PMM processes. They provide theoretical and practical steps for integrating these processes, offering a conceptual framework for aligning HRM and PMM to improve firm performance. Their encouragement of case studies to test and validate this framework underscores the need for empirical evidence to support theoretical models, a point that aligns with the shortcomings identified by Carden et al. (2021). . Garengo et al. (2022) offer a theoretical foundation for the alignment and integration of HRM and PMM to improve a firm's performance.

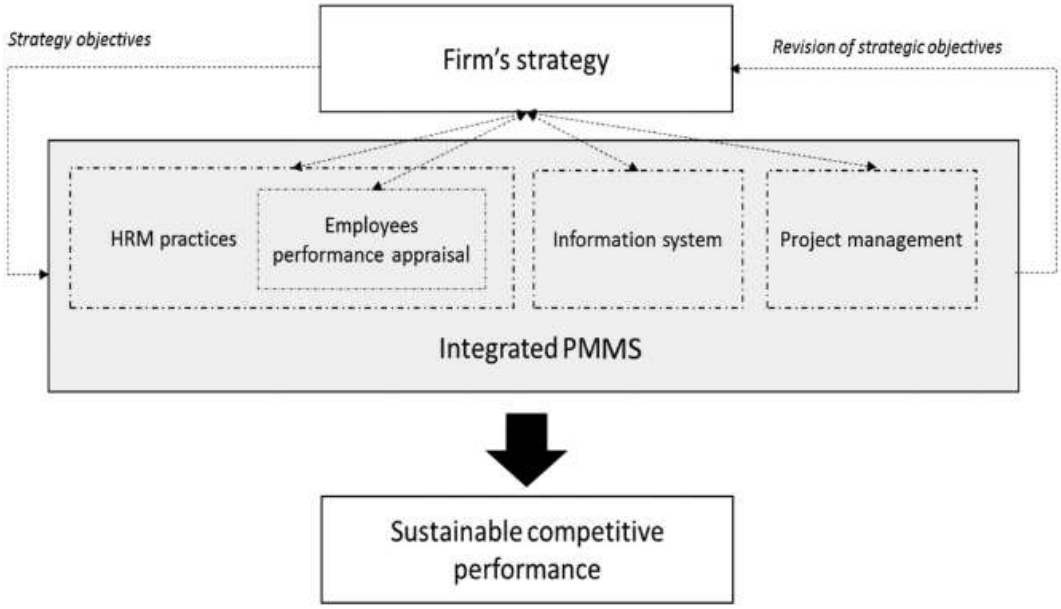

Figure 1: Conceptual Framework for Integrated PMMS (Garengo et al., 2022)

The association between company success and employee welfare through HRM systems was investigated by Ho and Kuvaas (2020). Their study, involving over 1300 firms, found that integrated HRM systems at moderate levels result in higher firm performance and are positively correlated with employee welfare and job satisfaction. However, at high levels of implementation, HRM systems negatively impact employee well-being. This finding suggests a delicate balance in HRM practices: while moderate implementation can be mutually beneficial, over-implementation may lead to employee burnout, an insight critical for sustainable HRM practices in industries such as mining.

Lastly, Korenková and Lis, (2019) identified a set of indicators used in manufacturing performance management, focusing on the PMS and the Z-MESOT method, which defines competency measurements. Their study highlighted the importance of consistently measuring key performance indicators (KPIs) to define firm performance, adaptable to different company styles. This focus on competency measurements and consistent KPIs aligns with the need for clear performance metrics in projects, as emphasized by Carden et al. (2021), but extends it to a broader, more sustainable operational context.

In summary, while Carden et al. (2021) provide valuable insights into the classification and management of HRs for project success, their approach requires further empirical validation and may not fully address the sustainability challenges faced by operational firms such as mining. In contrast, the integrated perspectives of Darwish et al. (2013), Garengo et al. (2022),Ho and Kuvaas (2020) and Korenková and Lis (2019) offer a more comprehensive understanding of the strategic and sustainable value of HRM practices, emphasizing the importance of balancing performance metrics, employee welfare, and consistent measurement systems for long-term organizational success

2.3.2 Human resource management systems and models

Carden et al. (2021) identified an approach for the classification of HRs at the beginning of their project, using augmented change requests to support organizations in managing HRs to improve the success rate of completing projects. This approach aimed to enable project managers to identify teams who should be part of projects. However, they found shortcomings in their study, including insufficient testing of the research and measuring the impact on project success. This highlights a critical gap in empirical validation, suggesting that while the theoretical framework may be sound, its practical effectiveness remains uncertain.

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that other operational firms do, indicating a potential misalignment when applying these insights to industries with different operational dynamics, such as mining.

Boon et al. (2019) indicated that in past decades, there was a shift in focus from HR practices to HR systems due to the interdependencies of HR practices on one another. Reviewing 495 studies, they found that the measurement and conceptualization of HR systems were unclear and that there was a misalignment between measurement and outcomes. Additionally, there was insufficient work on HR systems at different levels. Boon et al. (2019) proposed two frameworks: "the four approaches to interrelationships between HR practices" and "the five perspectives and their measurement using homogeneity, heterogeneity, and independence." These frameworks aim to enhance clarity and help develop measures for the interaction of HR practices within an HR system. However, their study, being a systemic literature review, lacked practical validation.

Boon et al. (2019) also highlighted future research gaps, including understanding why HR systems impact firm outcomes and the effects of different types of HR systems. There are opportunities to prioritize some HR systems and practically test this theory within various industries, addressing the need for empirical validation noted by Carden et al. (2021).

Chen and Cui (2022) examined SMEs in China where HRM still uses traditional modes and does not cater to current information. They highlighted significant challenges due to insufficient market competitiveness and increased economic globalization. They focused on the design and execution of an HR system that met corporate needs and was simple to use. Chen and Cui (2022) developed a natural resource management (NRM) system based on browser/server (b/s) mode, emphasizing the need for practical implementation. However, their study did not explore the impact of the implemented system on firm performance (FP), leaving an opportunity to understand this relationship, particularly for SMEs with limited resources.

The theoretical framework of HRM systems was detailed in Chen and Cui's (2022) study. However, as Ho and Kuvaas (2020) indicated, high-level implementation of HRM systems may have negative effects on employee well-being. Thus, future studies need to prioritize some HRM system models and understand their impact on employee

well-being, measured through sustainable FP. Some HRM system modules can be used for information sharing instead of being actively managed, balancing functionality and employee welfare.

Wang (2022) noted a trend toward integrating information technology with enterprise management, emphasizing information sharing between HR practitioners, employees, and managers. He investigated using a fuzzy assessment to optimize HR systems to enhance management and competitiveness. Wang's (2022) model showed that encouraging employee independence, supported by performance management, could meet organizational objectives. While Wang's experiment was conducted in a project environment, testing the model in an operational environment with sustainability considerations remains an opportunity.

Hu et al. (2022) used a two-phased approach to study the impact of HRM systems on employee job crafting in nine Chinese companies. They concluded that HRM system implementation could increase task completion and build relationships. However, due to the study's inability to quantify all variables, establishing a causal link was challenging. Their methodology could be used to prioritize and implement HRM system elements in various industries, including mining.

Chowdhury et al. (2021) investigated e-HRM's ability to enhance SEHRM systems and overall organizational performance in South African firms. They found that enhancing e-HRM practices led to improved SEHRM systems and organizational performance. While their study focused on e-HRM's impact, further research is needed to generalize findings to the mining industry, as only a small percentage of their respondents were from the industrial sector.

Zeng and Qi, (2021) built internet-based AI HR models to support organizations using traditional HR methods. Their model increased firm efficiency by 30%, demonstrating the potential of integrating internet and AI technologies into HRM systems. This study highlights the need for organizations to embrace technological disruptions to successfully implement HRM systems, providing insights into technological adoption and innovation.

Somarathna (2020) proposed an agent-based model to address the complexity of HRM processes, focusing on different strategy simulations and their impact on FP. Her

model simulated the long-term impact of recruitment strategies, highlighting key considerations for employee competency and onboarding investment. This study emphasizes understanding different human behavioral characteristics and their potential to model HRM strategies effectively.

Arifin et al. (2022) described HRM systems as crucial organizational strengths, aligning them with total quality management (TQM) strategies. They emphasized TQM's role in planning and supervising employee and leadership training. However, they noted the cost implications of TQM implementation. Organizations operating under TQM models could utilize these insights to integrate TQM into their HRM systems.

In summary, while Carden et al. (2021) provide valuable insights into the classification and management of HRs for project success, their approach requires further empirical validation and may not fully address sustainability challenges faced by operational firms. In contrast, the integrated perspectives of Boon et al. (2019), Chen and Cui (2022), Wang (2022), Hu et al. (2022), Chowdhury et al. (2021), Zeng and Qi (2021), Somarathna (2020), and Arifin et al. (2022) offer a comprehensive understanding of HRM's strategic and sustainable value. These studies emphasize balancing performance metrics, employee welfare, technological integration, and consistent measurement systems for long-term organizational success

2.3.3 Technology and artificial intelligence

Da Silva et al. (2022) highlighted the impact of technology and the internet on industries, promoting HRM systems for Industry 4.0 professionals across various sectors. They conducted a methodical review of the literature based on 75 journals, revealing how trends from Industry 4.0 influence the HRM discipline. Their study verified trends related to HRM and the digital technologies that drive HR systems, including training people and machines, retaining talent, diversifying firms, and addressing new workforce competencies in the digital age (da Silva et al., 2022). However, a critical gap in their study is the lack of focus on the sustainability of these systems post-implementation, particularly in environments like South Africa, where high turnover, disruptions, and connectivity challenges are prevalent. This oversight suggests the need for further research to understand the long-term viability and sustainability of Industry 4.0-driven HRM systems in diverse contexts.

Chowdhury et al. (2023) examined the transformation of HRM towards AI due to its potential value. Despite the promising literature, many firms have not realized the anticipated benefits from investing in AI. Their review provided an objective understanding of the capabilities required for AI in HRM, emphasizing non-technical skills and competencies. They proposed four elements to advance AI in HRM—framework, resources, readiness, and strategies—to facilitate AI adoption in businesses (Chowdhury et al., 2023). However, their study missed an opportunity to explore why some organizations fail to achieve the expected benefits from AI implementation, highlighting the need for future research to gather insights from HR professionals on trends and barriers in AI adoption.

Votto et al. (2021) noted that digitalization has increased the use of AI in HR information systems and HRM systems. AI is becoming more prominent in recruitment, performance management, compensation, and employee management in training and development systems. This trend underscores the growing importance of integrating AI in HRM practices to enhance efficiency and effectiveness.

In summary, this chapter explored the concepts of performance management, HRM systems, and technological development in the field. It found systems and models developed for HRM and PMS systems to measure these systems but identified an opportunity to understand why HR systems impact firm outcomes and different types of firm outcomes. Garengo et al. (2022) offer a theoretical foundation for aligning and integrating HRM and PMM to improve firm performance. Korenková and Lis (2019) introduced Z-MESOT for defining KPIs in an organization, adopting employee and operational performance levels to define firm performance. Various studies provided theories and models for applying HRM, with many yielding positive outcomes.

There is an opportunity to prioritize HRM systems and practically apply these models within the mining environment. Chowdhury et al. (2021) demonstrated that enhancing e-HRM practices results in improved SEHRM systems and overall organizational performance. However, with only 3% of respondents from the industrial sector, further studies are needed to generalize these findings to the mining industry.

da Silva et al. (2022) crevealed that the introduction of new systems is as crucial as ensuring sustainability, which aligns with the sustainability measures of mine

performance. Their study's emphasis on the digital age's competencies and the diversification of firms presents an opportunity to evaluate the long-term sustainability and practical application of these HRM systems within the unique challenges of the South African environment. Moreover, integrating insights from Chowdhury et al. (2023) and Votto et al. (2021) about AI and digital technologies into HRM practices can provide a comprehensive understanding of the evolving HR landscape, fostering more resilient and adaptive HRM systems

2.4 Research Framework

The literature review has shown that implementation of HR systems has been successful in various industries and sectors. This is further motivated by the literature which validates the theory of performance management within HRM. This study aimed to focus on the gap in understanding the impact of integrated HRM systems on a mine performance. This section details the research framework.

2.4.1 Theoretical underpinnings

HRM system integration is supported by the theory of the resource-based view (RBV) (Kraaijenbrink et al., 2010). According to the theory, a company's assets and capabilities are what gives it a competitive edge and enhancing these assets in a way that takes advantage of opportunities can help the organisation perform better. By leveraging these resources effectively, a company can achieve superior performance. The benefits of using this theory in HRM system integration include relating specifically to resources to avoid inaccurate generalisation, like that of industries, providing a strategic perspective for an organisation to follow and encouraging the use of a holistic approach in understanding problems and proposing solutions (Kraaijenbrink et al., 2010).

A drawback of the RBV theory is that due to its focus on internal resources to improve competitiveness, there is a risk of excluding external factors; for instance, in the case of this study, one needs to pay particular attention to legislation as mining is highly regulated. The theory is also limited to an organisation with established resources and capability and this may hinder opportunities to learn from small and new organisations. Sometimes the RBV theory presents difficulty in measuring resources as individual

resources and capabilities need to be carefully identified so they can be measured accurately (Kraaijenbrink et al., 2010).

The use of the RBV theory in the study of HRM systems integration could enhance the competitive advantage of an organisation as the focus will be on understanding the scarce, rare and valuable resource base and its capabilities and impact on strategic goals and competitiveness. Applying the RBV theory to the study of HRM system integration involves examining how the integration of an HRM system contributes to a firm's sustained competitive advantage and how it helps the firm achieve its overall strategy and goals.

This theoretical framework still presents an opportunity for understanding integration within HRM systems and the impact thereof on firm safety performance(Wright et al., 2001). As previous studies have preferred this theory, this study will utilise this theory Despite these limitations, RBV remains valuable for studying HRM system integration in mining. It helps identify scarce, rare, and valuable resources critical for competitive advantage and aligns HRM strategies with overall organizational goals. By understanding how HRM systems integration contributes to sustained competitive advantage, organizations can enhance their performance and safety outcomes.

Given the preference for RBV in previous studies and its applicability to HRM system integration, utilizing this theory while being mindful of its limitations can provide valuable insights into optimizing HRM practices in the mining industrywhile guarding against the drawbacks shared above.

2.4.2 Theoretical framework

Figure 2 indicates the theoretical framework based on RBV, as used by Chowdhury et al. (2021), for integrating e-HRM systems and testing their impact on FP. The framework consists of five variables that the study used to address answer the question on the impact of SEHRM systems on the firm’s safety performance. Two of the research questions were about the relationship between e-HRM practices and e-HRM systems and the relationship between SEHRM systems and FP.

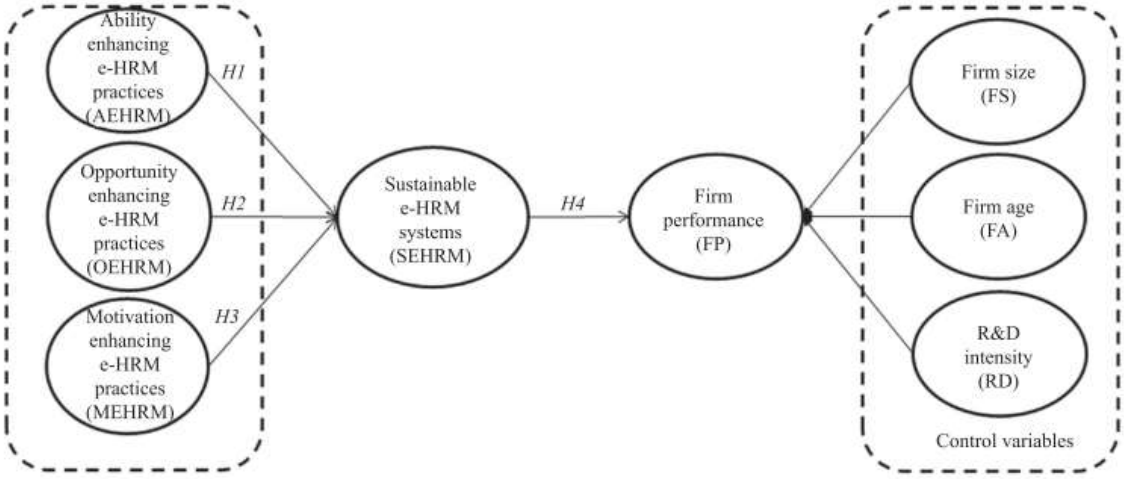

Figure 2: Theoretical Framework (Chowdhury et al., 2021)

The five variables that were tested in the various South African organisations made up the theoretical framework. An explanation of the various variables that were tested is provided below. According to Chowdhury et al. (2021), the dependent variable was firm safety performance and the independent variables were AEHRM, OEHRM and MEHRM practices. Control variables used in the model to enhance firm safety performance include size, age and R&D intensity.

Practices in e-HRM that improve abilities are HR procedures that use e-HRM technologies to enhance workers' abilities, knowledge and skills and can be conducted through online performance review systems and upskilling programmes designed to enhance the ability of employees to perform their job duties and contribute to organisation success (Chowdhury et al., 2021).

Systems that increase the chances for employees to contribute to the organisation are known as OEHRM systems (Chowdhury et al., 2021). Employee social networking sites, online suggestion boxes and employee involvement initiatives are a few examples of such systems. These systems are intended to improve employee involvement and participation in the company to open new doors for innovation and growth (Chowdhury et al., 2021).

E-HRM systems that are intended to improve employee motivation and work satisfaction are referred to as MEHRM systems (Chowdhury et al., 2021). Employee self-service portals, employee feedback systems and online recognition and reward programmes are a few examples of such systems. These programmes are intended to

boost employee engagement and motivation, which can result in better performance and output (Chowdhury et al., 2021).

Systems that are made to be both socially and environmentally responsible are referred to as SEHRM systems (Chowdhury et al., 2021). These solutions include telecommuting regulations, virtual meetings and paperless HR processes. These systems are intended to lessen the negative effects of HR procedures on the environment and to encourage sustainable business practices within a company (Chowdhury et al., 2021).

2.4.3 Conceptual framework

Based on the literature study, a conceptual framework was created for the current study using the RBV theory to construct secondary questions to address the major issues. Similar to the RBV theory, the theoretical framework included independent variables such as practices that improve ability, opportunities and motivation for e-HRM systems. An organisation can use e-HRM practices or technologies to enhance HR processes and outcomes, including those that promote employee capabilities, opportunities, motivation and opportunities for sustainability (Chowdhury et al., 2021). These procedures and frameworks are independent variables that may affect the dependent variable. Employee level and SEHRM will be looked at as the moderating variables.

According to the literature, the intensity of an e-HRM system can have an increasingly considerable and detrimental effect on employees. In addition, research by Chowdhury et al. (2021) that had a 3% involvement from the industrial sector was mostly focused on supervisors and higher-level employees. The goal of this study is to comprehend the effects of e-HRM system integration at lower levels, hence, the moderating variable of employee level.

The dependent variable that is influenced by firm age and company size will ultimately be firm safety performance because it is the outcome variable that is impacted by the independent variables of e-HRM practices and systems. The organisation's ability to effectively manage its human resources and accomplish its strategic goals and objectives, which can be influenced by the adoption of e-HRM practices and technologies, is a key factor in determining its overall performance. The controlling

variables are those that improve a company's performance regardless of its e-HRM system and the age and size of the organisation.

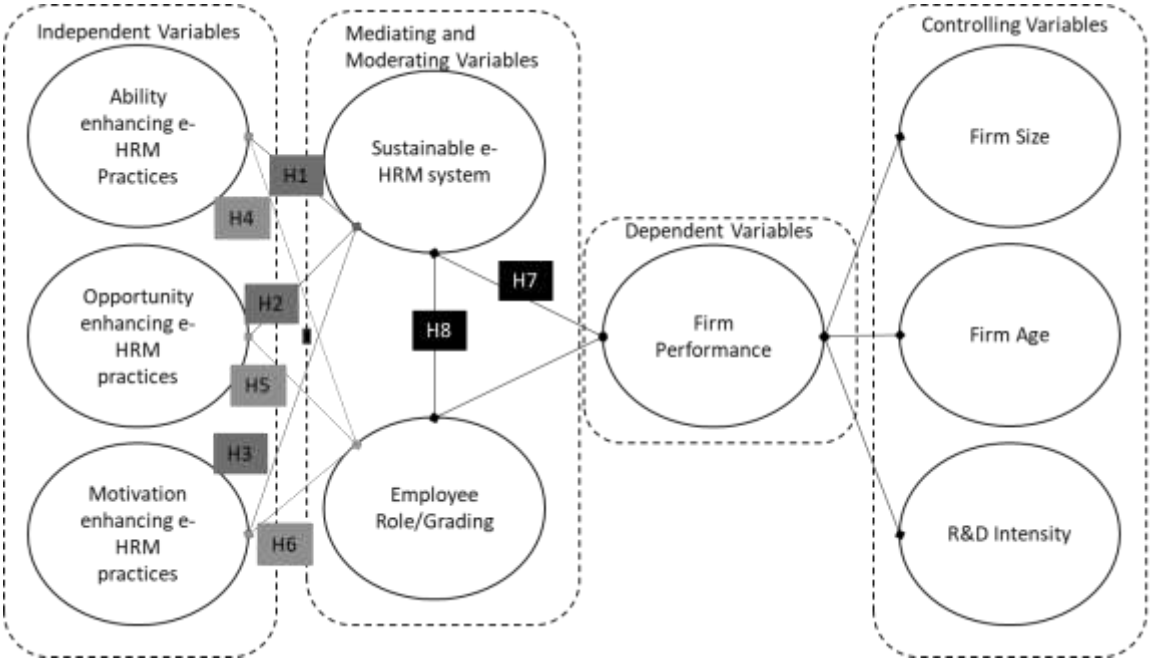

Figure 3: Conceptual Framework

2.4.3.1 Linking independent variables to dependent variables

AEHRM, OEHRM, and MEHRM practices are the three independent variables for the conceptual framework. Their interpretation and measures are defined in Table 2.

Table 2: Linking Independent Variables With the Dependent Variable

Construct	**Interpretation**	**Measures**	**References**
Ability-enhancing e-HRM practices	E-learning and training, performance management and talent management	Employee productivity, employee knowledge retention, employee satisfaction, retention rates, promotion rates	Al-Harazneh & Sila (2021), Chowdhury et al. (2021)
Opportunity-enhancing e-HRM practices	Employee engagement and experience, personalised experiences, policy and procedures' impact on	Turnover, employee performance, employee engagement and satisfaction	Al-Harazneh & Sila (2021), Chowdhury et al. (2021)

Construct	Interpretation	Measures	References
	employees, employee volunteer programmes		
Motivation-enhancing e-HRM practices	Positive work environment, employee engagement, rewards and recognition, job satisfaction, employee retention, growth, development	Employee retention, salaries and benefits, recognition (variable compensation and bonuses)	Al-Harazneh & Sila (2021), Chowdhury et al. (2021)

2.4.3.2 Linking moderate and mediating variables to dependent variables

The moderating variables for the study include the SEHRM system and the employee level towards the dependent variable which is firm safety performance. Interpretation and measures are defined in Table 3.

Table 3: Linking Moderating Variable With the Dependent Variable

Construct	Interpretation	Measures	References
Sustainable e-HRM system	Ethical e-HRM practices, learning assignments, optimum utilisation, reputation, goodwill	Cost and net productivity, return on investment (ROI)	Al-Harazneh & Sila (2021), Chowdhury et al. (2021)
Employee role/level	Front-end employees, mid-management level, senior management level, executives and board	KPIs aligned to levels of work Z-MESOT	Korenková & Lis (2019)
Firm Performance	Financial performance, sustainability, ROI, employee satisfaction, stakeholder benefits	Safety, financial sustainability	Al-Harazneh & Sila (2021), Chowdhury et al. (2021)

2.4.4 Hypothesis development

Within the context of the mining industry, the hypothesis section of this thesis seeks to investigate and test numerous correlations between various components of e-HRM practices, SEHRM, employee roles or levels, and firm safety performance. These theories offer an organised framework for empirical research since they are based on previously published work and theoretical frameworks as discussed above. The following hypotheses were developed:

H1: AEHRM and SEHRM relationship. Chowdhury et al. (2021) find that the relationship between AEHRM practices and SEHRM systems is significant. This hypothesis tested whether these findings could be achieved in the mining sector where technology is still behind and legislations mandate manual processes and systems for compliance purposes.

H2: OEHRM and SEHRM relationship. This hypothesis presupposes that a SEHRM system and OEHRM practices have a favourable relationship. According to Chowdhury et al. (2021), there is no connection at all between SEHRM systems and OEHRM practices. However, when employees are more engaged, they become more innovative and improve firm safety performance. This hypothesis was tested in the mining sector which has a minimal culture of inclusion and diversity.

H3: MEHRM and SEHRM relationship. This hypothesis assumes a positive relationship between MEHRM practices and SEHRM systems. Chowdhury et al. (2021) find that when a firm improves its practices, such as reward systems, recognition and technological advancement, there should be an improvement in the overall sustainability of the e-HRM systems and firm safety performance. This hypothesis tested whether these findings could be achieved in the mining sector with its high reliance on manual labour.

Following similar structured method, hypotheses H4 through H8 look into additional connections between various e-HRM practice variables, personnel roles or levels, and company safety performance in the mining industry. These theories, which seek to offer a thorough knowledge of the interactions between organisational dynamics, safety results, and HRM practices in a demanding industrial setting, are developed based on theoretical considerations and empirical observations.

H4: Ability-enhancing e-HRM practices and employee role or level. This hypothesis suggests that improving employee abilities at all levels has a positive impact on firm safety performance. Mining employees require different levels of training and technological understanding, such as practical training and planned task observation with a minimum number of working hours under observation.

H5: Opportunity-enhancing e-HRM and employee role or level. This investigation looked at the connection between OEHRM practices and employee role or level. It was expected that an engaged workforce would be a more productive workforce, as buy-in is simpler at lower levels of the organisation.

H6: Motivation-enhancing e-HRM and employee role or level. This hypothesis assumes a positive link between MEHRM and employee role or level in firm safety performance. Workers at various organisational levels have different motivations and this study looked at how each level was impacted by MEHRM towards firm safety performance.

H7: Sustainable e-HRM system and firm safety performance. This hypothesis assumes a positive relationship between SEHRM systems and mine safety. Chowdhury et al. (2021) finds this relationship to be significant. This study tested this finding in the mining environment as the mining industry has lagged in technological advancements.

H8: Employee role or level and sustainable e-HRM system. This hypothesis suggests a positive relationship between the employee roles or levels and the sustainability of e-HRM systems to impact firm safety performance.

This study aims to further theoretical understanding, provide guidance for practical interventions, and add to the larger conversation on e-HRM practices and organisational performance in resource-intensive industries like mining by methodically verifying these hypotheses. This research project attempts to provide insightful information with consequences for academic and industry stakeholders through thorough empirical investigation.

2.5 Conclusion

The literature was consulted for a enhanced comprehension of the problem of the influence of an integrated e-HRM system of first-line employees on firm safety performance faced in the study. Three concepts – performance management, HRM systems and technological development in the field – were explored. From the literature, one learnt that there are systems and models developed for HRM systems and PMSs to measure the systems. However, there is an opportunity, as indicated by the systematic review of HRM, to understand why HR systems impact the outcomes of a firm and the systems of different types of firms' outcomes (Boon et al., 2019). Furthermore, the literature provided ways theories and theoretical frameworks can be deployed to better understand the problem as presented in this study.

The three theoretical frameworks of e-HRM, PMMS and HRM system lifecycles were considered in the study's conceptual framework. By using the RBV theory for the integration of e-HRM systems and the impact they have on firm safety performance, as was used by Chowdhury et al. (2021), the study's conceptual framework was developed. Designation and SEHRM were tested as moderating and mediating variables respectively.

The conceptual framework wanted to uncover the relationship between the e-HRM system, SEHRM, employee role or level and mine safety performance which covers the question of this research on the influence of integrated e-HRM systems on front-line employees towards mine safety. The study utilised both the frameworks, to answer the primary question by answering the following secondary questions which were tested using quantitative methods:

RQ1: What is the relationship between AEHRM practices, OEHRM practices and MEHRM practices on SEHRM systems? The first three hypotheses (H1, H2, H3) which assume e-HRM practices that enhance ability, opportunity and motivation have a positive impact on SEHRM systems answer RQ1.

RQ2: What is the relationship between AEHRM practices, OEHRM practices, MEHRM practices and employee role or level? Hypotheses H4, H5 and H6 which assume that employee designation influences e-HRM practices such as ability, opportunity and motivation, answer RQ2.

RQ3: What is the relationship between SEHRM systems and mine safety performance? H7, which assumes a favourable correlation between SEHRM systems and firm safety performance, answers RQ3.

RQ4: What is the relationship between SEHRM systems and employee roles or levels? H8, which assumes a favourable correlation between employee role or level and SEHRM systems, answers RQ4.

3 RESEARCH METHODOLOGY

3.1 Introduction

This section describes the approach and design, data acquisition and data analysis processes and ethical considerations of the study. Figure 4 below indicate the research methodology summary.

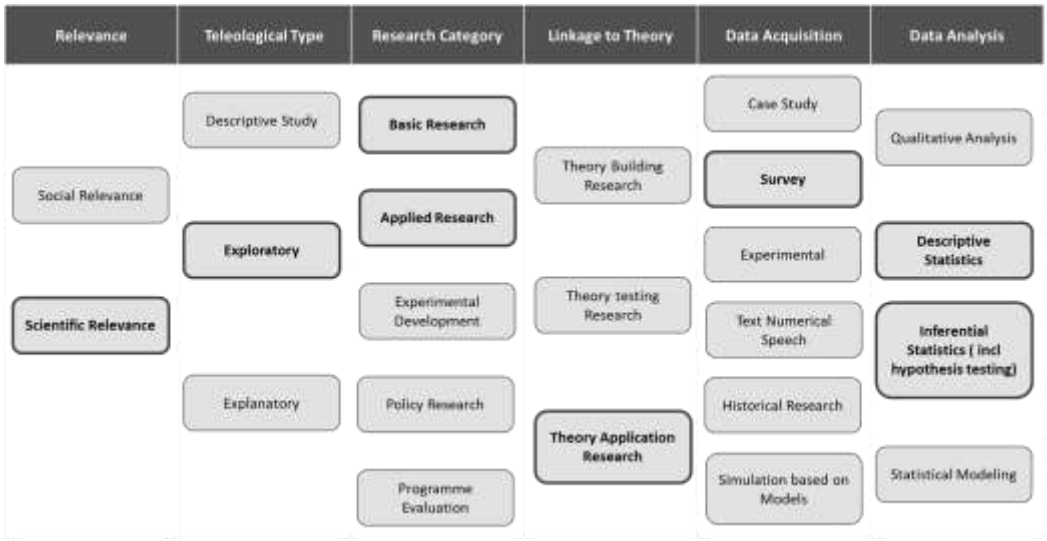

Figure 4: Summary of Research Methodology

3.2 Research Approach

Relevance: This research has scientific relevance for HRM and information and digitisation technological areas. The study will enable HR practitioners and organisations to prioritise e-HRM practices. Overall, organisations should be enabled to improve their key performance metrics.

Teleological type: This research was an explanatory study and investigated causal linkages to offer explanations about the links between different variables in the study. The primary goal was to establish the connections between e-HRM systems and mine safety.

Research category: This study applied research that was conducted to address the practical problem of integrating e-HRM systems to improve mine safety performance in a mining environment. The study aimed to close the gap between the HRM system theory and how it is applied in a mining environment. The study was motivated by the

challenges mining organisations face regarding employee training and motivation towards mine safety performance. Collaboration was established with the mining organisation as the interested party and beneficiary of the study**.**

Link to theory: The research was linked to the RBV theory and previous work conducted on understanding the e-HRM system's impact on mine safety performance. The focus of the study was mainly on front-level employees in the mining environment.

3.3 Sample Population

The research aimed to examine the HRM systems in mining firms, focusing on workers connected to Kumba Iron Ore and its service providers. A multi-stage sampling approach was used to ensure thorough knowledge, with a minimum of 116 respondents targeted for sample representativeness, indicating four respondents per question. The four respondents per question rule of thumb is a statistical research guideline that recommends a minimum of four respondents for each survey question, aiming to ensure statistical validity and reliability in quantitative methods(Wenzel & Babbie, 2014). Participants included front-line workers, managers, HR specialists, and representatives from other relevant disciplines. Representatives from Kumba Iron Ore and its network of service suppliers, including contractors, were also involved.

Specific information about individuals and organizations was kept confidential to protect confidentiality and privacy. Data analysis and interpretation were carried out using SPSS and PLS-SEM tools. The sample population was chosen to capture the diversity and richness of the HRM environment in the mining sector, offering lessons with broader applicability and significance. The involvement of various stakeholders, such as managerial personnel, front-line workers, and outside service providers, allowed for a comprehensive analysis of HRM dynamics in mining companies.

The methodological rigor used in sample selection was highlighted, ensuring the selected respondents were representative of the larger community. This method improves the study's generalizability and dependability, allowing for insightful comparisons and extrapolations both inside and outside the mining industry.

3.4 Research Design

A method or plan created to gather, measure and analyse data to answer a research topic is known as a research design (Sekaran & Bougie, 2009). An online survey was considered appropriate due to its main advantages of convenience, easy-to-reach respondents and its potential to save respondents' time. The researcher was cognisant of the challenges involving a low response rate to establish a representative sample, the impact of low computer literate respondents and lost opportunities to understand respondents.

The goal of quantitative research is to collect numerical data, such as attitudes, behaviours, and perceptions concerning HRM systems in mining businesses, for statistical analysis and precise measurement. This is made possible by the uniform structure that questionnaires provide, which guarantees consistency in participant answers and facilitates the analysis of relationships, patterns, and trends. By using questionnaires for standardised data collection, the researcher hopes to lessen bias.

The study's external validity is strengthened by the findings' applicability to a broader population. Moreover, when it comes to huge samples or groups that are dispersed geographically, questionnaires are affordable and effective. The intention is to increase the generalizability of the data so that more broadly applicable insights concerning HRM may be drawn. Regression analysis, inferential statistics, and descriptive statistics are quantitative analytic techniques that assist the researcher in examining relationships between variables, validating hypotheses, and deriving empirical conclusions from numerical data.

Appendix A provides the detailed survey that was used for collecting feedback. An online questionnaire was administered to employees at the different mines. The survey was internet-based to make it easy for employees at different levels to provide feedback on their experiences of e-HRM. The web-based software Microsoft office forms and the survey link was circulated to employees at the mine to collect data .

The survey used close-ended questions to ensure that feedback from the respondents could be interpreted easily. The survey was arranged to start with acquiring information that would define the data and the moderating variables and was then followed by the different questions meant to answer the different hypotheses on the independent and

dependent variables. A 5-point Likert response choice was utilised for most of the questions in the survey.

The study presented a questionnaire comprising six sections aimed at investigating the impact of integrated e-HRM systems for front-line employees on the safety performance of a mine. In the first section, demographic factors – designation and individual number of years within the mining industry and at the current firm – were explored given their potential influence on integrated human systems and mine safety performance as discovered in the literature.

The second section consisted of seven factors measuring the ability to enhance e-HRM practices within an organisation and included online training, development programmes, digital development of skills and use of online information-related materials to attract job applications. The section emphasised the importance of AEHRM practices in mine safety performance.

The OEHRM section of the study questionnaire evaluated participants' perspectives on e-HRM practices. The questionnaire included four key questions: the presence of employee volunteer programmes, the promotion of member involvement in problem-solving, the involvement of employee representatives and unions in strategy design and the existence of employee surveys to assess workplace climate.

The MEHRM practices section of the research evaluated organisational practices aimed at boosting employee motivation. It included five questions, including performance goals, bonuses and variable pay, ethical behaviour, moral behaviour awards, employee retention and employee development programmes. The Likert scale was used to gauge participants' agreement or disagreement with these practices, providing insights into their prevalence and perceived effectiveness. The study aimed to improve employee motivation through e-HRM practices.

The SEHRM section of the study evaluated the organisation's commitment to SEHRM practices. It included four questions about ethical, social and e-HRM systems, practical implementation, including responsibilities, resource allocation and employee training, systematic audits and responsiveness to problems. The Likert scale allowed participants to express their agreement or disagreement, providing insights into the effectiveness of SEHRM practices.

The research in the FP section focused on perceptions of organisational performance. The first two questions assessed safety performance improvements, the next question evaluated employee performance enhancement and the last question evaluated meeting clients' needs. Participants expressed their opinions, which provided insights into the company's progress in safety, employee performance and meeting client requirements, particularly within e-HRM.

Finally, the development of the questionnaire involved reviewing and modifying the previously used questionnaire adapted from Chowdhury et al. (2021) to suit the study's context. The original draft of the instrument for this study was researcher-supervised. Once the data had been collected, SmartPLS statistical methods were employed to evaluate the theories and to answer research questions.

3.5 Data Analysis Strategies and Interpretation

This study analysis was conducted using quantitative analysis tools from SPSS and thereafter, the results were interpreted. Descriptive statistics of the data were conducted to understand the data characteristics. To ensure integrity, completeness and accuracy, the data gathered were examined for any errors, outliers and missing values and tested for significance using statistical tools.

Once the data accuracy had been determined and the descriptive statistics concluded, inferential statistical comparisons were conducted based on the right statistical analysis suitable for data distribution. Statistical methods were employed to examine the hypotheses for the study.

This study was quantitative, meaning it analysed data using measurement and analytical tools. Datan analysis was described through by both inferential and descriptive statistics. The information acquired for this investigation was then analysed using the PLS-SEM methodology. SPSS software was utilised for results analysis and presentation. Descriptive analysis was employed to characterise interesting phenomena (Sekaran & Bougie, 2009). In the course of the individual analyses, the descriptive data concerning the frequency, average score or central tendency (mean) of a particular occurrence of interest are statistically examined.

SPSS was used for data analysis for both descriptive and correlational reasons, descriptive analysis was used in this study to define the constructs. The suggested model was examined using structural equations and the PLS method, which is based on statistical modelling. It covers ideas that are not immediately observable and enables the simultaneous estimate of a set of equations by measuring variables and their relationships.

PLS-SEM is a statistical software that effectively works with structural equation models with multiple latent constructs (Hair et al., 2020). This study used PLS for several reasons: it is superior in performing estimations and assessing moderations compared to regressions, accounting for measurement error and providing accurate estimates for moderating effects (Sarstedt et al., 2014).

PLS path modelling is also attracting attention for handling complex models such as that in the study by Afthanorhan (2013). That study examined the relationships of variables within the structural model, indicating the model appropriateness for better prediction. This approach is particularly useful for real-world events and addressing complex models.

PLS-SEM is a reliable and significant statistical technique compared to SPSS as it can analyse multiple associations simultaneously (Lowry & Gaskin, 2014). It is popular in social and behavioural sciences due to its ability to analyse multiple associations simultaneously (Tabachnick et al., 2019). However, PLS modelling methods have drawbacks, such as measurement error in construct scores (Dijkstra & Henseler, 2015). Despite these, PLS offers benefits such as predictive power and the ability to estimate composite models (Shmueli et al., 2016). Overall, PLS-SEM is a popular statistical software tool in the field.

PLS seeks to maximise the variation that is described by items and latent constructs, reducing the variance explained by W1 and increasing the variance of endogenous latent variables (Afthanorhan, 2013). It combines linear, multiple regression for route analysis and ordinal least squares (OLS) estimation to complete a series of recurrent factorial investigations. Two steps of model estimation are completed: individual item reliability and internal consistency, and construct validity (Dijkstra & Henseler, 2015). The measurement model's strength for reflective constructs is assessed based on

these factors and the structural model's fit parameters are estimated using standardised path coefficients and the R^2 index (Hair et al., 2020).

The Stone-Geiser test evaluates a model's global fit and predictive relevance, with the Q^2 statistic representing the degree to which well-observed values are redesigned (Afthanorhan, 2013). PLS is suitable for smaller samples and allows for the analysis of many items or indicators (Afthanorhan, 2013). It also has an inherent method for handling non-normal data, known as PLS route modelling.

PLS analysis uses two models: measurement and structure (Sarstedt et al., 2014). The measurement model is centred on the connections between observable indicators and latent constructs, whereas the structural model scrutinizes the associations among latent constructs directly. (Hair et al., 2020). This method helps prevent normalcy issues during data processing (Lowry & Gaskin, 2014).

3.6 Possible Limitations and Challenges

Due to the sensitivity of the data sought, some employees might have been reluctant to provide information regarding the performance of their mine. As a result, fewer survey replies might have been obtained and it might have become more challenging to guarantee that the study's conclusions would be broadly applicable to the mining sector. In addition, employees at lower levels might have struggled with some of the information required by the study, e.g. mine safety performance measures; hence, a thorough understanding of the survey completed by the respondents was critical to ensure that the results are replicable.

3.7 Ethical Considerations

Written permission was requested from mining houses to gather data for the study. Employees were given clarity on the aim of the research project in a written context provided as preamble to the survey link.Employees were invited to participate voluntarily and no individual descriptive information was collected during the data collection. Data analysis was conducted and presented at the group level to ensure that no single participant’s views were traceable within the study.

3.8 Limitations

The current investigation provided supportive evidence for certain theoretical connections between the exogenous and endogenous latent constructs.

Cross-sectional methods employed in this study may have overlooked potential confounding variables and failed to capture changes in safety performance over time. Additionally, the relatively small sample size may have limited the generalisability of the findings to larger populations within the industry or across different sectors.

It is worth noting that the association between e-HRM systems and safety outcomes could be influenced by unexamined control variables such as organisational culture, leadership style, safety climate and technology infrastructure.

Resource constraints might have impacted the depth of analysis and the ability to explore complex interactions between variables. Furthermore, the study's scope and scale could have been affected by these limitations.

3.9 Conclusion

The research employed a survey or questionnaire to gather data. The survey and questionnaire targeted employees at different levels of the mining organisations. Due to time limitations and accessibility concerns, the research used a survey to gather data from workers at Kumba Iron Ore and its service providers. Over 400 organisations and 4500 employees were considered. Information about the individual and the organisations will not be shared.

4 RESULTS

4.1 Introduction

In this chapter, the results of the study aligned with the methodology in Chapter 3 are presented. Results from PLS-SEM version 4.0 path modelling software and SPSS 20 version software are presented in this section. The findings present how significant the relationship between the operational and relational (competency) constructs of e-HRM is and how e-HRM transformational (performance management and development) constructs impact SEHRM systems, employee roles and firm safety performance.

As stated in Chapter 3, the information utilised in this study came from an online survey administered at Kumba Iron Ore (Appendix A). This was done to fulfil the stated purpose of the research. The data screening, demographic profile, preliminary analysis, non-response bias and common method variance test of the respondents are the first subtopics covered in this chapter. These determine the data filtering process, the key elements of data from the respondents.

The findings of the hypotheses investigated to accomplish the stated goal using structural models and measurements are covered in the other subtopics. The measuring model was used to assess the validity and reliability of the study. The structural model's findings, including the importance of the path coefficients, R^2 values, effect magnitude and model Q^2, are also presented.

Finally, outcome of the PLS-SEM simulation, which examined the moderation effect of designation and mediating effects of SEHRM system on the relationship between the constructs and safety performance of the mine are presented. These results are relevant for the discussion to follow in Chapter 5. The last section presents the chapter summary.

4.2 Data coding

Table 4 presents the questionnaire for the data coding for analysis.

Table 4: Questionnaire Data Coding for Analysis(Chowdhury et.al. 2021)

Variable	Label	Type
Consent Letter	Consent	Binary
My Designation	My Designation	Ordinal
My number of years within mining industry	# Yrs.	Ordinal
My age of my firm	Firm Age	Ordinal
My organisation develops electronic brochures and other human resource	AEHRM 1	Nominal
My organisation Use electronic information -related materials to attract job applications	AEHRM 2	Nominal
My organisation attracts and selects employees who share organizational values	AEHRM 3	Nominal
My organisation uses the electronic hiring process for employees	AEHRM 4	Nominal
My organisation imparts online training that focuses on the skills and values of the organization	AEHRM 5	Nominal
My organisation provides online development programs	AEHRM 6	Nominal
My organisation focuses on developing digital skills among employees	AEHRM 7	Nominal
There is a presence of employee volunteer programs in my organisation	OEHRM 1	Nominal
My organisation encourages members to provide solutions when facing challenges	OEHRM 2	Nominal
My organisation involves employee rep and unions in the design, application, and review of the organization	OEHRM 3	Nominal
Employee surveys in place to monitor the climate of my organisation	OEHRM 4	Nominal
My organisation developed performance goals on an electronic platform	MEHRM 1	Nominal
My organisation link bonuses and variable pay to ethical behaviour based on digital performance objectives	MEHRM 2	Nominal
My organisations promote awards for good citizenship (moral behaviour)	MEHRM 3	Nominal
My organisation monitors and improve employee retention	MEHRM 4	Nominal
My organisation has an employee development programs	MEHRM 5	Nominal
My organisation has designed ethical, social, and e-HRM systems	SEHRM 1	Nominal
My organisation has put into practice, assigned responsibilities, allocated resources, and continuously trained employees on e-HRM systems	SEHRM 2	Nominal
My organisation monitors the progress of e-HRM systems by means of systematic audits	SEHRM 3	Nominal
My organisation has improved on talent management and ability to retain employees	SEHRM 4	Nominal
Our HR asks to correct any problems that may be detected, constantly updating the e-HRM system	SEHRM 5	Nominal
My organisation has improved in safety performance	FP 1	Nominal
My team improved in safety performance	FP 2	Nominal
My organisation has managed to enhance employee performance	FP 3	Nominal
My organisation ability to meet client's needs within the time specified has improved	FP 4	Nominal

4.3 Data Cleaning

The response rate evaluates the first round of data in a study. A variety of tests, including the value of missing analysis, outliers' evaluation, Common method variance tests, non-response bias test, multicollinearity test, and normality test, were used to conduct preliminary data analyses after the data had been coded and entered. For studies comparing early and late questionnaire feedback, a non-response bias test is advised and for self-report surveys, a common method variance test is advised(Meterko et al., 2015). These examinations aid in guaranteeing the accuracy and consistency of the gathered data.

4.3.1 Response rate

In the study, a total of 123 employees participated in online survey which was distributed through online platforms and different media channels to employees at Kumba Iron Ore. Participation was allowed for permanent employees and contractors or service provider organisation employees at the mines. Participants were required to consent before completing the survey and those who did not consent were not able to participate.

Of the 123 responses to the survey, 118 consented to the survey and five participants did not consent indicating a consent rate of 96%. Therefore, a response rate of 72% is considered a high response rate (Holtom et al., 2022). Table 5 provides a summary of the response rate items.

Table 5: Questionnaire Response Rate

Participants	**Frequency**
No. of participants	123
No. of participants who consented	118
No. of participants who did not consent	5
Response rate	96%

In every multivariate study, data screening at the preliminary research phase is essential because it enables researchers to identify potential breaches of the fundamental presumptions about the application of multivariate data analysis

techniques (Taherdoost, 2020). Additionally, preliminary data screening helps to better understand the information in the study.

4.3.2 Missing values

Analysis using the structural equation model (SEM) may not be successful if the data set contains missing data. The appropriateness of data arrangement and transformation into a suitable format determines the quality of data analysis. Ensuring accurate data entry requires data screening. As mentioned by Sekaran and Bougie (2009), respondents' unwillingness to respond or incapacity to comprehend questions can result in missing data.

Table 6: Total Number of Missing Data

	N	Missing		No. of extremes	
		Count	Per cent	Low	High
Consent	118	0	0	.	.
Designation	117	1	0,8	0	0
@#Yrs	117	1	0,8	9	0
Firm Age	118	0	0	0	0
AEHRM1	117	1	0,8	0	0
AEHRM2	117	1	0,8	10	0
AEHRM3	117	1	0,8	9	0
AEHRM4	117	1	0,8	13	0
AEHRM5	117	1	0,8	15	0
AEHRM6	116	2	1,7	0	0
AEHRM7	117	1	0,8	0	0
OEHRM1	116	2	1,7	8	0
OEHRM2	116	2	1,7	0	0
OEHRM3	116	2	1,7	0	0
OEHRM4	116	2	1,7	6	0
MEHRM1	116	2	1,7	0	0
MEHRM2	115	3	2,5	11	0
MEHRM3	115	3	2,5	0	0
MEHRM4	115	3	2,5	0	0
MEHRM5	116	2	1,7	0	0

	N	Missing		No. of extremes	
		Count	Per cent	Low	High
SEHRM1	114	4	3,4	5	0
SEHRM2	115	3	2,5	5	0
SEHRM3	115	3	2,5	7	0
SEHRM4	115	3	2,5	0	0
SEHRM5	115	3	2,5	0	0
FP1	115	3	2,5	7	0
FP2	115	3	2,5	0	0
FP3	114	4	3,4	6	0
FP4	115	3	2,5	5	0
Total	3362	60	1,7	116	0

In this study's dataset, of the 3 304 data points, 60 data points were arbitrarily missed, which accounted for 1.7%. No missing data occurred on firm age, while designation and number of years in the organisation had one data point missing. AEHRM constructs had eight missing data points, indicating an average 1.1 missing points per variable; OEHRM had eight missing data points, indicating an average 2 missing data points per variable; MEHRM had 13 missing data points, indicating an average of 2.6 missing data points per variable; SEHRM had 16 missing data points, indicating an average of 3.2 missing data points per variable and FP had 13 missing datapoints, indicating an average 3.2 missing data points per variable.

Even in cases when there is not a sufficient the proportion of missing values in the dataset to support a legitimate statistical conclusions, researchers usually concur that a missing rate of five percent or less is not statistically significant (Tabachnick et al., 2019). Various approaches, such as closing the case, are proposed to deal with missing data (Tabachnick et al., 2019). This study relied on replacement using techniques that suggest that, in cases when there is a reduced percentage of missing responses, missing values in SPSS can be replaced with the mean. Therefore, the mean value was utilised in this study to fill in the blanks.

4.3.3 Extreme outliers

Outliers in the data set have the potential to greatly skew regression coefficient estimates in regression-based analysis and yield unreliable results (Widerberg, 2019). According to Hair et al. (2020), subsets of observations known as outliers are those that are discovered to be inconsistent with the rest of the data. To detect observations that, for whatever reason, fall below the value labels – such as incorrect data entry – frequency tables with the minimum and maximum figures were provided for each construct. According to the outcome, no values were discovered to be outside of the likely range.

In this investigation, none of the examples were identified as possible univariate outliers based on conventional values. The Mahalanobis distance (MD), was used to identify multivariate outliers. The MD was assessed by using a comparison with a chi-square distribution resulting in a total of four outliers (Table 7).

Table 7: Total Number of Datasets That Exceed Mahalanobis Values

ID	**Mahalanobis values (MD)**	**Probability (MD)**
22	30.54	0.00000
23	17,83	0.00048
41	19.27	0.00024
96	29.01	0.00000

As shown in Figure 5 of the chi-square Q-Q plot of MD**,** this method detected four outliers located on one side of the data. The outliers' case numbers are 22, 96, 41 and 23.

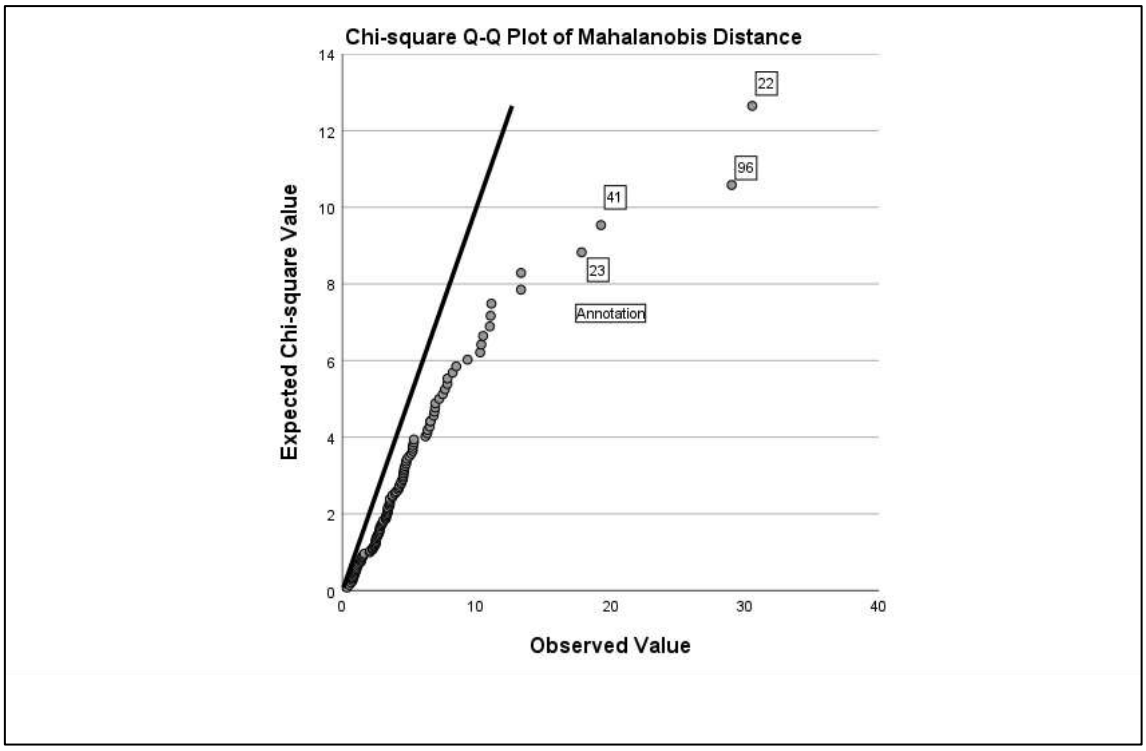

Figure 5: Q-Q Plot of the Mahalanobis Distance

Following Mahalanobis values criteria and because outliers may have an impact on the precision of the data analysis method, four of the datasets that did not meet the criteria were eliminated. Thus, the final dataset in this study was 114.

4.3.4 Normality test

Bootstrapped standard error estimates can be affected by data skewness or kurtosis, potentially underestimating the statistical impact of path coefficients (Sarstedt et al., 2014). PLS-SEM provides precise model estimates in non-normal data situations but researchers should conduct a normalcy test, such as the normality test, to ensure accurate results (Sarstedt et al., 2014). This helps researchers better understand the statistical impact of path coefficients in non-normal data situations.

This study used a graphical method, as recommended by Tabachnick et al. (2019), to examine the normalcy of the data gathered. He indicated that, a larger sample reduces standard errors, increasing statistical values for skewness and kurtosis. This explains why the graphical normality test method is preferred over statistical alternatives. To make sure that the normalcy assumptions were upheld, a histogram and normal probability plots were used in the current investigation. Figure 6: Test for Normality.

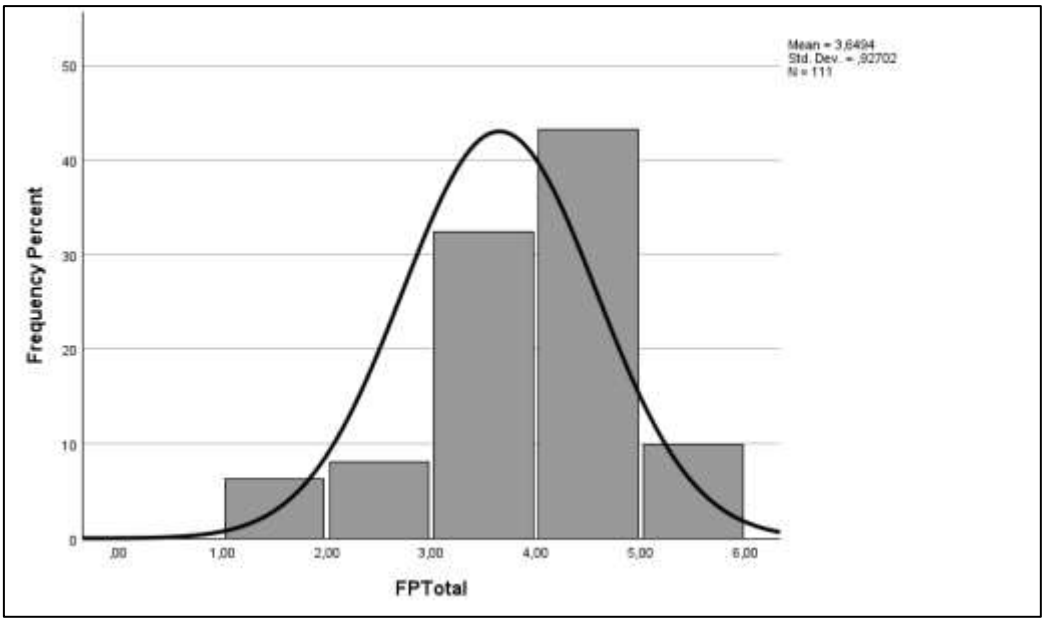

Figure 6: Test for Normality

As every bar on the graph was relatively confined to a normal curve, data gathered for this study followed a normal pattern. Furthermore, as can be seen in Figure 6, the scores are fairly dispersed, with the majority of the scores falling in the middle of the distribution. Figure 7 displays the normal probability plots, labelled normal P-P plots, in support of the normality test. The observed value for each score on the normal p-p plot is displayed in the current study against the expected value. A normal distribution is suggested by a decent straight line.

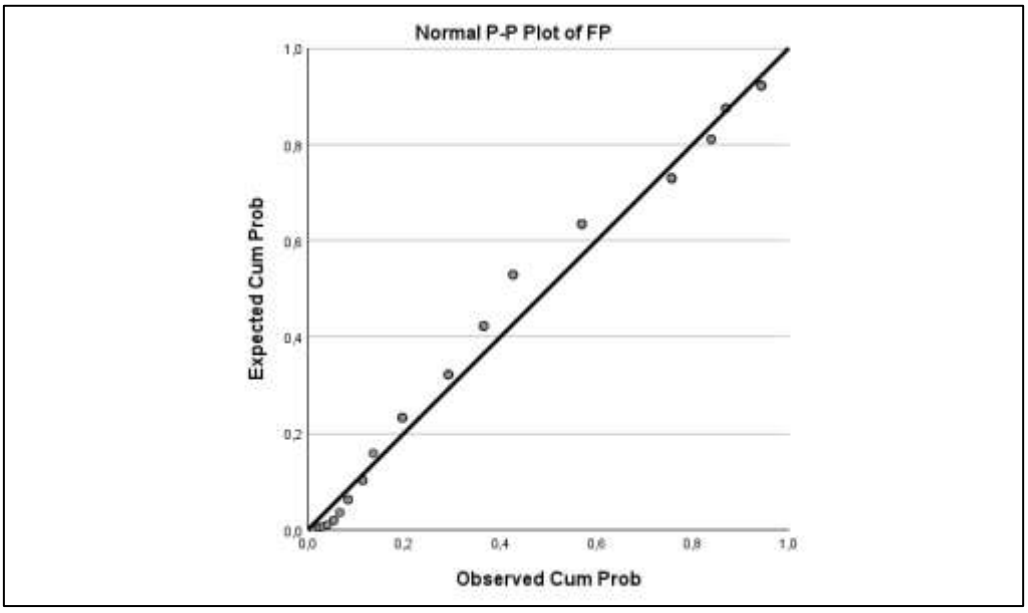

Figure 7: Normal P-P Plot of FP

4.3.5 Tests for multicollinearity

Multicollinearity is a condition where independent variables have high correlation levels, leading to significant misrepresentation of regression coefficient estimates and statistical significance tests (Dijkstra & Henseler, 2015). This can cause standard error coefficients to rise, making the coefficients statistically non-significant. This study utilised two approaches to identify multicollinearity (Hair et al., 2020).

The correlation matrix of independent variables shows multicollinearity, with a correlation coefficient of 0.90 or higher (Hair et al., 2020). However, correlations were observed falling below the recommended threshold of 0.90 as can be seen in Table 8. As proposed by Hair et al. (2020), this suggests that variables are less correlated and are independent.

Table 8: Correlation Matrix

Variables	AEHRM	OEHRM	MEHRM	SEHRM	FP
AEHRM	1				
OEHRM	,746**	1			
MEHRM	,710**	,775**	1		
SEHRM	,706**	,762**	,775**	1	
FP	,640**	,615**	,621**	,661**	1

Furthermore, upon evaluating the correlation matrix, a potential multicollinearity issue was investigated by examining variance inflation factor (VIF) and the tolerance values. According to Sarstedt et al. (2014), multicollinearity should be addressed if the tolerance value is below 0.20 and the VIF value exceeds 5. Table 9 below shows the results.

Table 9: Collinearity Statistics

Variables	**Tolerance**	**VIF**
AEHRM	0,384	2,605
OEHRM	0,29	3,445
MEHRM	0,3	3,335
SEHRM	0,297	3,369
Designation	0,949	1,054

All VIF values were found to be below 5 and tolerance values were above 0.20, indicating no multicollinearity among the exogenous latent variables (Sarstedt et al., 2014). Therefore, multicollinearity was not a concern in this study. Additionally, the Durbin-Watson d-value of 1.802 suggested no first-order linear autocorrelation present in the data. According to Field (2009), a value of more than 3 and less than 1 should raise concerns. Furthermore, as suggested by Tabachnick et al. (2019), the results of Barlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sample suitability indicated that the data were appropriate. The KMO is 0.886 which is considered excellent while the Barlett test is ($p < .001$).

4.3.6 Non-response bias

Non-response bias occurs when sample characteristics are inaccurately assessed due to the underrepresentation of certain respondents. Berg, (2004) proposes a time-trend extrapolation method to compare early and late respondents, acknowledging that this bias exists in both early and late responses to questionnaires. Regardless of the extent of non-responses, it is essential to investigate potential biases.

Hence, a non-response bias analysis was imperative for this study. Tabachnick et al. (2019) define non-response bias as the discrepancies in responses between non-respondents and respondents. Arifin et al. (2022) recommend that 50% is the minimal response rate. In this study, the first 50% of respondents are categorised as early respondents and the remaining 50% as late respondents.

The outcomes of the independent-samples t-test, showcased in Table 10, suggest that there is no notable distinction between the group means and standard deviations concerning early and late responses. The significance values for Levene's test for equality of variances are greater than 0.05, as suggested by Field (2009), indicating no significant differences in variance between early and late responses.

Table 10: Results of Independence Sample T-test for Non-response

Response	Mean	N	Std. deviation	Std. error mean	Levene's Test	
					F	Sig
AEHRM Early Response	3,80	58,00	0,83	0,11	0,09	0,76
AEHRM Late Response	3,83	58,00	0,95	0,13		
OEHRM Early Response	3,66	57,00	0,92	0,12	0,00	0,95
OEHRM Late Response	3,66	57,00	0,93	0,12		
MEHRM Early Response	3,51	57,00	1,05	0,14	0,39	0,53
MEHRM Late Response	3,63	57,00	0,96	0,13		
SEHRM Early Response	3,36	56,00	0,92	0,12	0,02	0,90
SEHRM Late Response	3,54	56,00	0,94	0,13		
FP Early Response	3,73	56,00	0,87	0,12	0,04	0,85
FP Late Response	3,65	56,00	0,93	0,12		

Consequently, it can be concluded that this study did not exhibit non-response bias. Moreover, with a response rate of 96%, in line with Arifin et al. (2022) recommendation, it did not seem that non-response bias was of significant concern.

4.3.7 Variance test

Common method variance (CMV) pertains to variance associated with the measurement technique rather than the variable being studied. Scholars caution that researchers utilising self-report questionnaires should be mindful of CMV as it has the

potential to inflate correlations between constructs measured by self-reports, as highlighted by (Tehseen et al., 2017).

To address the concerns raised by Tehseen et al. (2017), this study implemented procedural remedies aimed at mitigating the effects of CMV. These remedies included ensuring confidentiality to minimise evaluation anxiety and avoiding ambiguity in questionnaire items. Furthermore, scale items were refined to feature clear, precise and straightforward wording. Additionally, the analysis revealed that the bulk of covariance in the data was not explained by a single factor in both exogenous and endogenous variables, aligning with Yusuf's (2017) assertion that common method bias is unlikely to artificially inflate connections between measured variables and is not a significant concern.

Table 11 below illustrate the total variance explained by the various items. Six components were retained, collectively representing 71.3% of the variance, with Component One explaining 46.4%, Component Two 6.3%, Component Three 5.8%, Component Four 4.7%, Component Five 4.3% and Component Six 3.7%. The remaining 29.7% of the variance may be attributed to other components.

Table 11: Total Variance Explained

Total Variance Explained						
	Initial eigenvalues			Squared loadings sums		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12,987	46,384	46,384	12,987	46,384	46,384
2	1,761	6,289	52,673	1,761	6,289	52,673
3	1,644	5,871	58,543	1,644	5,871	58,543
4	1,325	4,732	63,275	1,325	4,732	63,275
5	1,229	4,390	67,665	1,229	4,390	67,665
6	1,030	3,680	71,345	1,030	3,680	71,345
7	0,789	2,818	74,163			
8	0,745	2,662	76,825			
9	0,727	2,598	79,423			
10	0,683	2,440	81,863			
11	0,620	2,215	84,078			

Total Variance Explained						
	Initial eigenvalues			Squared loadings sums		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
12	0,576	2,058	86,136			
13	0,512	1,830	87,966			
14	0,456	1,629	89,595			
15	0,415	1,480	91,075			
16	0,342	1,222	92,297			
17	0,296	1,056	93,352			
18	0,265	0,947	94,299			
19	0,249	0,890	95,189			
20	0,229	0,816	96,005			
21	0,217	0,775	96,780			
22	0,191	0,681	97,461			
23	0,183	0,653	98,114			
24	0,136	0,486	98,600			
25	0,125	0,445	99,045			
26	0,118	0,422	99,467			
27	0,088	0,313	99,780			
28	0,062	0,220	100,000			

The scree plot depicted in Figure 8 reveals a break after the 6th component, as the slope begins to flatten out. The eigenvalues of the six components are greater than one point.

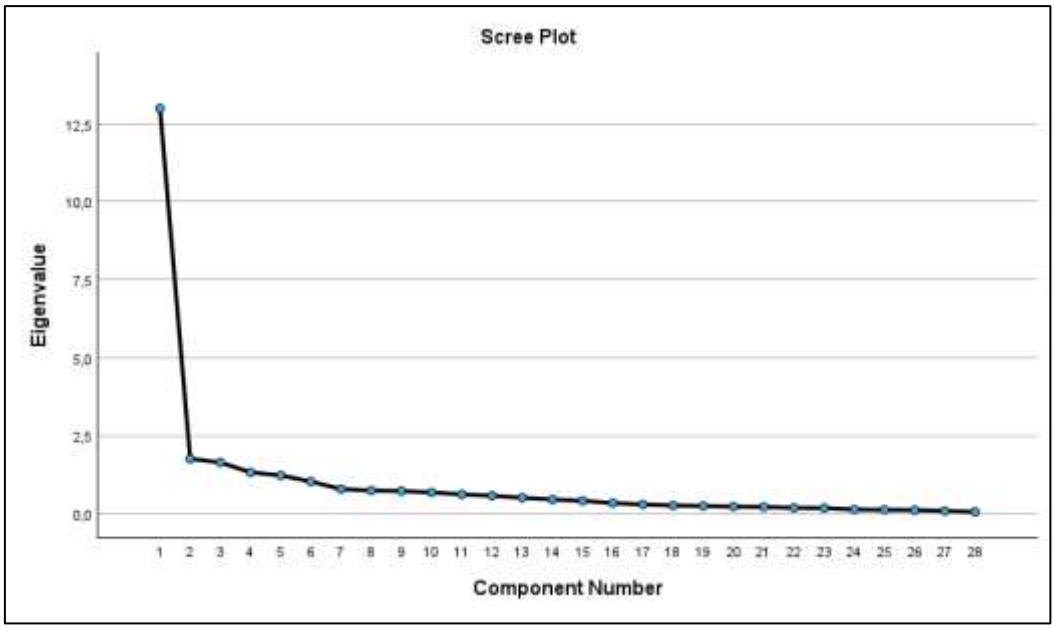

Figure 8: Scree Plot

4.3.8 Demographics of respondents

The study examined several demographic factors, including designation, firm age and the number of affirmative responses within an organisation. The data are provided in Table 12.

Table 12: Profile of Respondent's Designation and Number of Years

Designation * # Yrs Crosstabulation						
Designation	**# Yrs**	**0–2 yrs**	**2–5 yrs**	**5–10 yrs**	**>10 yrs**	**Total**
Front-line employee	Count	5	7	2	14	28
	% within Designation	18%	25%	7%	50%	100%
Junior management	Count	3	7	9	10	29
	% within Designation	10%	24%	31%	35%	100%
Middle-level management	Count	1	5	14	31	52
	% within Designation	2%	10%	28%	61%	100%
Top management	Count	0	0	3	5	8
	% within Designation	0%	0%	38%	63%	100%
Total	Count	9	19	28	60	117
	% within Designation	8%	16%	24%	52%	100%

Table 12 indicates the crosstabulation of designation and number of years of respondents within the mining industry. The respondent's designation was divided into 24% of the respondents being front-line employees, 25% junior management, 43% middle-level management and 7% top management. Top management was the minority respondents to the questionnaire which was expected considering the organograms within the mining industry which have fewer executives than compared to other roles.

The number of years of the individuals who took part in the research were, 8% with 0–2 years, 16% were those with 2–5 years and 76% were those with greater than 5 years. The majority of participants possessed over 5 years of experience in the mining industry; among front-line employees, 50% had accumulated over 10 years of mining experience; over 66% of junior management had more than 5 years of experience; while 89% and 76% of middle management and top management had more than 5 years of experience in mining, respectively.

Table 13 indicates the crosstabulation of designation and the duration for which the participant's organizations have been in operation.

Table 13: Demographic Profile of Respondent's Designation and Firm Age

Designation * Firm Age. Crosstabulation						
Designation	**Firm Age**	**0–10 yrs**	**11–20 yrs**	**21–30 yrs**	**>31 yrs**	**Total**
Front-line employees	Count	6	5	4	13	28
	% within Designation	21%	18%	14%	46%	100%
Junior managers	Count	5	3	7	14	29
	% within Designation	17%	10%	24%	48%	100%
Middle-level managers	Count	12	9	2	29	52
	% within Designation	23%	17%	4%	56%	100%
Top managers	Count	2	0	0	6	8
	% within Designation	25%	0%	0%	75%	100%
Total	Count	25	17	13	62	117
	% within Designation	21%	15%	11%	53%	100%

The duration for which the participant's organizations had been operating was 21% within 0–10 years, 15% were those with 11–20 years, 24% were those with 11–20 years, 11% within 21–30 years and 53% had greater than 31 years. A total of 60% of front-line employees worked for organisations with more than 20 years, over 72% of junior management worked for organisations with more than 2 years, while 60% and 75% of middle management and top management worked for organisations with more than 20 years, respectively. Over 20% of employees worked in organisations which have operated between 0 and 10 years.

4.3.9 Descriptive statistics

The statistical values of average and standard deviations are used in assessing descriptive analysis of this study for the general statistical description of the variables used. The dependent, mediator, moderator and independent variables' values were computed. Table 14 below shows analysis results.

Table 14: Descriptive Analysis of the Latent Constructs

	Designation	**# Yrs**	**Firm Age**	**AEHRM**	**OEHRM**	**MEHRM**	**SEHRM**	**FP**
Mean	2,34	3,21	2,94	3,82	3,64	3,55	3,45	3,68
Median	3	4	4	4	3,75	3,8	3,6	4
Mode	3	4	4	4	3,75[a]	4	4	4
Std. D	0,9	1	1,2	0,891	0,949	1,022	0,959	0,93

a. Multiple modes exist; the smallest value is shown.

According to Table 14, the means of all the variables vary from 3.45 to 3.82 and the standard deviations of all the dimensions range from 0.891 to 1.022. Descriptive statistics show that, with a mean value of 3.82, AEHMR was comparatively higher than the means of the other five variables, which are FP 3.68, OEHRM 3.64, MEHRM 3.55 and SEHRM 3.45. SEHRM has the biggest standard deviation and the lowest mean value. The data indicates that the average score is higher than the mean score.

4.3.10 SmartPLS-SEM path model results

The assessment and reporting of the PLS-SEM path results in this study followed a two-phase process, as advised by Yusuf (2017). These steps include the evaluation of a measurement and structural model.

4.3.10.1 Assessment and significance of the measurement model

This research employed Smart PLS software and PLS-SEM to examine a measurement model, which encompassed assessing content, validity and reliability. PLS-SEM is a technique employed to assess the consistency and effectiveness of a measuring instrument through multiple regressions and factor analysis (Sarstedt et al., 2020). It examines construct validity, internal consistency and reliability to evaluate the external model. Additionally, Moreover, the standard path coefficient and the predictive capability of the model elucidate the association between independent and dependent variables are determined using the R-squared (R^2) values of endogenous variables (Sarstedt et al., 2020). These R^2 values, which indicate the variance explained by the model, are interpreted similarly to multiple regression analysis. Figure 9 displays the PLS measurement model.

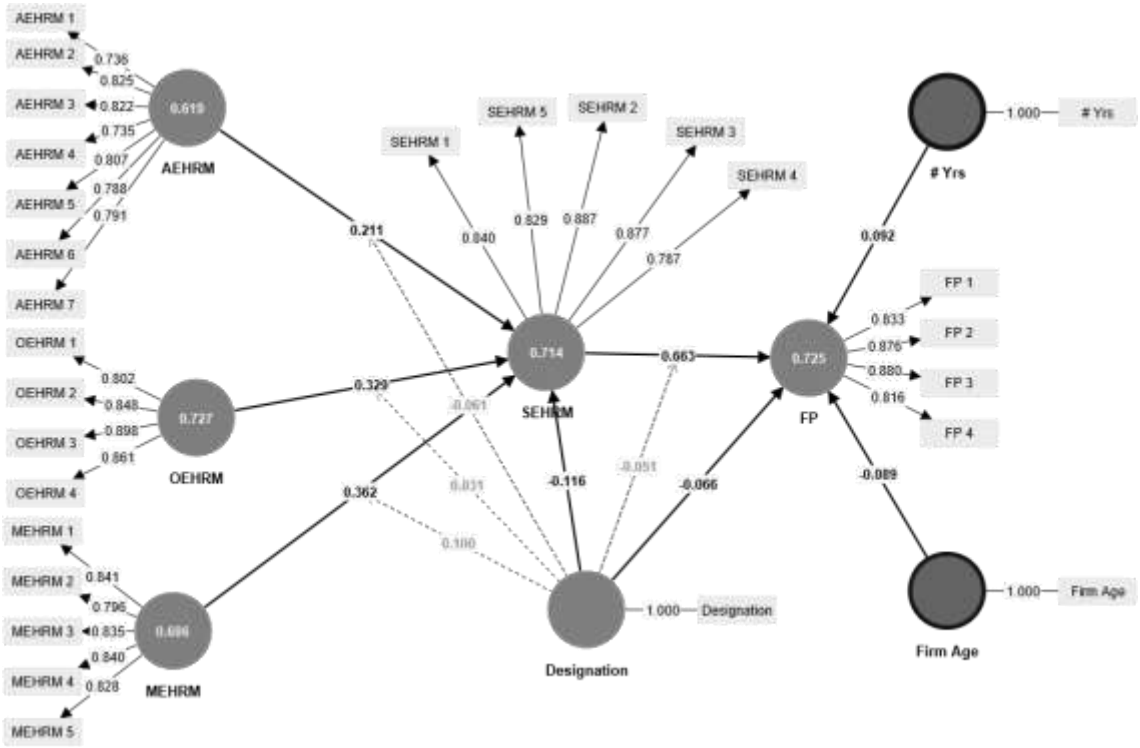

Figure 9: PLS Measurement Model

4.3.10.1.1 Reliability

The reliability of individual items was examined by assessing the outer loading of each measured variable(Frederik & Ahlemann, 2010). Outer loading indicates the extent to which the variance of each indicator is accounted for by its respective latent construct. Values above 0.700 are considered significant, although, for exploratory studies, a lower threshold may be acceptable (Ahlemann & Urbach, 2010). Table 15 presents the individual loadings observed in the study. The individual loadings for all variables were more than 0.700 which is the minimum required loading to retain an item, thus, for this study all the items or individual variables were retained.

Table 15: Individual Variables Loadings

Construct	**Variable**	**Loadings**
AEHRM	AEHRM 1	0.736
	AEHRM 2	0.825
	AEHRM 3	0.822
	AEHRM 4	0.735
	AEHRM 5	0.807
	AEHRM 6	0.788
	AEHRM 7	0.791
OEHRM	OEHRM 1	0.802
	OEHRM 2	0.840
	OEHRM 3	0.898
	OEHRM 4	0.861
MEHRM	MEHRM 1	0.841
	MEHRM 2	0.796
	MEHRM 3	0.835
	MEHRM 4	0.840
	MEHRM 5	0.828
SEHRM	SEHRM 1	0.840
	SEHRM 2	0.829
	SEHRM 3	0.887
	SEHRM 4	0.877
	SEHRM 5	0.787
FP	FP 1	0.833

	FP 2	0.876
	FP 3	0.880
	FP 4	0.815

4.3.10.1.2 Convergent validity

Convergent validity assesses how well items demonstrate the intended latent construct and its correlation with other measures of the same construct. Ahlemann and Urbach (2010) recommend a CR of 0.700 and an AVE of at least 0.500. Table 16 indicates the convergent validity factor outcome of the study.

Table 16: Convergent Validity Factors

Construct	**Cronbach's alpha**	**Composite reliability (rho_a)**	**Composite reliability (rho_c)**	**AVE**
AEHRM	.897	.906	.919	.618
FP	.874	.877	.913	.725
MEHRM	.885	.887	.916	.685
OEHRM	.875	.879	.914	.727
SEHRM	.899	.904	.926	.714

Table 16 indicates that all individual latent constructs exhibited CR values exceeding 0.9, surpassing the lowest threshold of 0.7 required to establish convergent validity. Moreover, the AVE for each individual latent construct exceeded 0.6, which surpasses the required 0.5 threshold for achieving convergent validity. Hence, It is evident that all individual latent constructs in this study successfully demonstrated convergent validity.

4.3.10.1.3 Internal consistency reliability

Internal consistency reliability pertains to the uniformity of items within a subscale assessing the same concept. In organisational research, both Cronbach's alpha and the CR coefficients are commonly employed metrics to assess this reliability (Ahlemann & Urbach, 2010). As depicted in Table 16, Cronbach's alpha exceeded 0.874 for all constructs and the CR coefficient surpassed 0.913 for all constructs,

surpassing the threshold of 0.600 for both metrics. Therefore, the study's constructs demonstrated internal consistency reliability.

4.3.10.1.4 Discriminant validity

The degree of distinction between constructs is known as discriminant validity(Ahlemann & Urbach, 2010). It ensures that the measures do not inadvertently capture something else. In SEM using PLS, two metrics are commonly utilised: cross-loadings and the Fornell-Larcker criterion (Ahlemann & Urbach, 2010).

Cross loading involves correlating component scores with other variables, demonstrating that indicators are not interchangeable. According to Fornell-Larcker criterion, a latent construct ought to exhibit greater shared variance with its indicators to which it is assigned, requiring an AVE higher than any other relationship's highest squared correlation of latent construct (Ahlemann & Urbach, 2010). Table 17 presents the assessment of external validity for the study.

Table 17: Discriminant Validity

Construct	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
# Yrs	**1.000**							
AEHRM	0.048	**0.786**						
Designation	0.280	-0.010	**1.000**					
FP	0.057	0.655	-0.105	**0.852**				
Firm Age	0.159	0.068	0.043	-0.092	**1.000**			
MEHRM	0.078	0.713	0.042	0.616	-0.003	**0.828**		
OEHRM	-0.046	0.747	0.047	0.616	-0.005	0.777	**0.852**	
SEHRM	-0.002	0.714	-0.075	0.672	-0.024	0.771	0.771	**0.845**

Note: Diagonals (boldface) represent the square root of the AVE, while the other entries indicate correlations.

The results presented in Table 17 demonstrate that the AVE value for each construct exceeds the highest squared correlation with any other latent construct. This indicates that all latent variables in the study exhibited discriminant validity.

4.3.10.1.5 Cross-loading

Examining the cross-loadings entails correlating the item scores of each latent variable with all other items. When, indicators exhibits a stronger loading on its assigned construct than on any other construct, and if each construct predominantly loads on its own items, it suggests distinctness of constructs in the model (Ahlemann & Urbach, 2010). Table 18 presents the cross-loadings.

Table 18: Cross-loadings

Variable/ construct	**# Yrs**	**AEHRM**	**Designation**	**FP**	**Firm Age**	**MEHRM**	**OEHRM**	**SEHRM**
# Yrs	**1.000**	0.048	0.280	0.057	0.159	0.078	-0.046	-0.002
AEHRM 1	-0.004	**0.769**	-0.055	0.567	0.118	0.506	0.544	0.513
AEHRM 2	0.042	**0.846**	-0.009	0.574	0.046	0.553	0.623	0.545
AEHRM 3	0.129	**0.829**	-0.060	0.581	0.146	0.646	0.697	0.632
AEHRM 4	-0.015	**0.735**	0.137	0.412	-0.049	0.455	0.559	0.461
AEHRM 5	-0.002	**0.773**	0.020	0.406	0.003	0.563	0.571	0.611
AEHRM 6	0.036	**0.767**	0.032	0.431	0.040	0.556	0.531	0.544
AEHRM 7	0.048	**0.779**	-0.063	0.564	0.021	0.629	0.572	0.620
Designation	0.280	-0.010	**1.000**	-0.105	0.043	0.042	0.047	-0.075
FP 1	0.050	0.566	-0.069	**0.844**	-0.030	0.533	0.568	0.528
FP 2	0.092	0.553	-0.107	**0.877**	-0.077	0.492	0.467	0.550
FP 3	0.026	0.590	-0.116	**0.876**	-0.091	0.586	0.567	0.647
FP 4	0.031	0.518	-0.064	**0.809**	-0.117	0.477	0.489	0.557
Firm Age	0.159	0.068	0.043	-0.092	**1.000**	-0.003	-0.005	-0.024
MEHRM 1	0.084	0.702	0.066	0.541	0.006	**0.849**	0.714	0.645
MEHRM 2	0.060	0.621	0.151	0.499	-0.048	**0.804**	0.661	0.578
MEHRM 3	0.030	0.521	0.066	0.461	0.003	**0.826**	0.643	0.635
MEHRM 4	0.065	0.507	-0.075	0.515	-0.005	**0.832**	0.584	0.688
MEHRM 5	0.077	0.591	-0.027	0.525	0.031	**0.827**	0.614	0.644
OEHRM 1	-0.029	0.642	-0.037	0.521	-0.028	0.618	**0.806**	0.635
OEHRM 2	-0.028	0.610	-0.015	0.589	0.002	0.706	**0.852**	0.711
OEHRM 3	-0.044	0.690	0.080	0.510	0.029	0.693	**0.895**	0.658

Variable/ construct	# Yrs	AEHRM	Designation	FP	Firm Age	MEHRM	OEHRM	SEHRM
OEHRM 4	-0.062	0.604	0.153	0.462	-0.021	0.619	**0.855**	0.611
SEHRM 1	0.124	0.688	0.042	0.609	0.009	0.634	0.680	**0.843**
SEHRM 2	0.031	0.673	-0.072	0.618	-0.097	0.725	0.695	**0.887**
SEHRM 3	-0.021	0.589	-0.033	0.561	0.027	0.658	0.669	**0.877**
SEHRM 4	-0.106	0.508	-0.176	0.495	-0.037	0.602	0.579	**0.784**
SEHRM 5	-0.066	0.536	-0.100	0.543	0.002	0.632	0.624	**0.829**

From Table 18, it is evident every indicator loaded on each of its unique constructs ranges between 0.735 and 0.887. Furthermore, each indicator exhibited a stronger loading at its own specific construct compared other constructs.

4.3.10.2 Assessment of significance of the structural model

The structural model assessment was conducted after the measurement model, using the bootstrapping approach to evaluate path coefficients for direct and indirect loadings. The study resampled 5000 samples and 118 instances, following the recommendations of Hair et al. (2020). The structural model includes testing hypotheses through the path coefficients, evaluating variance in endogenous variables and determining effect size and predictive relevance (Ahlemann & Urbach, 2010).

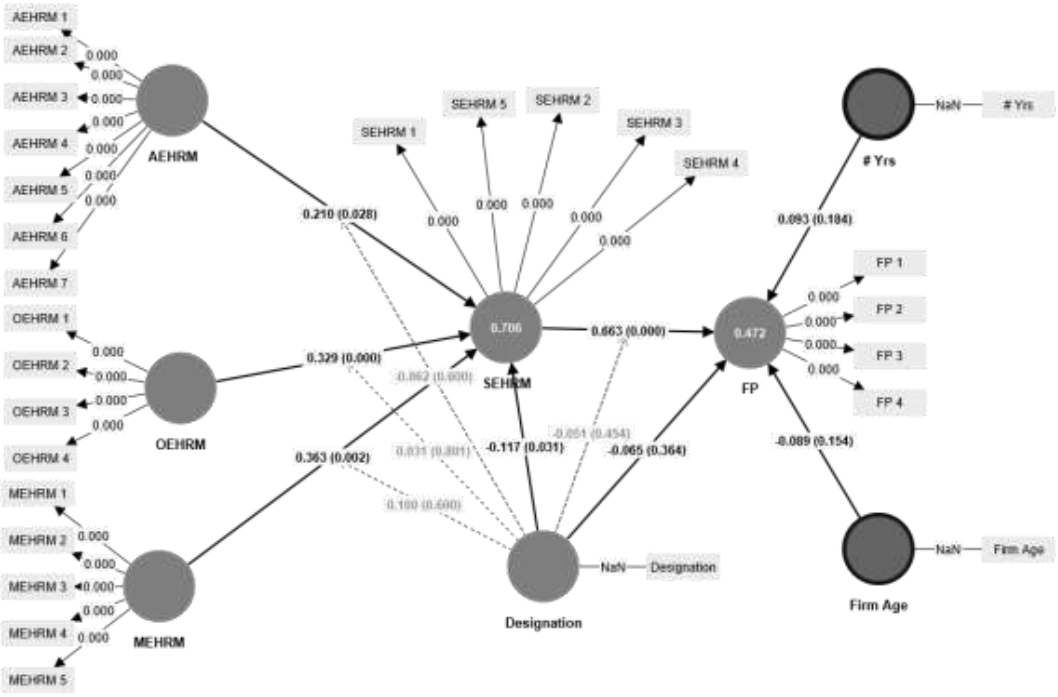

Figure 10: Structural Model

The purpose of the study was to investigate the influence of integrated e-HRM systems on the safety performance of a firm's front-line employees. To address this question, a structural model was employed to explore the connections among the e-HRM system, SEHRM system, employee role or level and mine safety performance. Hypotheses about direct relationships, mediation and moderation effects were tested and the findings of these tests are presented in Table 19.

Table 19: Hypothesis Testing

Hypothesis	**Relationship**	**Standard deviation (STDEV)**	**T-Values**	**P-values**	**Outcome**
H1	AEHRM -> SEHRM	0.095	2.203	0.028	Supported
H2	OEHRM -> SEHRM	0.094	3.521	0.000	Supported
H3	MEHRM -> SEHRM	0.116	3.138	0.002	Supported
H7	SEHRM -> FP	0.071	9.368	0.000	Supported
H8	Designation -> SEHRM	0.054	2.138	0.033	Supported

The outcomes of the testing of hypotheses shown in Table 19 reveal compelling findings. For H1, the t-value of 2.203 exceeds the threshold of 1.96 and the p-value of 0.028 is below the threshold of 0.05. The results indicate a significant link between AEHRM practices and SEHRM systems.

Likewise, for H2, the t-value of 3.138 surpasses the threshold of 1.96 and the p-value of 0.002 falls below 0.05. The results demonstrate a significant link between OEHRM practices and SEHRM systems.

Concerning H3, the t-value of 3.521 exceeds 1.96 and the p-value of 0.000 is below 0.05. The results demonstrate a significant link between MEHRM practices and SEHRM systems.

For H7, the t-value of 9.368 is well above 1.96 and the p-value of 0.000 is below 0.05, demonstrating a strong and significant relationship between SEHRM systems and firm safety performance.

4.3.11 Testing mediating effect

Mediating variables, which are often referred to as intervening or intermediary variables, aid in clarifying the underlying processes of a relationship between variables (Ahlemann & Urbach, 2010). In essence, mediating factors give a more thorough knowledge of the link between the dependant and independent variables by pointing out the mechanisms or processes that allow the effects to happen.

Table *20* shows the results of assessing SEHRM systems as a mediating variable

Table 20: Testing for Mediating Effect

Total Effects			
Link	**Standard deviation**	**T-statistic**	**P-value**
AEHRM -> FP	0.066	2.120	0.034
MEHRM -> FP	0.080	2.998	0.003
OEHRM -> FP	0.067	3.255	0.001
Specific indirect effects			

MEHRM -> SEHRM -> FP	0.080	2.998	0.003
OEHRM -> SEHRM -> FP	0.067	3.255	0.001
AEHRM -> SEHRM -> FP	0.066	2.120	0.034
Total direct effects			
AEHRM -> FP	0.096	3.035	0.002
MEHRM -> FP	0.120	0.987	0.323
OEHRM -> FP	0.126	0.670	0.503
SEHRM -> FP	0.135	2.175	0.030

The analysis reveals significant total indirect effects between the independent variables (AEHRM, OEHRM, MEHRM) and FP, as indicated by t-values ranging from 2.120 to 3.255, surpassing the threshold t-value of 1.96, with corresponding p-values of 0.001 and 0.034.

Moreover, when examining the specific indirect effects of the independent variables on the mediating variable (SEHRM systems) and the dependent variable, similar significant relationships are observed, with t-values exceeding 2.120 and 2.998 and p-values ranging between 0.001 and 0.034.

However, upon reviewing the direct effects, it is noted that only AEHRM exhibits a significant direct relationship with FP, with a t-value of 3.035 and a p-value of 0.002, suggesting a direct link without the mediating variable. Consequently, SEHRM systems act as a complementary and partial mediator between AEHRM and FP.

Conversely, OEHRM and MEHRM demonstrate t-values of 0.670 and 0.987, respectively, falling below the threshold of 1.96, with corresponding p-values of 0.503 and 0.323, indicating an insignificant direct relationship with FP. Therefore, the association between OEHRM, MEHRM and FP is fully or completely mediated by SEHRM systems.

4.3.12 Testing moderating and controlling effect

Factors that influence the direction or degree of different variables relationships are referred to as moderating variables, or interaction variables (Sharma et al., 2023). Stated differently, they affect the degree to which one variable affects another in various contexts. Meaning the link can be altered by moderators in one of two ways: it

can get stronger or weaker. Within the framework of this investigation, moderating variables may comprise elements such as personal traits (Sharma et al., 2023).

To guarantee an accurate assessment of the relationship between the independent and dependent variables, characteristics that are maintained constant or modified are referred to as controlling variables (Sharma et al., 2023). Although not the main focus of the study, these factors are included to eliminate any potential confounding effects they might have on the relevant relationship. Table 21 indicates the moderation and controlling effect within the study.

Table 21: Moderation and Controlling Effect

Link	**Standard deviation**	**T-statistic**	**P-value**
# Yrs -> FP	0.070	1.329	0.184
Designation -> FP	0.072	0.908	0.364
Firm Age -> FP	0.062	1.424	0.154
Designation x MEHRM -> SEHRM	0.191	0.524	0.600
Designation x OEHRM -> SEHRM	0.125	0.252	0.801
Designation x SEHRM -> FP	0.069	0.749	0.454
Designation x AEHRM -> SEHRM	0.118	0.525	0.600

The outcome revealed in Table 21 indicates that the t-test for the moderation and controlling effect relationships is between 0.252 and 1.329 which is below the threshold of 1.96 and the p-values are between 0.154 and 0.801 which is above the threshold of 0.05, indicating a rather partial to insignificant moderation and controlling effect between the variables.

4.3.13 Assessments of variance R^2

In PLS-SEM, the variance R^2 serves as a pivotal metric for gauging the extent to which endogenous constructs elucidate variance (Hair et al., 2020). This metric quantifies the squared correlation between anticipated and actual values, with higher scores denoting a more robust explanatory capacity (Hair et al., 2020).

When assessing latent variables' variance in relation to their overall variance, values approximately around 0.670 are deemed substantial, those around 0.333 are moderate and values nearing 0.190 are categorised as weak (Ahlemann & Urbach, 2010).

Figure 11 reveals that the variance R^2 for SEHRM systems and FP (safety) is 0.706 and 0.472, respectively. These findings suggest that the R^2 for SEHRM systems is significant, surpassing the threshold of 0.67, while the R^2 for FP is moderate, exceeding the threshold of 0.33.

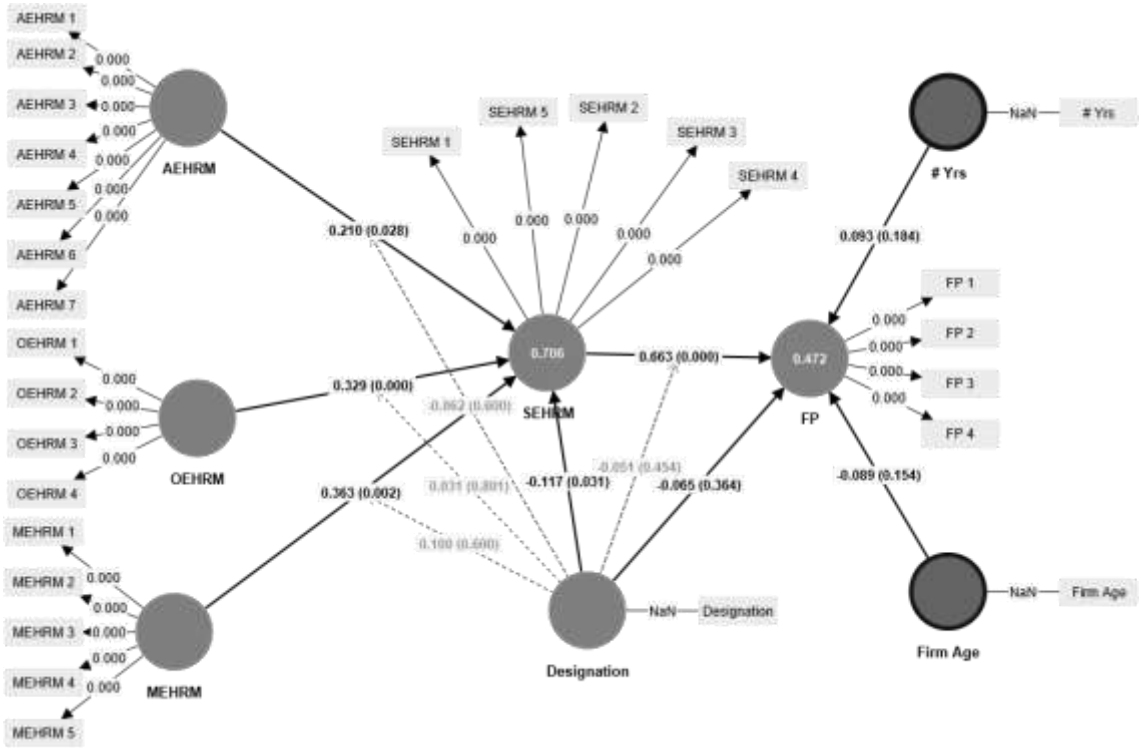

Figure 11: Model Showing the R2 Explained

Additionally, in Table 22 is the outcomes of the variance assessment, showing that for FP and SEHRM systems, the t-statistics are 5.947 and 11.117, respectively. Both t-values are above the threshold of 1.96. Similarly, the p-values for both the latent variables are 0.0000 which is below 0.05, indicating a significant explanation of dependent variables in the model.

Table 22: Assessment of Variance Explained

Construct	Original sample	Sample mean	Standard deviation	T-statistics	P-values
FP	0.472	0.492	0.079	5.947	0.000
SEHRM	0.706	0.734	0.063	11.117	0.000

4.3.14 Assessment of effect size

In PLS-SEM, the F_2-statistic serves as a vital measure for assessing the predictive relevance of a construct in explaining its associated indicators (Hair et al., 2020). It indicates how effectively a latent variable predicts its indicators. The F_2-statistic is computed using the R^2 value for each latent construct, which quantifies the variance in the indicators that the construct explains.

A high F_2 value suggests strong predictive relevance for the indicators, with values of 0.020, 0.150 and 0.350 denoting low, medium or large effects of the predictor variable in the structural model (Ahlemann & Urbach, 2010). By analysing the F_2-statistic, researchers can assess the significance of each construct in their PLS-SEM model.

Table 23: Effect Size of Latent Variables F_2

Construct	FP	SEHRM
# Yrs	0.014 small	
AEHRM		0.058 small
Designation	0.007 small	0.045 small
FP		
Firm Age	0.014 small	
MEHRM		0.140 partial moderate
OEHRM		0.102 Small
SEHRM	0.827 large	

The results above, show the effect sizes of SEHRM for AEHRM, Designation, MEHRM and OEHRM were 0.058, 0045, 0.14 and 0.102, respectively, indicating small, small, partial moderate and small effect sizes (Ahlemann & Urbach, 2010). Similarly, the

effect sizes #Yrs, Designation, Firm Age and SEHRM were 0.014, 0.007, 0.014 and 0.827, respectively, indicating small, small, small and large effect sizes (Ahlemann & Urbach, 2010). Nonetheless, even tiny impact sizes can have significant theoretical and practical significance (Bakker et al., 2019).

4.3.15 Assessment of predictive relevance

In assessing the quality of measurement (Q2) in PLS-SEM, researchers rely on predictive relevance metrics (Hair et al., 2020). Q2 evaluates a model's predictive performance compared to a baseline model, often the mean of the dependent variable or a simple naïve model. Stone-Geisser's Q2 is a widely used metric for Q2 assessment; it gauges the predictive significance of endogenous components by calculating the difference between the baseline model's R^2 and the R^2 of the endogenous construct (Hair et al., 2020).

A higher Q2 indicates greater predictive significance and one way to assess changes in a model is to compare its Q2 values. It is suggested that Q2 should be greater than 0 (Ahlemann & Urbach, 2010), with Hair et al. (2020) categorising Q2 values of 0.02, 0.15 and 0.35 as indicating weak, moderate and strong degrees of predictive relevance, respectively.

Table 24: Construct Validated Measure Q2

Construct	**Q^2 predict**	**RMSE**	**MAE**
FP	.393	.796	.607
SEHRM	.598	.643	.439

From Table 24, the Q2 values for both FP and SEHRM systems are 0.393 and 0.598 which are above 0.35, indicating stronger degrees of predictive relevance in the study.

4.4 Summary of Findings

Following the presentation of all the findings, including the main, mediating, moderating and controlling effects, the earlier sections provide an overview of the outcomes for all the tested hypotheses (Table 25).

Table 25: Summary of Hypothesis Testing

Hypo-thesis	**Relationship**	**Statement**	**Findings**
H1	AEHRM -> SEHRM	There is a positive relationship between AEHRM practices and the SEHRM system.	Supported
H2	OEHRM -> SEHRM	There is a positive relationship between OEHRM and the SEHRM system.	Supported
H3	MEHRM -> SEHRM	There is a positive relationship between MEHRM and the SEHRM system.	Supported
H4	Designation x MEHRM -> SEHRM	There is a positive relationship between AEHRM practices and employee role or level.	Not Supported
H5	Designation x OEHRM -> SEHRM	There is a positive relationship between OEHRM and employee role or level.	Not Supported
H6	Designation x AEHRM -> SEHRM	There is a positive relationship between MEHRM and employee role or level.	Not Supported
H7	SEHRM -> FP	There is a positive relationship between the SEHRM system and firm safety performance.	Supported
H8	Designation -> SEHRM	There is a positive relationship between employee role or level and the SEHRM system.	Supported

5 DISCUSSIONS

5.1 Introduction

In this chapter, the research findings from the previous chapter are expanded upon and further analysed concerning theoretical and empirical viewpoints, as well as earlier studies on SEHRM systems towards safety performance. This chapter is structured as follows:

The primary aim of the study was to identify the impact of integrated e-HRM systems for front-line employees on safety performance. Based on the findings of the analysis that addressed the following research questions, it can be concluded that this study succeeded in adding to the present understanding of the relationship between e-HRM systems and safety performance:

1. What is the relationship between AEHRM practices, AEHRM practices and MEHRM practices on SEHRM systems?
2. What is the relationship between AEHRM practices, OEHRM practices, MEHRM practices and employee role or level?
3. What is the relationship between SEHRM systems and mine safety performance?
4. What is the relationship between SEHRM systems and employee roles or levels?

The study examined the influence of six distinct constructs, namely, AEHRM, OEHRM, MEHRM, SEHRM, employee designation or level and mining safety performance. These constructs collectively contribute to 71% of the variation in SEHRM systems and 47% in the overall model, which is considered a substantial and moderate contribution, respectively, in social science research – although a moderate contribution according to Hair et al. (2020). Details of these results can be found in Table 22 regarding R^2.

Following Ahlemann and Urbach's (2010) guidelines, the study indicated that the effect sizes of SEHRM for various factors – AEHRM, Designation, MEHRM, OEHRM and #Yrs – were classified as small, small, partial, moderate and small, respectively. However, it is worth noting that even small effect sizes can hold significant theoretical

and practical implications, as highlighted by Bakker et al. (2019), as demonstrated in Table 23.

Regarding convergent validity, the values of CR between the constructs and AVE range from 0.618 to 0.725 and 0.913 to 0.926, respectively. These results affirm satisfactory convergent validity.

The study identified significant indirect and specific indirect effects of AEHRM, OEHRM and MEHRM on FP, as outlined in

Table *20*. These effects surpass the threshold t-value of 1.96, suggesting the positive influence of SEHRM systems. However, only AEHRM exhibits a direct relationship with FP, implying that SEHRM serves as a complementary mediator. In contrast, other variables display an insignificant direct relationship, indicating that SEHRM systems mediate the connection between OEHRM and MEHRM.

Table 21 illustrates a range from moderate to insignificant moderation and controlling effects between variables, with t-test outcomes falling below the 1.96 threshold and p-values exceeding the 0.05 threshold. This suggests a partial to insignificant relationship among the variables. Consequently, the study upholds the theoretical association between exogenous latent variables such as AEHRM systems and endogenous latent variables, namely, SEHRM systems.

Mediating variables also referred to as intervening or intermediary variables, elucidates the relationship between a dependent and independent variable by identifying the mechanisms through which effects occur. This concept is illustrated in

Table *20*.

Moderating variables, also known as interaction variables, exert influence on the relationship between independent and dependent variables, either strengthening or weakening the link and often include personal traits. Controlling variables, which are held constant or manipulated, ensure an accurate assessment of the relationship. The study's findings indicated a partial to insignificant moderation and controlling effect among the variables, with t-tests falling below the 1.96 threshold and p-values exceeding the 0.05 threshold. The moderation and controlling effects are analysed

presented in Table 21. The table reveals a range of moderate to insignificant moderation and controlling effects between variables, with t-test results below the 1.96 threshold and p-values above the 0.05 threshold, signifying partial to insignificant relationships.

Table 19 presents the hypothesis testing results for e-HRM practices. The findings demonstrate a significant link between AEHRM practices and SEHRM systems. Specifically, for H1, a t-value of 2.203 indicates a signifcant relationship between AEHRM practices and SEHRM systems. For H2, a t-value of 3.138 suggests a significant relationship between OEHRM and SEHRM. Lastly, for H3, a t-value of 3.521 indicates a significant relationship between MEHRM practices and SEHRM systems

5.2 Research Respondents' Demography and Descriptive Statistics

This section presents an analysis of the demographic components of the research study. The study examined three demographic questions, namely, designation or role within the organisation, the number of years within the mining industry and how long the organisation has been in operation.

The results reveal the distribution of respondents across various roles in the mining industry. Front-line employees constituted 24% of the respondents, junior management 25%, middle-level management 43% and top management 7%. It is noteworthy that top management was a minority group, which aligns with the industry's typical organisational structure featuring fewer executives at that level.

The majority of respondents reported having over 5 years of experience, with 50% of front-line employees having more than 10 years of experience. Similarly, junior management reported over 66% experience, while both middle management and top management reported over 5 years of experience.

Furthermore, the findings indicate that 21% of respondents' organisations have been operating for 0–10 years, 15% for 2–5 years, 24% for 11–20 years, 11% for 21–30 years and 53% for more than 31 years. Notably, 60% of front-line employees work for organisations with over 20 years of operation.

The distribution of respondent employee levels aligns with Chowdhury et al.'s (2021) study on SEHRM systems and FP, where the majority of respondents occupied lower

levels, specifically middle to junior management positions. In the current research, 24% of respondents were front-line employees at lower levels. Additionally, 24% of the participants reported having fewr than 5 years of experience, in contrast to the study by Chowdhury et al. (2021) where 100% reported having over 5 years of experience. This inclusion of employees, often referred to as novices, with fewer years in the industry, offers unique insights as they may not be fully acclimated to the industry's current environment.

Moreover, the majority of organisations (79%) reported having over 10 years of experience, compared to the study by Chowdhury et al. (2021) where all organisations reported having more than 10 years of operation. The presence of new entrants was anticipated, considering the mining organisations' efforts to meet mining charter requirements for transformation through supplier development and localised procurement. This dynamic creates a unique aspect of FP for mining organisations, especially in terms of safety performance.

Descriptive statistics demonstrated that the range of all variables' mean values are between 3.45 to 3.82, meaning the majority of respondents agreed with most of the questions in the survey for all constructs. The standard deviations from the results were between 0.891 to 1.022, indicating a spread between disagree and agree on the Likert scale. AEHMR has the highest mean (3.82) of the other five variables, with SEHRM having the lowest mean value. Overall, the results indicated the average score for all constructs.

5.3 Discussion

Discussion on the relationship between AEHRM practices and SEHRM systems – Hypothesis 1

Chowdhury et al. (2021) explored the correlation between AEHRM practices and SEHRM systems in the context of FP. Notably, the mining sector often faces technological constraints, with compliance regulations mandating manual processes for certain systems. Results underscore the significant relationship between AEHRM practices and SEHRM systems, as evidenced by a t-value of 2.203 and a p-value of <0.028. This emphasises the pivotal role of AEHRM practices in nurturing SEHRM systems within mining organisations.

The research suggests that mining entities can enhance their AEHRM practices to ensure sustainability, aligning with previous studies by Chowdhury et al. (2021). Moreover, leveraging e-HRM technologies can enhance employees' skills, knowledge and abilities. This can be achieved through various initiatives, such as online performance review systems and training and development programmes, aimed at enhancing employees' capacity to fulfil their roles effectively and consequently, contributing to the sustainability of e-HRM systems. Consequently, this facilitates rapid improvements in employee productivity, knowledge retention, satisfaction, retention rates and promotion rates within the organisation.

Discussion on the relationship between OEHRM practices and SEHRM systems – Hypothesis 2

Chowdhury et al. (2021) investigated the correlation between OEHRM practices and SEHRM systems in the realm of FP, particularly focusing on safety performance within the mining industry. The study was conducted within a context where technological advancements are limited and compliance regulations necessitate manual processes for certain systems.

The findings of the research, captured through the second hypothesis, reveal a significant relationship between OEHRM practices and SEHRM systems in driving FP. Specifically, the study highlights a substantial positive association between OEHRM and SEHRM systems, supported by a hypothesis test t-value of 3.138 and a p-value of <0.002. Notably, OEHRM practices emerge as the primary contributor to the SEHRM construct, with an R^2 value of 0.727.

These results align with prior studies conducted by Chowdhury et al. (2021) on the relationship between OEHRM practices and SEHRM systems. Consequently, the study suggests that implementing OEHRM systems, such as employee social networking sites and online suggestion boxes, can foster employee engagement and participation within the organisation. This, in turn, stimulates innovation and growth within an SEHRM systems-led organisation. Moreover, an engaged workforce cultivates a psychologically safe environment conducive to innovation, thereby enhancing firm safety performance.

Discussion on the relationship between MEHRM and SEHRM system – Hypothesis 3

The third hypothesis of the study examined the significance of this relationship, revealing a substantial connection between MEHRM practices and SEHRM systems towards FP. The hypothesis test yielded a noteworthy t-value of 3.521 and a robust p-value of <0.000, emphasising the importance of MEHRM practices in nurturing SEHRM systems within mining organisations. These findings echo results from Chowdhury et al. (2021) study of the association between MEHRM practices and SEHRM systems.

Therefore, the study suggests that implementing MEHRM systems, such as employee self-service portals, feedback mechanisms and online recognition programmes, can foster heightened employee engagement and motivation, ultimately leading to improved performance and productivity, particularly when executed sustainably.

5.4 Research Question 1

The primary research question examined the relationship between AEHRM, OEHRM and MEHRM practices and SEHRM systems. This inquiry was addressed through the testing of the first three hypotheses (H1, H2 and H3). The findings of these hypotheses, as detailed in the preceding section, support a significant relationship between AEHRM, OEHRM and MEHRM practices and SEHRM systems. These results are aligned to previous studies across various industries, suggesting their generalisability to mining organisations.

In contemporary HR management, the integration of AEHRM, OEHRM and MEHRM practices with SEHRM systems is essential. Opportunity-enhancing activities offer avenues for meaningful work experiences and career advancement while ability-enhancing practices focus on developing employees' skills and knowledge. Simultaneously, motivation-enhancing techniques enhance staff commitment and morale.

When these practices are integrated into SEHRM systems, they contribute to socially and environmentally responsible organisational objectives while mitigating adverse effects. Employees who engage in ability-enhancing behaviours are better positioned to leverage the opportunities provided by these practices. Moreover, motivated

employees are more likely to capitalise on these opportunities, leading to enhanced organisational output and a conducive environment for creativity to flourish

In conclusion, the implementation of ecologically and socially responsible practices through SEHRM systems not only enhances societal and environmental well-being but also provides mining organisations with a competitive edge in the industry.

5.6 Mediation Effect of Sustainable Electronic Human Resource Management

This section elaborates on the mediation effect of SEHRM systems on AEHRM, OEHRM and MEHRM practices. While the preceding sections highlighted the total effects of the relationships between these constructs, this section delves into the examination of the mediation effect of SEHRM within the model. According to Ahlemann and Urbach (2010), mediating variables offer a deeper insight into the dependent and independent variables relationship by identifying the mechanisms or processes that facilitate the effects.

In this study, the contribution of direct effects and indirect effects to the total effects for independent variables, namely AEHRM, OEHRM and MEHRM practices on firm safety performance, was analysed to understand the role of an SEHRM system as a mediator. Table 20 in the results section indicates that the total effects of all the independent variables are significant, with AEHRM having a t-value of 2.12, p-value = 0.034, OEHRM with a t-value of 3.255, p-value = 0.001 and MEHRM with a t-value of 2.998, p-value = 0.003, indicating a significant relationship with firm safety performance.

However, upon examining the direct relationship in

Table *20*, it is observed that with the removal of the mediating variable, the direct effects of the constructs are only partially significant. The results show that AEHRM has a t-value of 3.035, p-value = 0.002, OEHRM with a t-value of 0.670, p-value = 0.503 and MEHRM with a t-value of 0.987, p-value = 0.323.

These findings indicate a significant direct effect between AEHRM and firm safety performance, while no direct relationship between MEHRM and OEHRM with firm safety performance is observed. Furthermore, the results suggest that SEHRM is a partial mediator for the relationship between AEHRM and firm safety performance, while it is a full mediator for the relationship between MEHRM and OEHRM with firm

safety. Based on these results, SEHRM systems are supported as the mediator in the model under study. The observed results are in line with Chowdhury et al.' (2021) study, where an SEHRM system acts as a mediator within the e-HRM system model.

SEHRM technologies amalgamate AEHRM systems, OEHRM systems and MEHRM systems for comprehensive HR management, thereby promoting long-term business success. They encompass sustainability plans, ethical data handling and technology effectiveness, necessitating awareness and commitment to develop robust and efficient HR systems. SEHRM systems enhance FP by improving efficiency, productivity, talent acquisition, strategic alignment, risk management, compliance and innovation. Integrating environmentally and socially responsible practices into HR processes creates a competitive advantage and benefits society and the environment

5.7 Moderation Effect of Employee Role and Controlling Variables

This section delves into the moderating effect of employee role or designation on the relationship between AEHRM, OEHRM and MEHRM practices with SEHRM systems and SEHRM with FP. They can either strengthen or weaken the link between the variables and may include personal traits within the context of this investigation.

Hypothesis tests (H4, H5 and H6) were conducted to confirm or refute the interaction variable effect of designation (employee role).Table 21 indicate that the moderating effect of employee role or designation is insignificant, for instance, the t-value for Designation (employee role) x MEHRM -> SEHRM is 0.5 with a p-value of 0.600. Similarly, the t-values for other moderating effects, such as Designation x OEHRM -> SEHRM and Designation x AEHRM -> SEHRM, are below the threshold, leading to the rejection of the hypotheses. These results imply that employee role does not influence the interaction between e-HRM systems and SEHRM systems, as well as SEHRM systems and firm safety performance.

According to Al-Harazneh & Sila, (2021), the work environment and interactions with managers affect employees' perceptions of HRM applications. While the literature indicates the moderating effect of employee roles on e-HRM practices, with different job functions impacting the effectiveness of e-HRM initiatives, in this study, the focus on safety performance within the mining environment suggests a common understanding of safety systems and initiatives across all organisational levels.

The study suggests that employee levels do not moderate e-HRM systems concerning mining safety performance, emphasising the need for organisations to ensure systemic and standardised e-HRM systems for all employees at different levels to enhance safety performance. However, this does not discount the need for categorising different systems to cater to various levels in the organisation.

Similarly, controlling variables, as shown in Table 21, were not significant for safety FP. Firm age, number of years employees had in the mining industry and designation did not yield significant results, suggesting that safety performance is not solely dependent on these variables but rather on the systems an organisation has in place. Nonetheless, as organisations mature in systems (not age), safety performance also tends to improve

5.8 Research Question 2

This question delved into the moderating impact of employee level. It sought to elucidate how employee level moderates the relationship between AEHRM, OEHRM and MEHRM practices and SEHRM, additionally to the moderating influence on the connection between SEHRM and firm safety performance. Three hypotheses (H4, H5, H6) were formulated to explore this aspect.

The results of the investigation showed that the moderating effect of employee level is insignificant, with t-values and p-values falling below the threshold, leading to the rejection of the hypotheses. These results indicate that employee level does not exert influence on the relationships between AEHRM, OEHRM, MEHRM and SEHRM systems and firm safety performance.

These outcomes imply that standardised safety protocols, comprehensive training initiatives, adherence to legal regulations, collaborative efforts, robust technological safeguards and a strong safety-oriented organisational culture collectively contribute to mitigating the potential impact of employee roles on safety outcomes in mining enterprises.

5.5 Research Question 3

Discussion on SEHRM system and firm safety performance

The question delved into the connection between SEHRM systems and firm safety performance, particularly focusing on safety performance within mining organisations. This relationship was also explored in the study Chowdhury et al.'s (2021) study. While Chowdhury et al. (2021) examined various aspects of FP, such as employee performance enhancement, retention rate, return on assets, net profit after tax, productivity, cost control, meeting client time specifications and reputation, this study narrowed its focus to safety performance, a crucial aspect governed by the MHSA.

Hypothesis 7 was formulated to test the connection between SEHRM systems and firm safety performance within mining organisations. The results indicated a robust test t-value of 9.368 and a significant p-value of <0.000, thereby supporting the hypothesis.

The outcomes suggest that SEHRM solutions play a pivotal role in streamlining HR procedures and technology platforms, ultimately enhancing organisational performance by improving employee safety. These solutions offer features such as flexible work schedules and self-service portals, which enhance worker productivity and satisfaction. Moreover, they support personnel acquisition and retention, fostering an inclusive and safe workplace culture.

Furthermore, SEHRM solutions provide valuable data-driven insights into personnel trends and performance indicators, facilitating strategic alignment. They also contribute to risk management and compliance efforts by reducing the risks associated with data breaches, training gaps and legal non-compliance. By promoting ongoing education and skill development, successful e-HRM systems encourage creativity and flexibility among employees.

5.9 Research Question 4

Discussion on the relationship between SEHRM systems and employee role or level

The eighth hypothesis aimed to explore the relationship between SEHRM systems and employee designation, addressing the fourth research question. The results show a

significant correlation between SEHRM systems and employee level, with a hypothesis test t-value of 2.138 and a p-value of <0.033, underscoring the significance of employee influence on SEHRM systems.

To enhance organisational dynamics and employee experiences, the adoption of SEHRM solutions is crucial. These solutions leverage digital platforms to provide employees with access to HR data, services and tools tailored to their roles or hierarchies within the organisation. Managers can leverage these systems to augment their capabilities in talent development or performance management by tailoring functionalities to meet diverse needs.

The effectiveness of these systems is contingent upon the degree of autonomy and empowerment afforded to employees. While lower-level employees may utilise them for routine administrative tasks, higher-level employees may leverage them for strategic initiatives such as workforce planning, succession management or leadership development. By offering training modules, online learning resources and assessment tools, e-HRM systems facilitate employee engagement and skill enhancement. Through thoughtful consideration of employees' specific requirements and expectations, these systems can effectively support talent development and organisational growth.

5.10 Summary

The study investigated how AEHRM, OEHRM and MEHRM practices influence SEHRM systems, employee roles or levels and mine safety performance. The research began by scrutinising the demographics of respondents in the mining industry, particularly focusing on their roles, tenure within the industry and the firm’s operational history. The majority of participants possessed over five years of experience, reflecting the industry's progression towards transformation and supplier development initiatives.

Significant positive associations were uncovered between these practices and SEHRM systems, underscoring their pivotal role in nurturing sustainable systems. The study proposes that organisations enhance their AEHRM practices to bolster sustainability. Initiatives such as online performance reviews, training programmes and other

interventions were identified as means to boost employee productivity, knowledge retention, satisfaction, retention rates and promotion rates.

Notably, OEHRM practices emerged as the primary contributor to the SEHRM construct, indicating their substantial impact on organisational sustainability. Results also highlighted that the sustainable implementation of these practices, such as employee self-service portals and recognition programmes, fosters improved performance and output, driving employee engagement and motivation.

Moreover, the research revealed a positive and significant relationship between SEHRM and firm safety performance. This suggests that streamlined HR procedures and technology platforms bolster organisational performance and employee safety. These solutions facilitate personnel acquisition and retention, cultivate an inclusive workplace culture, offer data-driven insights, ensure strategic alignment and enhance risk management.

The study further investigated the mediation effect of SEHRM systems on firm safety performance. While a significant direct effect between AEHRM and firm safety performance was observed, no direct relationship was found between MEHRM and OEHRM. SEHRM systems are identified as partial mediators for AEHRM and full mediators for MEHRM and OEHRM, emphasising their role in comprehensive HRM for long-term business success.

Examining the moderating effect of employee role or designation on the relationship between e-HRM systems and FP, the study found no significant moderating effect at the employee level. This suggests that standardised safety procedures, extensive training, legal compliance, collaborative efforts, technology safeguards and a robust safety culture collectively mitigate the impact of employee roles on safety outcomes in mining companies.

Additionally, the study explored the relationship between employee roles and SEHRM, revealing a significant association. This underscores the importance of employee influence in forming the connection between SEHRM systems and employee roles. By tailoring HR systems to employee roles, managers can optimise these systems for talent development and performance management, fostering employee engagement and skill enhancement through tailored resources and evaluation tools.

6 RECOMMENDATIONS, IMPLICATIONS AND CONCLUSIONS

6.1 Introduction

This chapter explores the practical implications of the study's findings, offers recommendations for future actions and summarises the key conclusions derived from the research, highlighting the significance of these findings and offering actionable insights.

6.2 Implications

The study outcomes have several significant ramifications for theory development and industry practices. Thus, the following is a discussion of the implications.

6.2.1 Managerial implications

The use of integrated e-HRM systems for mining front-line employees has an important managerial ramification. These tools can facilitate data-driven decision-making, improve training and communication and expedite incident reporting and response. Supervisors can provide safety information, offer instant updates on safety laws and create online training programmes that are customised for certain work functions or risks. This improves safety performance by guaranteeing that front-line staff members are knowledgeable about safety procedures and have the tools necessary to follow them.

Making decisions based on data is an advantage of e-HRM systems. Managers can examine patterns in near misses, safety events or compliance levels to make well-informed decisions on safety performance. This facilitates the efficient allocation of resources and the execution of focused interventions aimed at reducing risks. Additionally, e-HRM solutions also provide compliance monitoring and continuous development. Through dashboard analytics and reporting features, managers can monitor key performance metrics linked to safety performance. This allows for proactive actions to close safety gaps and guarantee continued adherence to regulatory standards.

6.2.2 Theoretical implications

The performance of safety can be greatly impacted by the integration of e-HRM systems for front-line workers in a mining context. The social exchange theory contends that people trade resources and advantages with one another which implies a greater dedication to safety procedures (Cook & Rice, 2006). This study shows that better mining performance can be achieved through investments in staff development, training and education and front-line employees can be improved via integrated e-HRM systems, which provide chances for ongoing education and safety-oriented skill development. Employees help create a safer workplace by increasing their knowledge and skills in safety procedures.

According to RBV, e-HRM systems should give workers instant access to safety procedures, hazard alerts and training materials so that they can recognise and reduce safety hazards (Grant, 1991). When integrated e-HRM systems with a high priority for safety-related features are implemented, front-line staff members feel obligated to follow safety procedures and promote a safe work environment. This shows the organisation's dedication to the workforce safety.

6.3 Recommendations

The study offers suggestions for resolving issues, streamlining procedures and maximising opportunities to guide stakeholders in implementing strategies to overcome obstacles and achieve desired goals.

An organisation operating in the mining sector will discover that the safety performance of its front-line staff improves significantly with the adoption of integrated e-HRM systems. The organisation must provide comprehensive training and onboarding programmes to ensure that staff are well-versed in the functionalities of the system, particularly safety regulations and reporting protocols. Given that front-line staff may need to access safety information and report incidents while on the move or in remote locations, the system should be user-friendly, easy to navigate and accessible via mobile devices.

The e-HRM system should incorporate real-time communication tools including interactive forums for safety-related discussion, employee feedback and development

opportunities through alerts and instant messaging. This will improve situational awareness and make it possible to react quickly to safety-related problems. It is possible to predict safety risks, identify possible dangers and gain insights into safety performance patterns by using data analytics for safety insights.

It is crucial to promote a culture of continuous improvement by asking front-line staff members for input on how well the e-HRM system supports safety performance. It is imperative for leaders to proactively encourage the use of the system, provide funds for its upkeep and enhancement and ensure that managers are responsible for implementing the safety measures that the system makes possible. By putting these suggestions into practice, mining companies can optimise the influence of integrated e-HRM systems on safety performance, encouraging a culture of proactive safety and lowering the risk of accidents and injuries at work.

6.4 Suggestions for Future Research

Studies with a longitudinal design can evaluate the sustainability of improvements over time and pinpoint the elements that make them last. A qualitative study can shed light on the ways that e-HRM systems affect safety performance, including employee involvement, organisational culture, safety atmosphere and communication efficacy.

Comparative studies can evaluate how well various e-HRM system types or certain features/modules perform in terms of improving safety and research that crosses cultural boundaries might examine variations in the uptake and consequences of e-HRM programmes meant to enhance safety.

An investigation of the function of e-HRM platforms in enabling prompt communication, coordination, decision-making and resource allocation in times of crisis could shed light on organisational resilience and crisis management.

6.5 Conclusion of Study

The study investigated the influence of integrated e-HRM systems on safety performance within the mining sector. It discovered a notable positive correlation between AEHRM, OEHRM and MEHRM practices with SEHRM systems, employee roles and mine safety performance. SEHRM systems are instrumental in fostering enduring business success by amalgamating sustainability plans, enabling ethical data

management and implementing effective technology utilisation. Moreover, the role of employees is pivotal in the nexus between SEHRM systems and employee roles, underscoring the significance of employee empowerment and autonomy.

In mining enterprises, integrated e-HRM systems augment safety performance significantly. These systems facilitate informed decision-making and adherence to safety protocols by granting immediate access to safety guidelines, training resources and incident reporting mechanisms. They facilitate seamless communication and reporting among front-line workers, supervisors and safety personnel, expediting the resolution of safety concerns and implementation of risk mitigation strategies.

E-HRM systems play a vital role in ensuring that employees receive comprehensive training and skill development, enabling them to identify potential hazards, operate equipment proficiently and respond effectively to emergencies. Access to insightful data and analytics on safety performance metrics, incident trends and staff compliance levels is imperative for making informed, data-driven decisions.

The adoption of e-HRM systems fosters transparency, accountability and ongoing learning within mining organisations, fostering a culture of safety excellence. This collective commitment to maintaining a safe workplace enhances an organisation's resilience against safety hazards and regulatory compliance challenges.

This research holds substantial implications on theory and practice for the integration of SEHRM systems in enhancing safety performance within the mining industry.

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APPENDICES

Appendix A: Research Instrument

	General Question	Answer Format				
Q1	My Designation	Top management	Middle level management	Junior management	Front line employee (supervisor, artisan, operators etc.)	
Q2	Number of years within mining industry	0-2 years	2–5 years	5–10 years	>10 years	
Q3	Age of my firm	11-20 years	11-30 years	31-40 years	Above 40 years	

	Ability enhancing e-HRM practices (AEHRM) Adapted from Chowdhury, A. H. (2021)	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Q4	My organisation develop electronic brochures and other human resource					
Q5	My organisation information-related materials to attract job applications					
Q6	My organisation attract and select employees who share organizational values					
Q7	My organisation do the electronic hiring process for employees					
Q8	My organisation impart online training that focus on the skills and values of the organization					
Q9	My organisation provide online development programs					
Q10	My organisation focus on developing digital skills among employees					

	Opportunity enhancing e-HRM practices (OEHRM) Adapted from Chowdhury, A. H. (2021)	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Q11	There is a presence of employee volunteer programs in my organisation					
Q12	My organisation encourages members to provide solutions when facing challenges					
Q13	My organisation involves employee rep and unions in the design, application, and review of the organization					
Q14	Employee surveys in place to monitor the climate of the my organisation					

	Motivation enhancing e-HRM practices (MEHRM) Adapted from Chowdhury, A. H. (2021)	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Q15	My organisation developed performance goals on an electronic platform (using platforms such as success factor) that focus on metrics using not only outcome-based but also behaviour-based, performance evaluations)					
Q16	My organisation link bonuses and variable pay to ethical behaviour based on digital performance objectives					
Q17	My organisations promote awards for good citizenship (moral behaviour)					
Q18	My organisation monitors and improve employee retention					
Q19	My organisations have employee development programs					

	Sustainable electronic human resource management (SEHRM) Adapted from Chowdhury, A. H. (2021)	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Q20	My organisation has designed ethical, social, and e-HRM systems					
Q21	My organisation has put into practice, assigned responsibilities, allocated resources, and continuously trained employees on e-HRM systems					
Q22	My organisation monitors the progress of e-HRM systems by means of systematic audits					
Q23	My organisation has improved on talent management and ability to retain employees					
Q24	Our HR asks to correct any problems that may be detected, constantly updating the e-HRM system					

	Firm performance (FP) Adapted from Chowdhury, A. H. (2021)	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Q25	My organisation has improved in safety performance					
Q26	My team improved in safety performance					
Q27	My organisation has managed to enhance employee performance					
Q28	My organisation ability to meet client's needs within the time specified has improved					

Appendix B: Consent Letter

Dear Sir/Madam

I am a master's student at the University of Witwatersrand Business School. I am researching to support my mini dissertation. You are hereby invited to participate and contribute to my work.

The title of the research project is the **impact of Integrated electronic human resource management systems for front-line employees on Safety performance of the mine.**

This research aims to understand the impact of Integrated electronic human resource management systems for front-line employees on the Safety performance.

You were chosen as a respondent, because of your interactions with mining projects and mining procurement processes. Given your knowledge in this field I would like to take this opportunity to invite you to participate and contribute in this research.

Your participation is voluntary, and you can withdraw at any time. Throughout the survey your privacy will be protected, and your participation will remain confidential. Individual data will not be analysed, group data will be analysed through the computer which means you are assured of anonymity.

If you agree to participate, please complete the questions following this cover page. The survey should take about 15 minutes of your time.

If you have concerns, please contact me through the below details.

Researcher: Nyelisani Clement Mufamadi
Email: 0714072n@students.wits.ac.za
Cell : 0718703587

☐ Yes, I consent,
☐ No, I do not consent.