MHSC

Mine Health and Safety Council

SUMMARY OF RESEARCH PROJECTS

ANNUAL PUBLICATION

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TABLE OF CONTENTS

1. ABOUT THE MHSC

The MHSC is a national public entity established in terms of the Mine Health and Safety Act, No. 29 of 1996, as amended. The entity comprises a tripartite board represented by State, Employer, and Organised Labour members under chairmanship of the Chief Inspector of Mines. The MHSC is mandated to advise the Minister of Mineral and Petroleum Resources on Occupational Health and Safety (OHS) issues in the mining industry relating to the development and implementation of the MHSC annual OHS research programme, reviewing and development of mining OHS legislation and dissemination (knowledge and technology transfer) of MHSC research outcomes to improve OHS conditions in the South African mining industry (SAMI). In order to accelerate the attainment of Zero Harm in the sector, through the implementation of risk-specific activities, the 2014 OHS Summit Milestones were collectively developed by the tripartite stakeholders and agreed upon by the SAMI principals in November 2014.

CENTRE OF EXCELLENCE

The Centre of Excellence (CoE) was initially conceptualized in 2008 at the Tripartite Occupational Health and Safety Leadership Summit, this was one of tripartite stakeholder's initiatives identified under the theme of "Promoting a Learning Industry and Building Capacity". The CoE was launched in 2014 during the Summit with clear direction from Stakeholder Principals and milestones that were to be achieved so that the CoE was operational. The role of the CoE was envisaged as to conduct OHS research, providing inputs into training and education in the South African mines to create opportunities for development of mineworkers and facilitate the implementation and dissemination of research outcomes. Its establishment occurs in the year when we are celebrating the MHSC 20th anniversary of continuing with the journey to "ZERO HARM" of ensuring that "Every Mine Worker Return from Work Unharmed Every Day".

The key objectives of establishing the Centre of Excellence were:

1. To conduct research and facilitate implementation of research outcomes.
2. Manage and conduct laboratory testing e.g., rope testing, various statutory tests required for compliance.
3. Provide facilitation of monitoring oversight role in occupational hygiene measurements, availability of analytical laboratories required for monitoring of occupational exposures.

4. Provide health and safety related inputs into training and development of mine workers at all identified levels of development, .
5. Maintain an electronic library system of mine health and safety information. This relates to management of information or knowledge management on occupational health and safety within mandated Council activities.
6. Facilitate research capacity building nationally, by identifying and partnering with existing research centres, such as the CSIR, NIOH, UP and Wits. This included the provision of seed funding, for the purposes of upgrading the above Entities' facilities, so that they could be in a research ready state for the conduction of the MHSC research, through the CoE.

The Centre of Excellence aligned with National Development Plan (NDP). The most relevant chapter of the National Development Plan (NDP) to MHSC CoE is Chapter 9, which is: improving Education, Training and Innovation. The key items of the Chapter include: addressing levels of education, skills, research and innovation capacity. The CoE was fully capacitated and operational in 2018.

1. OVERVIEW

The MHSC has conducted various research projects, categorised into nine (9) Research Thrust Areas, namely; Human Factors and Behavioural Safety, Falls of Ground (FOG), Rock Bursts (Seismicity), Explosions and Fires, Transport and Machinery, Airborne Pollutants, Physical Hazards, Occupational Diseases and Special Projects. This classification is meant to assist in addressing specific OHS challenges in the SAMI. This Report includes summaries of research work that has been completed by the MHSC within the past few years to address some of the challenges faced by the mining industry.

The research summaries included herewith, do not however cover all 9 Thrust Areas. A lot of research work has been completed over the years, and Compendiums of these research projects in their related Thrust Areas are available on the MHSC website (www.mhsc.org.za) as well as the full research reports. The MHSC continues to conduct research in order to develop Knowledge and Technology that will assist the South African Mining Industry to eliminate incidents and accidents, with the ultimate goal of ensuring that every mine worker returns from work unharmed every day.

3. SUMMARIES OF RESEARCH PROJECTS COMPLETED

THRUST AREA 1

Human Factors and Behavioural Safety

PROJECT TITLE:	**EFFECTS OF CANNABIS ON OCCUPATIONAL HEALTH AND SAFETY IN THE SAMI AND BENCHMARK FOR MAXIMUM ALLOWABLE BLOOD LEVEL OF CANNABIS AT THE WORKPLACE**
Project number:	**CoE 210101**
Research agency:	**Mundele Business Consultancy**
Authors:	**Mbenenge K., Mhura D., Nemuramba K., Van Tonder N., Mhura M. & Wilson K.**
Date completed	**March 2025**

Background

In 2018, the Constitutional Court of South Africa decriminalised the use, possession and cultivation of cannabis in private spaces. However, no guidance was provided on how cannabis should be managed in the workplace. Since cannabis is a drug with psychoactive properties which can negatively impact workplace productivity, health and safety, guidance was required on how it should be managed at work.

Objectives of the study

The objective of this study was to develop a guidance document for testing and assessing the allowable limits of cannabis use while at work in the SAMI.

Methodology

A pragmatic research design was utilized in which a mixed methods approach was applied to collect, analyze and interpret the data for the study. For the literature, a scoping review, systematic review and meta-analysis of Odds Ratios based on the PRISMA principles were utilized. Data synthesis and analysis were conducted using the STATA v18.5 software. An exploratory approach was used to solicit inputs from the industry stakeholders through a questionnaire which gathered both quantitative and qualitative data. The results were analyzed using triangulation, descriptive statistics, and comparative statistics.

The workshop with industry stakeholders was highly interactive with in-depth discussions in a hybrid model that had options for physical or virtual participation. The data from all these activities were then synthesized resulting in a guidance document for testing and assessing the allowable limits of cannabis use while at work in the SAMI. The validity, reliability, ethical considerations, limitations, delimitations and the significance of the study were considered.

Findings of the study

The results from the literature review showed that the traditional methods of assessing and testing drug use were inadequate for cannabis due to its long half-life. The results from the industry stakeholders' survey showed that the existing drug testing and assessment procedures currently used to detect the presence of drugs on employees in the SAMI may not be effective enough for cannabis as had been argued in recent arbitration cases. The general impression was that cannabis decriminalisation had negative implications for health and safety in the SAMI.

The results from the benchmarking exercise showed that Delta9-tetrahydrocannabinol (THC) levels of less than 1 ng/ml in the body system are insignificant and impairment is mild. However, impairment worsens steadily with additional dosage of cannabis such that considerable impairment is evident at THC levels of 2 ng/ml and above.

Based on the outcomes of workshop engagements with the industry stakeholder, a guidance document was developed for managing cannabis, including revising the existing alcohol and substance abuse policy to include the allowable cut-off limits of cannabis for different work categories.

Conclusions

This project attracted key stakeholder buy-in throughout its duration due to the subsequent value that would potentially be realised in the SAMI if the recommendations are adopted.

Recommendation

The guidance document from this study should be disseminated to the Minerals Council South Africa and the DMPR who should facilitate the implementation of the proposed revisions to the Alcohol and Substance Abuse Policy, Cannabis Assessment and Testing Procedures and the Mandatory Code of Practice to Perform Work at a Mine.

ACCESS REPORTS TO PROJECT COE 210101

Link: Final Report

Link: Guidance Document on Cannabis

THRUST AREA 3

Rock Falls

PROJECT TITLE:	**DETERMINING BEST/LEADING PRECONDITIONING PRACTICES APPLICABLE FOR SHALLOW, INTERMEDIATE, DEEP, AND ULTRA-DEEP MINING, TAKING COGNISANCE OF ROCK STRENGTH AND TYPE OF MINING METHOD DATABASE**
Project number:	**CoE 190301**
Research agency:	**Council for Scientific and Industrial Research (CSIR)**
Authors:	**H. Greeff and J. Hanekom**
Date completed	**March 2025**

Background

South Africa's mining industry, particularly in deep-level operations reaching depths of 4 km, faces serious challenges due to high rock stress. These conditions contribute to rockfalls, seismic events, and strain bursts—major causes of injuries and fatalities underground. Preconditioning, a technique that redistributes stress by fracturing rock ahead of the mining face, offers a proactive way to improve safety and stability. Although proven effective, preconditioning practices in the South African mining industry remain inconsistent. To address this, the Mine Health and Safety Council (MHSC) launched this project to identify the best/leading preconditioning practices suitable for varying mining depths and geological conditions.

Objectives of the study

The project's goal was to define optimal preconditioning practices tailored to shallow, intermediate, deep, and ultra-deep mining. This involved:

- Conducting a comprehensive literature review.
- Engaging industry stakeholders through workshops and interviews with rock engineers, geologists and safety experts.
- Reviewing design practices through field investigations across 16 gold and platinum mines.
- Developing a preconditioning design tool and guideline.

Methodology

The methodology was designed to address the complexities and variability of preconditioning practices across different mining environments. In addition to literature review where local and international preconditioning research was conducted, the following methodology was undertaken:

Stakeholder Engagement: Subject matter experts, including rock engineers, mining engineers, geologists, and safety personnel, were engaged through surveys, interviews, and workshops. Key insights were gathered on current practices, challenges, and factors influencing the success or failure of preconditioning methods; and workshops provided a platform for participants to contribute feedback on preliminary findings and shape the development of the guideline.

Field Investigations: Mine visits were conducted at shallow, intermediate, deep, and ultra-deep gold and platinum mines to gather primary data on preconditioning practices.

Development of Preconditioning Guidelines and Tool: A flowchart-based tool was created as the foundation of the preconditioning guideline. The tool provides a flexible framework for designing site-specific preconditioning strategies, incorporating geological, operational, and stress-related variables. The guideline and tool were reviewed and refined through stakeholder feedback and technical quality control.

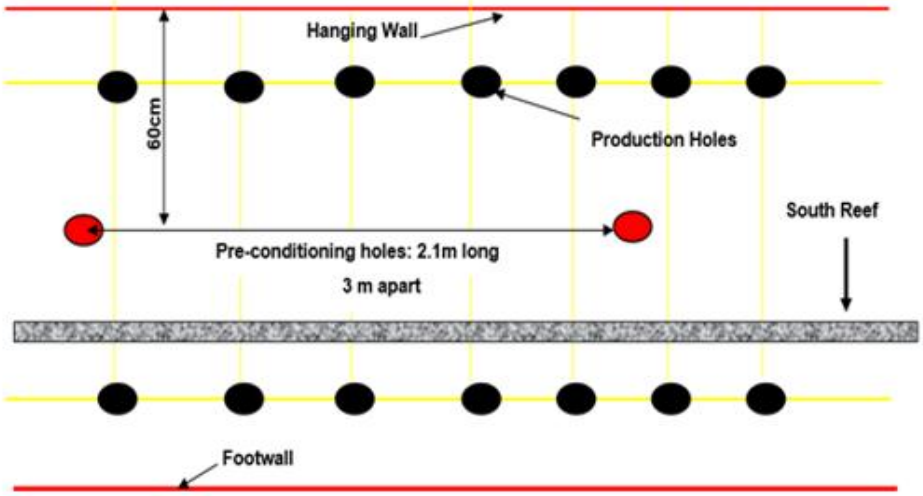

Figure 1: Generalised face-perpendicular preconditioning design

Findings of the Study

- *Literature Review:* Highlighted both the success and limitations of historical preconditioning efforts, particularly face-perpendicular techniques in gold mines.
- *Stakeholder Insights:* Emphasized benefits such as reduced face bursting, but also identified training gaps, operational inconsistencies, and worker resistance.
- *Design Practices:* Face-perpendicular preconditioning is dominant, with design variations in borehole length, spacing, and explosive use. Most shallow mines do not use preconditioning.

- *Special Conditions:* High-stress zones like remnants and dykes require tailored approaches, such as long-hole or face-parallel preconditioning. South Deep and Mponeng mines were noted for their innovative applications.
- Standardisation Gaps: There's a lack of industry-wide documentation and design guidelines for complex scenarios.

Conclusion

The project produced a best-practice guideline outlining leading techniques based on mining depth and rock conditions; and a flowchart-based preconditioning tool to help engineers design effective strategies using site-specific inputs.

Recommendations

To enhance the effectiveness, standardisation, and adoption of preconditioning in the SAMI, the following recommendations are proposed:

1. *Repackaging of Guidelines:* The existing preconditioning guidelines should be reformatted into an easy-to-read, industry-friendly format. Clear, simplified language and visual aids such as diagrams and flowcharts will improve readability and uptake among practitioners.

2. *Research on Preconditioning Effectiveness* - Further studies are required to refine preconditioning techniques, with a focus on explosive behaviour, geomechanical response and design optimisation. Examine the impact of hole diameter, spacing, and length on preconditioning efficiency to establish best practices.

3. *Technological Advancements* - Digitisation of the Preconditioning Tool: Converting the tool into a fully digital, interactive format will improve accessibility and usability across mining operations.

ACCESS THE FULL REPORT: PROJECT COE 190301

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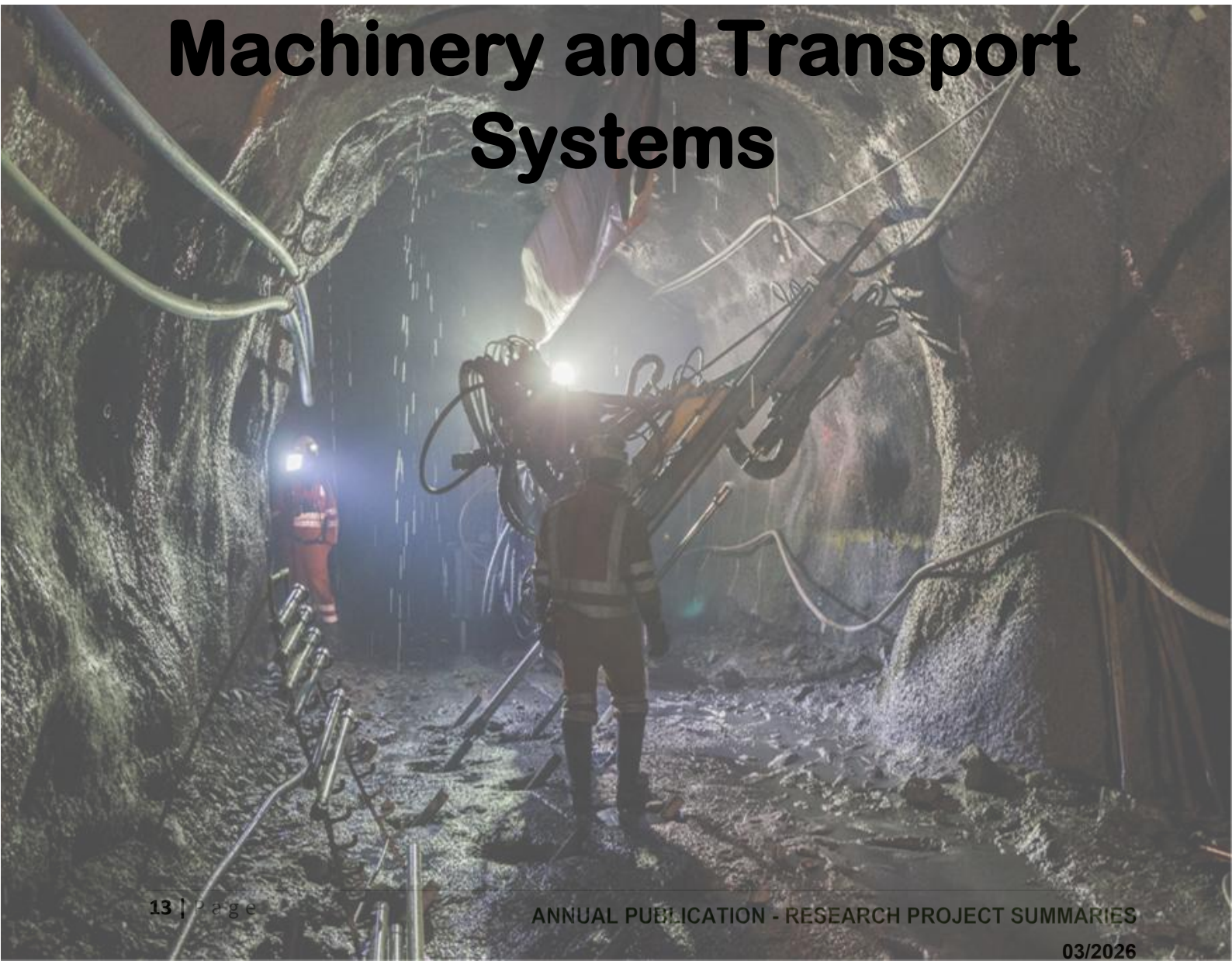
THRUST AREA 5

Machinery and Transport Systems



PROJECT TITLE:	**INVESTIGATIONS OF THE CURRENT USE OF WINCHES AND THEIR ACCESSORIES IN CLEANING OPERATIONS AND RECOMMENDATIONS FOR POSSIBLE FUTURE USE OF ROPELESS CLEANING METHODS IN UNDERGROUND MINING OPERATIONS**
Project number:	**CoE 210501**
Research agency:	**Council for Scientific and Industrial Research (CSIR)**
Authors:	**M. Mpofu, S. Ngobese and Dr T. Otto**
Date completed	**April 2025**

Background

Scraper winches are vital for rock cleaning in South Africa's narrow tabular hard rock mines but their safety risks remain stubbornly persistent. Despite years of usage and well-established safety standards, winch-related accidents continue due to systemic and operational shortcomings.

Objectives of the study

The primary aim of the project was to identify and recommend practical solutions to reduce injuries and fatalities associated with the use of winches in underground mining operations. To achieve this, the project focused on the following key objectives:

- Assess current practices and trends in the use of winches and their accessories within narrow reef hard rock mining environments.
- Evaluate existing and emerging design modifications that could improve the safety and efficiency of winch systems.
- Investigate the integration and potential benefits of technologies—both hardware and software—in enhancing winch safety.
- Explore alternative face-cleaning solutions, including ropeless systems, that can reduce reliance on traditional scraper winches.
- Review and assess alternative mining layouts that may support the transition to safer, more mechanised cleaning methods.

Methodology

A mixed-methods approach was employed, combining qualitative and quantitative techniques to comprehensively investigate the use of scraper winches in narrow reef hard rock mines. In addition to the literature review, where a detailed review of academic and industry sources focusing on scraper winch use, design innovations, safety issues, alternative equipment, and mining layouts was done. The following research process was conducted:

- *Field Investigations and Interviews*: Semi-structured interviews were conducted with mine personnel, manufacturers, and technology suppliers to capture operational insights. Observational studies at mine sites during both day and night shifts allowed for direct assessment of winch usage, behavioural patterns, and safety practices. Secondary data from previous projects supported the findings.
- *Quantitative Analysis*: Historical winch-related accident data (2015–2023) was analysed to identify trends, contributing factors, and common hazards.
- *Stakeholder Workshop*: A hybrid workshop with over 40 mining industry stakeholders was held in November 2024 to validate findings and gather feedback. Attendees included OEMs, mine workers, safety representatives, and technology providers.

Findings of the study

Persistent Hazards and Missed Innovations - Investigations revealed that many mines have winch safety standards in place, but actual adherence is inconsistent. Key challenges include:

- Shortages of critical spare parts.
- Reactive maintenance practices.
- Rushed safety assessments under production pressures.
- Poor lighting and hazard identification.

Training that emphasizes procedure compliance over adaptive problem-solving.

Accident data from 2015–2023 reflects recurring risks such as rope degradation, unsafe rigging, and poor worker positioning. Most incidents are linked to weak supervision and failures in situational awareness.

Underused Technology and Industry Reluctance - Advanced technologies like proximity detection systems (PDS) and remote-controlled winches have been piloted but not widely adopted. Pilots often faced technical issues, while manufacturers cited high costs and low industry demand as barriers to integrating safety-enhancing features. Alternative technologies, including waterjets, remote-controlled dozers, and reef boring methods, show promise in reducing risk but uptake has been slow.

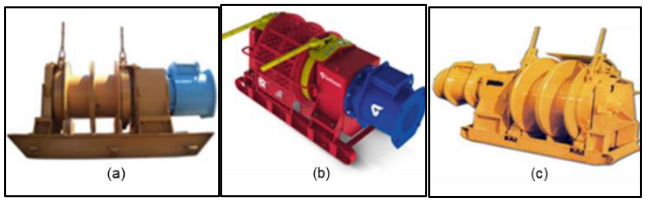


Figure 1: Typical scraper winch components

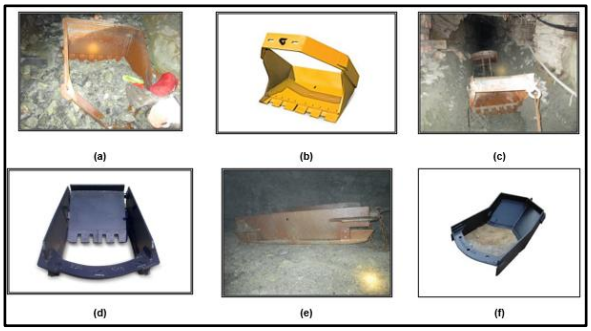


Figure 2: Various models of scrap0ers used in the SAMI hoe type scoops (a, b, c) and box or hinge type scoops (d, e, f)

Conclusion

Scraper winches continue to be the main equipment for moving broken rock in South Africa's underground hard rock mines, yet they have seen minimal innovation compared to advancements in areas like rock engineering and ventilation. While alternative technologies and safety solutions such as remote-controlled and automated winches, proximity detection systems (PDS), and proactive rope inspection routines exist, their uptake remains limited due to high costs, perceived unreliability, and resistance to change.

Investigations reveal that persistent risks, including rope failure, poor rigging, and unsafe operator behaviour, are compounded by systemic shortcomings like inadequate training, inconsistent safety enforcement, reactive maintenance, and production-driven time pressures. Accidents often stem from being struck or pulled by winch components, with contributing factors including poor lighting, rushed hazard assessments, and insufficient supervision.

Alternative cleaning equipment, such as waterjets, vacuums, and ultra-low-profile (ULP) dozers, show promise especially waterjets, which offer enhanced safety for face cleaning. ULP dozers and vacuums can support cleaning and vamping tasks but require infrastructure changes.

Mechanical mining methods like reef boring and reef cutting offer a long-term solution to eliminate scraper winch risks, though these require major mine design adjustments and are best suited to new operations.

Recommendations

The project recommends a phased transition away from conventional winch systems by:

- Strengthening the enforcement of winch safety protocols and proactive rope assessments.
- Integrating technologies such as PDS and remote-controlled dozers where infrastructure allows.
- Exploring alternative mining methods like reef boring and reef cutting to eliminate winch use entirely.
- Prioritizing training reform that empowers workers with practical hazard recognition and problem-solving skill.

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PROJECT COE 210501

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THRUST AREA 7

PROJECT TITLE:	**IS THE HEAT TOLERANCE SCREENING (HTS) TEST AN ADEQUATE TOOL TO ASSESS IF AN EMPLOYEE IS HEAT TOLERANT AND ARE THE METHODS USED TO DETERMINE HEAT TOLERANCE VALID?**
Project number:	**CoE 190702**
Research agency:	**Mundele Business Consultancy**
Authors:	**T. Hofmann , D. Mhura, E. Mudzviti, N. Van Tonder, and N. Mhura**
Date completed:	**September 2025**

Background

The effectiveness and reliability of the HTS tests and assessment methods in the South African mining industry (SAMI) have recently come under scrutiny due to numerous appeals from employees who were deemed unfit for duty after failing the HTS test during their routine medical check-ups.

Objective of the Study

The goal of this study was to identify the weaknesses in the HTS tests and to propose a series of interventions to enhance the efficiency of the heat stress management (HSM) practices. These improvements are aimed at reducing the number of HTS test failures within the SAMI.

Methodology

A pragmatic research design was utilized in which a mixed methods approach was applied to collect, analyze and interpret the data for the study. To explore the literature, a scoping review approach was employed, while an evaluative method was used to pinpoint the shortcomings in the existing HTS practices and identify opportunities for improvement. A descriptive approach was utilised to gauge the readiness of mining companies to embrace the recommended HSM practices and to assess the feasibility of implementation. The results were then analyzed using a blend of descriptive statistics, triangulation, content analysis, and comparative statistics, which were subsequently shared at a workshop with the industry stakeholders for enrichment towards an effective solution. The validity, reliability, ethics, limitations, delimitations, and significance of the study were considered.

The data from all these activities were then synthesised resulting in several recommendations to improve the HSM practices in the SAMI.

Findings of the study

The results of the study showed that the existing HTS tool is adequate, valid, and effective in its fundamental function of identifying heat intolerant workers and that it is not the cause of

HTS test failures in the SAMI. Rather, HTS test failures stem from suboptimal application of HTS protocols and diminished physical conditioning of workers in the SAMI.

In order to enhance HSM practices in the SAMI, it was recommended that comprehensive medical screening, fatigue, physical and functional work capacity assessments be conducted before referring workers for HTS testing. An integrated HTS data storage and transfer system was recommended along with sensors in the climatic chambers and heart rate monitors for real-time data synergy. The recommended quality controls included regular HTS audits, enhanced hygiene standard for the climatic chambers and thermometers, upskilling of HTS personnel, HTS induction of the general staff and heat acclimatisation for workers exposed to hot working environments.

For ongoing HSM, reinforced fatigue awareness and healthy lifestyle programs were recommended together with wearable technology for self-pacing and heat strain warning and increased proficiency levels of skill to maintain body cooling during emergencies.

Conclusions

This project attracted key stakeholder buy-in throughout its duration due to the subsequent value that would potentially be realised in the SAMI if the recommendations are adopted.

Recommendation

The recommended HSM practices from this study should be disseminated to mining companies in the SAMI through technical experts from the MHSC and the Minerals Council South Africa who should facilitate the adoption thereof.

ACCESS THE FULL REPORT FOR PROJECT COE 190702

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THRUST AREA 9

Special Projects

PROJECT TITLE:	**THE IMPACT OF OVER-EXERTION ON WOMEN'S HEALTH AND SAFETY IN THE SOUTH AFRICAN MINING**
Project number:	**CoE 210903**
Research agency:	**Council for Scientific and Industrial Research, in collaboration with The Work Expert and Mishumo Health Group**
Authors:	**J. Pelders, R. Teleka, T. Hofmann, R. Koen, I. Meyer, K. Venter, M. Mothemela.**
Report date:	**February 2025**

Background

The South African mining industry (SAMI) is historically male-dominated, but increasing numbers of females are entering the workforce. However, some challenges still need to be addressed, including those related to the occupational health and safety (OHS) of women in mining (WIM). As a result, there is a need for further research to assess factors that impact the OHS of WIM.

Over-exertion is defined as when the demands placed on a person exceed their capacity or capability. Due to physiological and anatomical differences, and the design of equipment or tools based on male physiques, women might have to work closer to their physical capacities than men, which can lead to increased risk of fatigue, accidents, and injury. The aim of this project was to assess the impact of over-exertion on women's health and safety in the SAMI.

Objectives of the study

Methodology

The study used a mixed methods approach, and quantitative and qualitative data were gathered using the survey tool developed in the project and in focus group discussions. Questionnaires were completed by 549 WIM. Focus group discussions were held with over 90 individuals from 9 mining companies and an industry organisation. Ethics approval was granted by the CSIR Research Ethics Committee (Ref: 478/2024).

Findings of the study

Impacts of over-exertion include fatigue, physical and mental strain, injury, musculoskeletal disorders, occupational disease, impaired reproductive health, and vulnerability to harassment in exchange for assistance with tasks that WIM could not handle.

Numerous contributors to over-exertion were identified, including high workloads, lifting heavy loads, long travelling distances underground, heat, personal protective equipment (PPE)

design and quality, inadequate ablution facilities, lack of respect, discrimination, and difficult work-life balance.

Reporting channels available for WIM to report OHS challenges relating to over-exertion include health and safety departments, anonymous whistleblower hotlines, human resources, medical centres, unions and WIM committees. Interventions should be made to address concerns relating to reporting channels, including lack of trust in the anonymity and confidentiality of reports, fear of victimisation, lack of feedback and inaction.

Conclusions

Over-exertion is multifactorial and can relate to physical and psychological strain. Numerous factors contribute to over-exertion of WIM in the SAMI, including those relating to the physical work environment, job demands, workplace culture, and work-life balance.

Recommendations

Recommendations from the project include the following:

- Updates to guidelines on minimum standards of fitness to work at a mine and for medical surveillance, and in particular improved Occupational Risk Exposure Profiles (OREPs).
- Improved risk assessments, including participatory ergonomic assessments and interventions.
- Improved access to adequate change houses, toilets, emergency sanitary pads, and drinking water underground.
- Continued improvements to PPE quality, design and availability.
- Training and awareness campaigns on a range of topics, including factors relating to over-exertion, reporting channels available and gender inclusivity.
- Increased development and promotion opportunities are important.

The assessment tool that was developed in the study should be updated and could be used for periodic assessment of over-exertion in the industry to provide anonymous insights into areas where interventions can be implemented and where improvements are evident.

ACCESS THE FULL REPORT: PROJECT COE 210903

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PROJECT TITLE:	**ASSESS THE IMPLEMENTATION OF THE CULTURE TRANSFORMATION FRAMEWORK (CTF) BY THE SOUTH AFRICAN MINING INDUSTRY.**
Project number:	**CoE 200903**
Research agency:	**PricewaterhouseCoopers Incorporated (PwC)**
Authors:	**PricewaterhouseCoopers Incorporated (PwC)**
Date completed	**August 2024**

Background

The project aimed to evaluate the implementation of the Culture Transformation Framework (CTF) within the South African Mining Industry (SAMI), a key part of the Leadership Summit Action Plan. The CTF seeks to enhance the health and safety culture across the mining industry, recognising that organisational factors directly influence health and safety performance.

Objectives of the study

The project assessed how the SAMI has implemented the CTF and identified areas where further improvements were needed. The study included a desktop review of the CTF and its impact on SAMI, the development of survey and interview tools to assess implementation.

Methodology

Stakeholders across all demographics were interviewed, including representatives from the Minerals Council South Africa (MCSA), the Department of Mineral Resources and Energy (DMRE), and Organised Labour. Of the 20 planned interviews, 12 were completed, providing a 60% response rate. A survey was deployed to mines in the SAMI, with 51 mines responding. The survey assessed CTF implementation across various pillars.

Findings of the study

Several themes emerged from the interviews and surveys:

- **Leadership Commitment to Zero Harm:** Larger mines are making progress, but production is often still prioritised over safety.
- **Communication and Change Management:** Smaller mines need more support in implementing CTF initiatives.
- **Performance Management:** Current bonus structures prioritise production over safety achievements.
- **Recognition and Reward:** A gradual cultural shift is needed to embed safety practices across the industry.

- **Risk Management:** While risk practices are adequate, there is room for improvement in using advanced risk analytics.
- **Employee Empowerment:** A move toward open communication and empowerment of employees is needed to shift the traditional top-down management culture.
- **Diversity and Inclusion:** Efforts to integrate women and other underrepresented groups into mining have improved, but more focus on cultural sensitivity and inclusion is needed.
- **Employee Wellbeing:** Addressing psychological risks, in addition to physical ones, is critical for achieving Zero Harm.

Conclusion

The study revealed both strengths and gaps in the implementation of the CTF across different pillars. Risk management is the strongest-performing pillar, while leadership practices and performance incentives require the most improvement.

Recommendation

Recommendations for embedding a culture of health and safety across the mining industry:

1. Leadership's commitment to Zero Harm
2. Communication and change management
3. Performance management
4. Recognition and reward
5. Risk, accident and incident management
6. A culture of fear versus a culture of empowerment
7. Diversity and inclusion
8. Creating a culture of health and safety that sticks
9. Employee wellbeing
10. Creating a culture of health and safety that sticks

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Mine Health and Safety Council

EVERY MINEWORKER RETURNING FROM WORK UNHARMED EVERY DAY.

"ZERO HARM IN OUR LIFETIME"