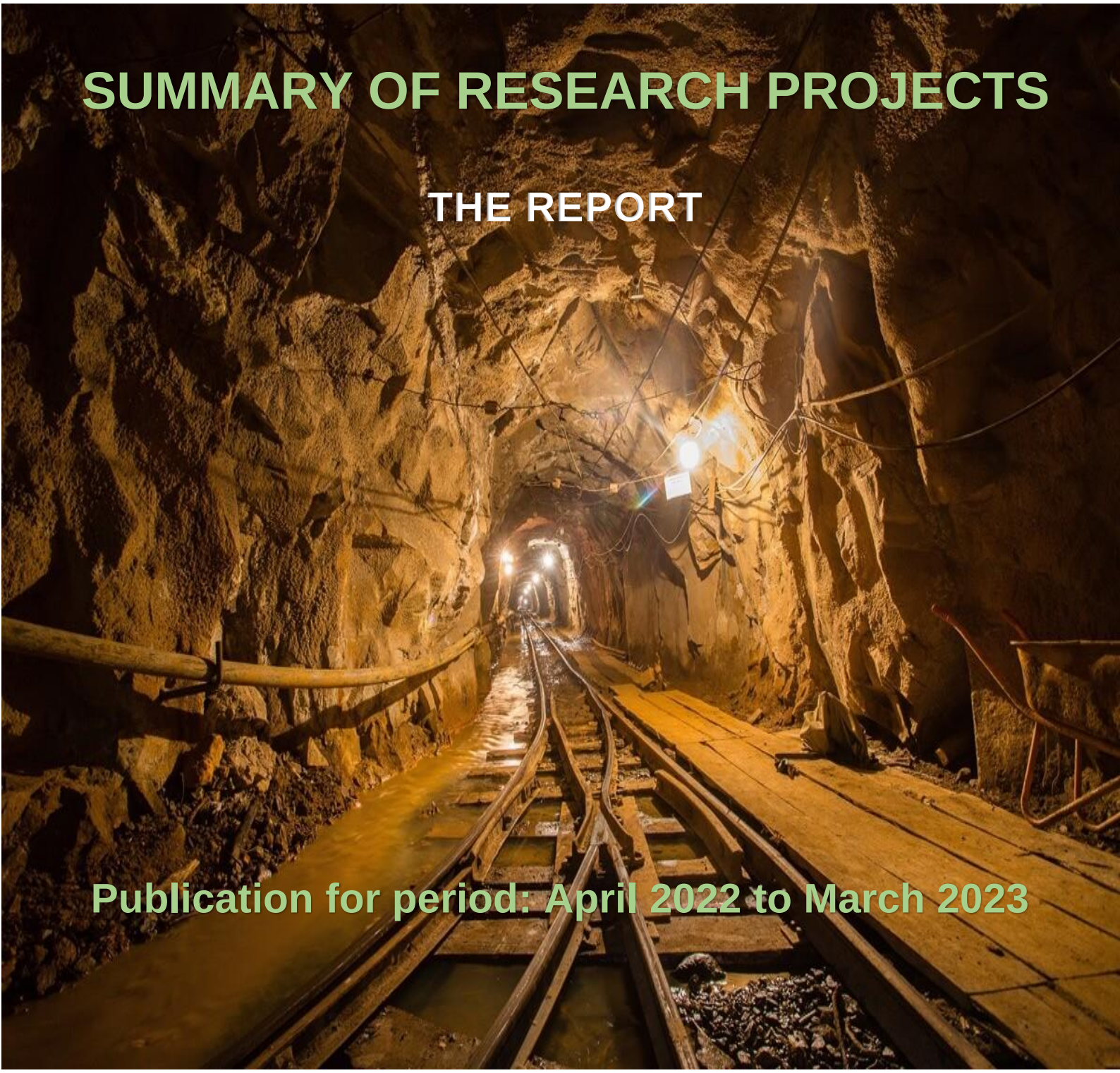
MHSC

Mine Health and Safety Council



SUMMARY OF RESEARCH PROJECTS

THE REPORT

Publication for period: April 2022 to March 2023

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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 Resources and Energy 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 education and training at all identified levels of development, mainly inputs into training and development of mine workers.
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.

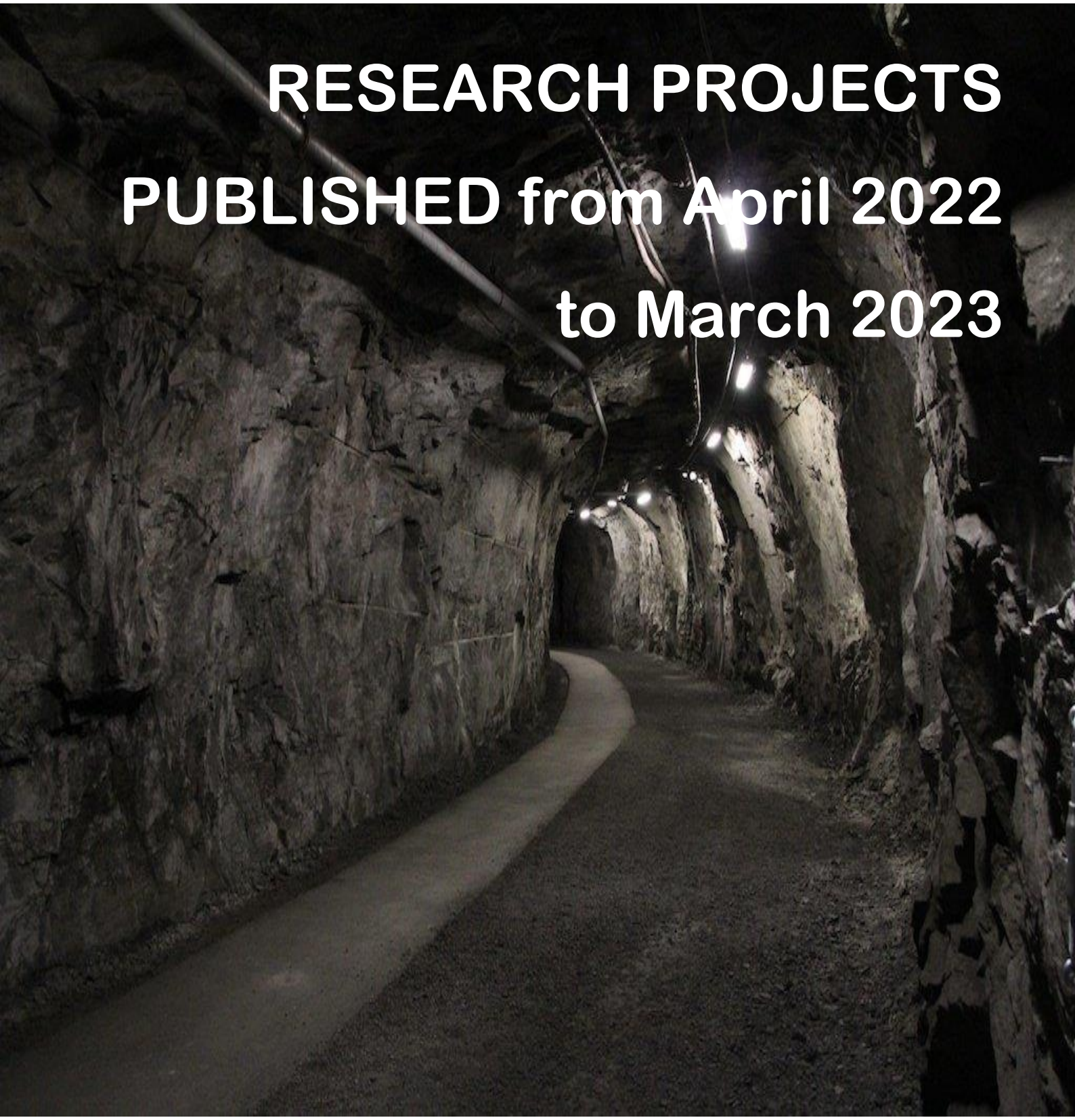
The Centre of Excellence aligned with National Development Plan (NDP). The most relevant chapter of the National Development Plan (NDP) to MHSC CoE is Chapter 9, which is: improving Education, Training and Innovation. The key items of the Chapter include: addressing levels of education, skills, research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

1. OVERVIEW

The MHSC has conducted over 400 research projects, categorised into nine (9) Research Thrust Areas, namely; Human Factors and Behavioural Safety, Falls of Ground (FOG), Rock Bursts (Seismicity), 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 PUBLISHED from April 2022 to March 2023



PROJECT TITLE:	**REVIEW THE CURRENT SAMI NOISE EXPOSURE LIMIT AND CONDUCT A STUDY ON VIBRATION OEL IN RELATION TO THE SAMI**
Project no:	**COE 180701**
Research agency:	**Enterprises at the University of Pretoria**
Authors:	**Prof Stephan Heyns, Kobus Dekker, Jason Ker-Fox, Dr Abrie Oberholster, Dr Nico Claassen, Dr Johan Schoeman, Sibonelo Dube, Jennifer van der Walt, Marguerite Pullen, Eugene Preis**
Date completed:	**February 2021**

SUMMARY

The insidious and cumulative nature of noise induced hearing loss (NIHL), as well as recent studies indicating potential NIHL below 85dB(A) suggested a review of the occupational exposure limit (OEL) of noise in South Africa. At the same time South Africa also does not currently have OELs for vibration. This is not aligned with international best practice. The Mine Health and Safety Council (MHSC) therefore contracted Enterprises University of Pretoria to review the current SAMI noise exposure limit and conduct a study to explore the desirability of OELs for vibration in the SAMI.

The outcome of this study is intended to support the MHSC in making recommendations pertaining to noise and vibration OELs to the minister of Minerals Resources and Energy. These recommendations are intended to improve occupational health and safety conditions in the South African Mining Industry (SAMI). In 2019 the SAMI employed 454 861 employees (Mineral Council South Africa Integrated Annual Report, 2019) across all commodities. These employees work in different mining environments, under different conditions and according to different work schedules, where they are exposed to different environmental stressors.
Noise and vibration are two of these stressors and are categorised as so-called physical environmental stressors.

Exposure to such physical stressors is known to cause detrimental health effects:

- Noise can cause auditory effects such as noise induced hearing loss (NIHL) and non-auditory effects such as adversely affected communication, elevated heart rates and increased annoyance. There is also evidence that exposure to noise is a contributing factor for the development of hypertension and diabetes (Schoeman and Van den Heever, 2015).
- Hand-arm vibration can lead to Raynaud's disease which can cause severe pain and discomfort (Griffin, 1990).
- Continuous excessive whole-body vibration may cause musculoskeletal injuries and adverse kidney effects (Griffin, 1990).

Although it is generally accepted that an OEL is a “safe” level of exposure to which workers could be exposed to on a daily basis for their entire working life without becoming ill, the occurrence of occupational disease remains high.

The subsequent compensation and administrative costs, as well as the associated penalties, warrant a regular revision of OELs. It is believed that OELs in the SAMI may need to be amended to reflect specific South African environmental conditions and population characteristics. The work schedules of different mines may also influence the specific exposure limits that must be implemented.

One of the significant risks associated with noise, whole-body vibration and hand-arm vibration exposure is that the health effects are initially unnoticed and generally develop gradually. It is presumed that in many cases, workers may only experience the full brunt of work related NIHL, WB- and HA vibration exposure, once they retire from work. Some occupational related CoE 180701 Final Report 3 diseases only start to manifest in general 15 to 40 years after continuous excessive exposure. This course of things is also quite typical of noise and vibration exposure.

This project addresses the desirability of changing the current SAMI noise exposure limit. It also addresses the need for setting vibration exposure limits for the SAMI. In structuring the project, five main milestones were set.

CONCLUSION

While whole-body vibration and hand-transmitted vibration are both important physical stressors and both classes of vibration problems need to be carefully considered in the SAMI, a number of general conclusions were reached.

ACCESS THE FULL REPORT HERE:

Link: COE 180701 - Full Report or Scan the QR code.

PROJECT TITLE:	**REVIEW THE CURRENT AIRBORNE EXPOSURE LIMITS AS LISTED IN SCHEDULE 22.9(A)**
Project No:	**COE 180607**
Research agency:	**Enterprises University of Pretoria**
Authors:	**Claassen, JL du Plessis, J van der Walt, E Preis, B Girdler-Brown, J Ker-Fox, C Pretorius, T Els, ASK Ledwaba, C de Beer, S van der Walt, J Jacobs**
Date completed:	**June 2021**

SUMMARY

The number of compensation cases and reported deaths associated with airborne pollutant exposure in the mining industry serves as an indicator that mining employees in the South African Mining Industry (SAMI) may be exposed to airborne pollutant dose levels that may induce lung and other related pathologies. Review of occupational exposure limits (OELs) may contribute to the reduction of incidence of airborne pollutant pathologies, which was the focus of this project.

The objectives of this research project were to:

1. Determine the impact of the current airborne pollutant exposure limits on employees' short- and long-term health.
2. Recommend appropriate OELs for the SAMI in line with Schedule 22.9(A) of the MHSA, including but not limited to, classification bands in terms of exposure risks.
3. Conduct a stakeholder workshop arranged and hosted by MHSC in Gauteng to present the outcomes of the project.

Ethical clearance was obtained from the Faculty of Health Sciences Ethics Committee. (Clearance: 51/2019) Different sources were reviewed to determine which occupational disease have the highest prevalence. Fifteen of the occupational diseases with the highest number of reported cases were ranked, high to low: silicosis, emphysema, pulmonary tuberculosis, silico-tuberculosis, other respiratory conditions, primary lung cancer, asbestosis, coal workers' pneumoconiosis, chronic obstructive pulmonary disease, mesothelioma, allergic contact dermatitis, massive pulmonary fibrosis, mixed dust pneumoconiosis and occupational asthma. The health effects that are associated with the occupational diseases with the highest prevalence involve primarily the respiratory tract and the skin.

Of the 786 pollutants listed in Schedule 22.9(A), the respiratory system is targeted by 68.1% of the listed chemicals. Most noteworthy other target organs and systems that were identified include the eye, skin and the central nervous system. Fourteen of the fifteen occupational diseases that were identified are associated with the respiratory system and the other one was associated with the skin (allergic contact dermatitis). Diseases related to the respiratory system, eyes, skin, central nervous system and kidneys contribute to more than 80% of the occupational diseases with the highest prevalence. Of the airborne pollutants listed in Schedule 22.9(A), 78% of the pollutants have a combined health impact on more than five target organs.

A cost-benefit analysis framework was developed that can be applied by both government and industry to determine the financial impact, should an OEL be amended. In principle, the framework determines the net financial impact when the cost to comply with an OEL is subtracted from the benefits that will be derived now and in the future. The framework presents extensive coverage of the identification of various 'cost categories' which will be impacted as a result of any change in OEL. The model is only intended to provide a framework and, while a thorough model has been developed, further work needs to be performed to be able to determine detailed financial implications resulting from a change in OEL. The costing equations (and components thereof), in conjunction with some of the modelling already performed, will drive the value determination and the next steps in the research. At the stakeholder workshops most of the respondents agreed that a comprehensive cost-benefit analysis should form part of the implementation plan for revised OELs. All 786 of the Schedule 22.9(A) OELs were selected to compare the current SAMI OELs with other national and international government agencies and standards generating organisations.

Of all the current South African OELs, 85 airborne pollutants have OELs that are less stringent or potentially less protective when compared with international leading practice. When compared with international leading practice, Schedule 22.9(A) lacks important notations (which highlight toxicity endpoints of chemical substances) that convey important information regarding the route of exposure, toxicological and/or associated health effects. The most important differences were that skin notations, the influence on pregnancy and reproduction and classification in terms of carcinogenicity were lacking in Schedule 22.9(A). Following the literature review and tabulated comparison of the OELs, inputs were obtained from experts, government, industry and labour on which airborne pollutants should be prioritised for OEL review. The purpose of the priority list is mainly to provide direction to the process to be followed to review OELs of airborne pollutants on completion of this project. Considering that there are 786 airborne pollutants in Schedule 22.9(A), some pollutants may require a

comprehensive OEL review in the next five years while other pollutants can be reviewed over the next 10 to 15 years.

The objective of the expert target group engagement was to obtain an industry priority list from the Schedule 22.9(A) airborne pollutants, whose OELs should be reviewed following the recommendations from the participating industry and scientific experts. It is important to note that the participating experts did not have any knowledge of the OELs identified for revision by the research team. Pollutants could only be included on this industry priority list if 100% agreement or consensus was reached between all the participating experts. A modified Nominal Group Technique (NGT) was used during the workshop to reach consensus on the pollutants that should be prioritised for review in the opinion of the experts. The priority list, as suggested by the experts, consisted of the following pollutants (in alphabetical order), namely, carbon monoxide (CO), chromium (metal and inorganic compounds), coal dust (respirable particulate), diesel particulate matter (DPM), nitrogen dioxide (NO2), silica (crystalline, respirable particulate) and welding fumes. The industry stakeholder engagement was held with a larger group of industry stakeholders, that included representatives from government and labour.

The objective of this engagement was to allow various industry and governmental stakeholders to review and comment on the priority list of airborne pollutants that was developed during the expert target group engagement. The participants were asked questions on whether they agreed or disagreed with the OEL priority pollutant (six) list as identified by the experts for review. This include DPM as a new airborne pollutant in Schedule 22.9(A). In summary, most of the participants agreed that the OELs for CO, chromium, coal dust, silica and welding fumes should be prioritised for review. However, most of the participants disagreed that the OEL for NO2 should be prioritised for review. Further to these pollutants, the participants recommended that the following airborne pollutants should be prioritised for OEL review: All airborne pollutants with carcinogen, skin and sensitizer notations; ammonia, asbestos, benzene and associated compounds, coal tar pitch volatiles (CTPV), cyanide (hydrogen cyanide), fused silica, hydrogen sulphide, cyanide (hydrogen cyanide), particles not otherwise classified (PNOC), titanium dioxide, vanadium pentoxide, and wood dust.

The recommended OEL for hydrogen sulphide was opposed and there were mixed reactions on the proposed OELs for trivalent chromium (Cr(III)), hexavalent chromium (Cr(VI)) and vanadium pentoxide.

A few special recommendations are made.

- The recommendation to retract the welding fume OEL was supported by most of the participants.
- Furthermore, there was consensus that an OEL for diesel exhaust emissions (DEE) as total carbon (respirable fraction)), should be included in Schedule 22.9(A). However, there were concerns that the DEE OEL was too low considering the current engine technology, types of machines (tier) and quality of fuel.
- A recommendation to change the OEL of iron oxide, dust and fume [as Fe] from inhalable to respirable fraction was also supported. The recommended OEL for coal dust was supported by 17% of the respondents while 28% of the respondents disagreed with this recommendation. Half of the respondents agreed with the recommend OEL but provided qualifying comments. Concerns were raised about noncompliance and the challenges associated with current control technologies. Respondents supported the health-based approach but prefer to focus on the 2024 Milestone for coal dust namely 1.5 mg/m3 , in this instance. The recommended OEL for crystalline silica was supported by 38% of the respondents while 12% disagreed entirely. Some of the respondents (26%) commented that the focus should remain on the current 2024 Milestone, i.e. 0.05 mg/m3 . Other respondents (24%) noted factors such as challenges with current compliance, engineering compliance capabilities and the capabilities of current analytical laboratories to analyse samples within 95% confidence intervals. There was a majority agreement among the respondents that the ACGIH TLVs® should be adopted as a standardized approach in the SAMI and no objections or health-based reasons were presented against this proposal. The respondents commented that a realistic phase-in period, will be between three to seven years, depending on the pollutant.

Some of the key comments were that the OEL adoption of the recommended OELs should not deter the prevention strategy and that each pollutant should have its own phase-in period, based on the changes required and the controls available.

Based on the outcomes of this project, several recommendations are made for consideration.

- It is recommended that additional target organs / systems are included in the medical surveillance programmes following a comprehensive risk assessment of exposure to airborne pollutants.
- It is recommended that the comprehensive, tabulated comparison of all the Schedule 22.9(A) OELs with international leading practice is made available to industry as a standalone, reference document.
- It is recommended that the cost-benefit analysis framework is made available to government and industry for them to conduct a more comprehensive financial impact analysis when a revised OEL is implemented.

- It is recommended that policymakers approve the adoption of ACGIH TLVs, notations and BEIs® as a national process for OEL setting and review. Where the ACGIH does not have a notation, it is recommended not to adopt notations from another organisation to remain consistent with the ACGIH adoption strategy.
- It is also recommended that biological monitoring for specific airborne pollutants, as a form of medical surveillance, is included in the MHSA and that a BEI notation of the ACGIH is included as a note to those airborne pollutants listed in Schedule 22.9(A).

Considering the feedback and contributions from the respondents of the stakeholder workshop, further recommendations are made:

- Define a process of annual/biennial review of OELs to avoid long periods that may lapse without reviewing OELs, because the magnitude of change and/or reduction is too much for industry to comply with. Internationally, a defined process of review is followed and therefore, alignment with the ACGIH TLVs® can be considered as a best practice approach to review OELs.
- The proposed OEL changes for airborne pollutants with existing milestone OELs (e.g. coal dust and silica) beyond the existing 2024 Milestones, should only be considered after the milestone due date.
- A targeted workshop must be held with industry stakeholder, the Department of Mineral Resources and Energy (DMRE) and organised labour to discuss the implementation of revised OELs in industry. Each stakeholder should critically assess potential aspects within their control that may be a stumbling block on the road to compliance with the revised OELs such as conflicting business processes and/or restrictive legislation.
- Chemical laboratories that analyse for airborne pollutants should also be consulted when the implementation of revised OELs is discussed. The laboratories will have to align their testing to the reduced concentrations and need enough time for such an alignment.

ACCESS THE FULL REPORT HERE:

Link: COE 180607 - Full Report or Scan the QR code.

PROJECT TITLE:	**IS THE CURRENT CRYSTALLINE SILICA DUST EXPOSURE MEDICAL SURVEILLANCE SYSTEM IN THE SAMI COMPREHENSIVE TO MONITOR ALL ORGANS ADVERSE HEALTH OUTCOMES**
Project no:	**COE 190605**
Research agency:	**Mundele Business Consultancy Project number:**
Authors:	**Nyirenda T., Mhura D., Mamabolo M., Mhura M., and Mudzviti M**
Date completed:	**January 2022**

SUMMARY

The main objective of the Mine Health and Safety Act 29 of 1996 (MHSAct) is to provide for protection of the health and safety of employees and other persons at mines through authorized enforcements of standards and code of practices developed under the act. In Section 5 of the act, it is stipulated that the employer must, as reasonably as practicable, ensure the health and safety of employees at the mine. Section 13.2 further mandates mining employers to establish and maintain systems of medical surveillance aimed at eliminating or minimizing, controlling, preventing and detecting occupational diseases.

Guidelines regarding medical surveillance for silica dust exposure are provided in Section 11.7 of the MHSAct. Currently, medical surveillance for Respirable Crystalline Silica (RCS) dust exposure is mainly focused on the cardiorespiratory organs according to stipulations of Section 11.7 of the MHSAct. This is due to the airborne nature of respirable silica dust which when inhaled, ends up in bronchioles leading to cell fibrogenesis causing lung impairment and disease. The cardiorespiratory system is also what is stipulated in the mandatory Code of Practice (COP) for RCS dust exposure medical surveillance for monitoring in the South African Mining Industry (SAMI). However, recent record review and case study articles of RCS dust exposed individuals have found increasing risk of other diseases such as lung cancer, renal diseases, and systemic autoimmune diseases like progressive multiple sclerosis. It is therefore necessary to assess regulations, standards and practices in the SAMI to determine the effectiveness of the RCS dust exposure medical surveillance system in place.

Aim of the study

The aim of this research study is to determine if the existing RCS dust exposure medical surveillance system in the SAMI is effective enough to monitor all organs that are adversely affected.

Methodology

A combination of the exploratory and confirmatory research study was conducted to determine the clinical diagnosis methods applied/utilized and/or available during standard medical surveillance currently in the SAMI. The exploratory method was used to survey the current crystalline silica dust exposure medical surveillance systems and their comprehensiveness to monitor all organs adverse health outcomes in the SAMI whereas the confirmatory method enabled validation of the theoretical framework established in the literature against the data that was collated as part of this research study. Due to mobility restrictions imposed as a result of the Covid-19 pandemic, a data collection methodology had been designed to ensure compliance to social distancing regulations. This methodology enabled collection of data through multiple channels such as face to face interviews, telephonic interviews or email communications depending on respondent preferences within the social distancing framework.

The same methodology was used for follow-ups with respondents to ensure data quality and accuracy. Ethical clearance was out of scope for this survey study as there was no requirement to collect data from/or on individual human participants. The population for the study was the mining operations in the SAMI which have considerably high silica content and are known for silica dust emissions. According to Biffi and Belle (2003), mines with considerably high silica content are found in South Africa's hard rock mines such as gold mines, platinum mines, silica and coal mines making up to 57% of the total number of mines in South Africa (Africa Mining IQ, 2021).

The target sample for the study was at least one mining house each from silica sand mine operations, gold mine operations, platinum mine operations and coal mine operations. This target sample was justified as medical surveillance is standardised at group level and is applicable to all mining operations within the mining group and the results would be generalisable to the rest of the population in the SAMI. The Survey Instrument for the study was a questionnaire which was used to solicit general information on the location, size, commodity, and type of the sampled mining operations. The general information helped to analyse the sample and gave comparative insights into medical surveillance across different mining operations. The questionnaire also enabled collection of key variables on clinical diagnosis methods used/available during medical surveillance in the SAMI and this was used to validate the literature review base for the study.

Secondary data was also gathered from other Page 9 of 134 sources such as the Minerals Council South Africa, the Department of Mineral Resources and Energy (DMRE) and

published data for selected mining houses to draw complimentary insights into the analysis of the data collected from mining houses. The survey was conducted between August 2020 and September 2020 with followups in subsequent months. The target respondents at each mining operation were resident Occupational Medical Practitioners (OMP) or Occupational Health Practitioners (OHP) who are responsible for RCS dust exposure medical surveillance. In line with social distancing protocols and the proposed data collection approach for this study, 92% of the respondents preferred telephonic interviews and/or email communications while only 8% of the respondent preferred face to face interviews. The data collected was consolidated and processed in Microsoft (MS) Excel where analysis was conducted using various statistical techniques. Pre-coding had been done for the variable on the number of employees (both permanent and contractors) to categorise mining operations into small, medium, and large operations.

Recommendations

Based on the gaps identified in the existing Mandatory COP for RCS dust exposure, it was recommended that the MHSC and its stakeholders update Regulation 11.7 of the MHS Act and the Mandatory COP for RCS dust exposure (DMRE 16/3/2/4-A1) to include following examinations:

- Cardiovascular examinations to detect Cor Pulmonale and CVD
- Renal examinations to detect CKD and ESRD
- Autoimmune examinations to detect RA, SLE and multiple scleroderma

The Mandatory COP for RCS dust exposure (DMRE 16/3/2/4-A1) should also be updated to recommend that tissue biopsy, DLCO test, bronchoscopy, CT scans, sputum test and skin test be added to the existing cardiorespiratory tests for more enhanced medical screening of pneumoconiosis.

Suggestions for further research

It is recommended that the Mandatory COP for noise and coal dust systems of medical surveillance should be reviewed for comprehensiveness to enable the realization of a zero-harm environment in the SAMI.

ACCESS THE FULL REPORT HERE:

Link: CoE 190605 - Full Report or Scan the QR code.

PROJECT TITLE:	**DETERMINE THE CAPACITY OF MINE HEALTH FACILITIES TO ACCOMMODATE SURROUNDING COMMUNITIES**
Project number:	**CoE 180906**
Research agency:	**Mundele Business Consultancy**
Authors:	**Nyirenda T., Mhura D., Mashange S., Mhura M. and Sithole V**
Date completed:	**January 2022**

SUMMARY

Access to healthcare is entrenched in the Constitution of South Africa Act No.108 of 1996 under section 27 of the constitution which stipulates that everyone has the right to access of quality healthcare services, including reproductive healthcare services and no one may be refused emergency medical treatment. However, South Africa has a dysfunctional health system historically and will take ages to correct according to Kleinert and Horton (2009).

Since the 19th century, mining has been pivotal to the South African economy and continues to contribute immensely to the country's Gross Domestic Product (GDP). Historically, the South African Mining Industry (SAMI) has relied on the migrant labour system for employment which subsequently led to the mushrooming of formal and informal communities and other non-mining work opportunities in and around mining operations (Balfour 2018).

As with any functioning community, mining communities require adequate access to healthcare services in order to bring out a productive workforce required for a thriving mining industry. Section 2.5 of the South African Mining Charter defines a mining community as an area where mining is conducted and includes major labour sending areas and adjacent or surrounding communities within a local municipality, metropolitan municipality or district municipality (Mining Charter, 2018). While major mining housing companies have historically provided health services to their employees, non-mining employees and the adjacent communities have depended on the already stretched public health services for their healthcare needs.

Aim of the study

The aim of this research study was to determine the capacity of mine health facilities to accommodate surrounding communities and was delivered in five milestones presented in subsequent sections of this document.

Methodology

A combination of the exploratory and causal research study was conducted on selected mines to investigate and determine the type, scale and potential of mine health facilities to extend their health care services to surrounding communities in the SAMI and to explain the causal effects of the capacity or lack thereof. The exploratory method was used to survey the capacity of mine health facilities to service adjacent communities in the SAMI while the causal effects of the capacity or lack thereof, of mine health facilities to service surrounding communities was explained using the causal method of research. Due to mobility restrictions imposed as a result of the Covid-19 pandemic, a data collection methodology was implemented to ensure compliance to social distancing regulations. This methodology provided for multiple data collection channels such as face to face interviews, telephonic interviews or email communications as preferred by respondents within the social distancing framework. The same methodology was used for follow-ups with respondents to ensure data quality and accuracy. Ethical clearance was out of scope for this survey study as there was no requirement to collect data from/or on individual human participants. The target population was the mine operations in the SAMI which have an existing mine health facility. The target sample was at least ten mine health facilities selected from specific mines representing two gold mines, two platinum mines, four coal mines and four small scale mines from Free State, Gauteng, Northwest, Limpopo, Mpumalanga, KwaZulu Natal and Northern Cape provinces as set out in the Terms of Reference (ToR) for this research study. The survey instrument for the study was a questionnaire consisting of the general information section and a section on the health service profile of mine health facilities in the SAMI.

Secondary data was also gathered from other sources such as the Minerals Council South Africa, the Department of Mineral Resources and Energy (DMRE) and published data for selected mining houses to draw complimentary insights into the analysis of the data collected from mining houses.

Conclusion

Despite the mobility constraints imposed as a result of the Covid-19 pandemic, the survey study obtained conclusive facts regarding the capacity of mine health facilities to service surrounding communities. The literature review informed the proposition that mine health facilities in the SAMI, in their current state, do not have the capacity to provide healthcare services required by surrounding communities. The results from the survey showed clear resource capacity limitations on the part of mine health facilities to accommodate neighbouring communities in form of limited and overutilized medical personnel, facility and laboratory infrastructure, consultation space and admitting bed capacity and annual financial allocations.

It was determined that mine health facilities in the SAMI do not have excess capacity which can be utilized by the community other than what is currently available to service the employees. The survey results further showed that there are potential opportunities for mine health facilities to expand healthcare services to surrounding communities in the SAMI. This was expressed through willingness by the mining houses to extend health services to surrounding communities on condition that they were capacitated to do so. Several expansion models were then recommended by the researcher and presented at a workshop with the industry stakeholders in the SAMI for further deliberation and broader participation. Overall, a clear and concise result was achieved from this study using the research methodology implemented as proposed and intended. Although delivered according to the stipulated ToR, the general limitation for the study was the impact of the COVID19 pandemic which restricted data collection to mostly virtual interactions. It is widely assumed that face-to-face contact with respondents would have provided more insights and value into the research output.

Recommendations

Based on the findings from the survey study, the following models were recommended for adoption in the SAMI to facilitate expansion of the capacity for mine health facilities to enable them to extend health services to surrounding communities:

1. Develop a business case for a co-funding partnership operating model between mining operations, the government and private investors. Such funding partnerships could enable expansion of infrastructure, equipment, manpower, utilities and working capital that would result in extra capacity to service both employees and surrounding communities. The business case could also suggest how operating models for certain mine health facilities could be restructured to extend operating hours and shifts to increase capacity.
2. Run awareness campaigns to promote mindset change and encourage mining companies to extend healthcare service such as HIV/Aids and TB to communities especially where there's resource capacity.
3. Leverage off existing resource capacity identified in this survey in the coal sector to pilot healthcare service expansion to neighbouring communities before rolling out to other mining sectors.

ACCESS THE FULL REPORT HERE:

Link: CoE 180906 - Full Report or Scan the QR code

PROJECT TITLE:	**DEVELOPMENT OF A FRAMEWORK FOR EMPLOYERS TO EFFECTIVELY MANAGE CONTRACTORS TO IMPROVE OHS PERFORMANCE IN THE SAMI**
Project number:	**CoE 180901**
Research agency:	**Mobi Go Solutions**
Authors:	**Dr WJ Coetzer, Dr LC Swanepoel, Ms S Goosen, Ms MJ van Kraayenburg**
Date completed:	**September 2021**

SUMMARY

The mining industry is characterised by a high incidence of accidents despite stringent workplace safety regulations, in the past even though prodigious improvement made by SAMI in recent years. Still, efforts to improve occupational health and safety and thus minimise the prevalence of incidences and accidents in the industry is non-ending, with efforts by the Department of Mineral Resources and Energy (DMRE), the Minerals Council South Africa, and mining houses both nationally and internationally, to create a safe and healthy, fatality and injury-free work environment. The Minerals Council South Africa (2020b) and its member companies launched, for instance, the Khumbul'ekhaya ('Remember Home') Health and Safety Strategy. The emphasis on the concept of 'home' acknowledges that fatalities have the most significant impact on loved ones at home and encourages mine employees and managers to bear these loved ones in mind while embarking on their daily tasks (Minerals Council of South Africa, 2020a).

Added to this is the reality that the mining sector remains highly labour intensive, and its reliance on contractors to ease the load continues to increase. When considering the particular pressure that contractors are under and the precarious nature of their employment, it can result in corner-cutting, work intensification, and excessive working hours (Gunningham, 2008). The reputation that they seem to have for flaunting safety and for being under-equipped (Allonby, 1998), the increased risk of work-related injuries, diseases, and fatalities, appears to be inevitable. No relevant information pertaining to contractor management and related practices could be found in mining legislation and/or mining regulations within the South African context; however, the South African construction industry regulatory framework guiding contractor management exists. The absence of comprehensive contractor management good practices or contractor management standards in the South African mining industry is evident. Furthermore, the terms "contractor" and "contractor management" are not

explicitly defined in both the Basic Conditions of Employment Act of 1997 and the Mine Health and Safety Act of 1996.

Research has indicated that most contractors have limited rights, none or limited benefits, and are, at times, treated differently by the mine owner as well as by their peers working permanently for the mine owner. These factors give rise to a sense of job insecurity. This affects the individual, but ultimately, this impacts the bottom line and results in the organisation not achieving its set targets. Participating owner organisations regarded individuals working on a site, receiving remuneration for services delivered, as employees, irrespective of whether they are permanently employed and/or working as a contractor. They define a contractor as a service provider, delivering a service and/or executing a certain task/job for a set period (i.e., short, medium, or long term).

They noted that contractors tend to have a contract in place with the owner organisation. Owner organisations know they are responsible for all employees' health and safety (albeit permanent or contractor-employees), Hermanus (2007) indicated that as per the Mine Health and Safety Act of 1996, the following are evident:

- Employers bear primary responsibility for a safe and healthy work environment.
- Risk management approaches to addressing health and safety hazards are mandatory.
- Workers have the right to participate in health and safety, health and safety information, training, and to withdraw from dangerous workplaces.
- Tripartite institutions are charged with responsibilities to develop policy, legislation, regulations and promote a culture of health and safety.

Participating owner organisations indicated that they have clear expectations of contractors, responsibilities for contractor management, and role differentiations are poorly defined and not documented. Defining Owner organisations and contractor managers' roles, authorisation boundaries, and specific responsibilities in the Contract Management Procedure is critical. Role clarity enables good stakeholder relations that lead to optimised production and safety performance results. The owner operations indicated that dependence on contractors is due to the contractors' ability to perform specialised skills, expertise, and knowledge that are not available within their own workforce. They often possess scarce skills that are ad hoc requirements, such as shaft sinking, access development, and major construction work. The owner organisations acknowledged the need for contractors and indicated that proper contractor management processes and procedures are critically important to address. The reliance on contractors reinforces the need to have effective and efficient contract

management processes (Malhotra, 2019). Regardless of the progress been made, mine and worker Occupational Health and Safety (OHS) remains crucial given the historically dismal record of fatalities and accidents in mining in South Africa (Stewart, Bezuidenhout, & Bischoff, 2019). Operating in an environment of complex organisational, physical, and technical aspects, mining organisations need to incorporate both 'hard' (i.e., technical) and 'soft' (i.e., organisational, and behavioural) perspectives in improving overall health and safety (Lööw & Nygren, 2019). Numerous preventative measures and practices have been introduced and adapted in the mining industry to mitigate the constant danger of, for example, rock falls and rock bursts due to seismic activities.

Research, however, indicated that attention should also be placed on human and organisational factors, so-called 'soft' issues, especially when considering that research findings indicated that nine out of ten accidents in mining are triggered by human action such as operator errors and violations, with unsafe leadership and organisational factors featuring in up to two-thirds of accidents (see Gui, Xuecai, Qingsong, Wenqing, & Ying, 2020; Lööw & Nygren, 2019; Mirzaei, Aghaei, Kalatpour, Soltanian, & Nikravesh, 2018; Refer Milestone Report 3). Information about perceptions and experiences of contractors or contractor employees in the owner organisation, in terms of how they are managed, health and safety practices, disciplinary processes, overall treatment, as well as accident and incident investigations, were collected. Results (Refer Milestone Report 4 and Milestone Report 5) indicated that contractors are likely to be more safety-conscious when safety leadership is displayed within the owner organisation and when they have the necessary management support (Refer Milestone Report 4 and Milestone Report 5).

Similarly, when contractors experience a sense of inclusivity and a sense of belonging, being equally treated, and have similar rights as permanent employees, their personal safety will be positively influenced and their safety awareness. However, it was noted that at-risk behaviour or having to work in high-risk or dangerous conditions would negatively impact safety awareness, any sense of belonging, safety leadership, safety accountability, and management support. Even worse, when safety leadership or management support is not experienced or there is no sense of inclusivity or belonging with the owner organisation, the more likely the at-risk behaviour will be displayed by the contractor. This may also result in a contractor being more likely to work in a place where his or her health, safety, and well-being may be compromised. Further statistical analysis (Refer Milestone Report 4 and Milestone Report 5) indicated that contractors are likely to be more safety aware when safety leadership is displayed in the owner organisation and when contractors have the necessary management support. Research by Xue, Fan, and Xie (2020) found that safety leadership positively

impacted safety behaviour, while Amponsah-Tawiah, Ntow, and Mensah (2016) found that safety leadership is crucial in the administration of occupational health and safety. When contractors also feel a sense of inclusivity and sense of belonging, being equally treated, and have similar rights as permanent employees, not only will their personal safety accountability be positively influenced but also their safety awareness. Wachter and Yorio (2014) noted that increasing worker engagement in safety might systematically act to reduce the probability of human errors from occurring by making workers more involved with and aware of their tasks or surroundings and associated risks. Thus, increased levels of worker engagement in safety activities along with involvement and inclusivity could be related to increased safety performance as measured by safety outcomes such as accident rates. Results (Refer Milestone Report 4 and Milestone Report 5) also indicated that risky behaviour and having to work in high-risk/dangerous conditions would negatively impact Safety Awareness, Sense of Belonging, Safety Leadership, Safety Accountability, and Management Support.

When contractors thus not experience safety leadership or management support by the owner organisation, and if no efforts are made by the owner organisation to include the contractor (i.e., sense of belonging), the possibility increase that contractors will then display risky behaviour and be more inclined to work in unsafe conditions. From the results, it was evident that the onus rests with the management of the owner organisation, to actively display safety leadership, give the necessary management support and ensure that the contractor is integrated and included into the daily operations of the organisation by involving contractors in decisions that directly influence them, be considerate of their opinions, making them feel part of the team and creating a pleasant work environment. Thus, it can be deduced that the safety climate and culture in an owner organisation with displayed safety leadership and management support will play an imperative role in improving and addressing the health and safety of contractors.

Behavioural indicators as part of the framework are therefore inevitable. Still, regardless of the level of contractor involvement in an organisation, guidance in terms of effective contract management processes aligned to correct legislative interpretation is required. Regardless of the level of contractor involvement in an organisation, the contractor management process is a unique improvement opportunity that is often mistakenly viewed, outside of an Occupational Health and Safety Context, as an onerous formality that can be sidestepped (Malhotra, 2019). In part, due to the difficulty of managing the contractor paradox, this perception is short-sighted at best and negligent at worst. The fundamental importance of contract management outweighs the associated risks. Through contract management, the organisation can increase control, increase effectiveness, reduce costs, and provide strategic and competitive

advantages (Malhotra, 2019). Things like control of work procedures, responsibility for health and safety practices and training, skills training, work stoppages, etc. all contribute to what Malhotra (2019) referred to as an inherent paradox whereby a contractor, most of the time, must seamlessly integrate with an owner's system, combining Occupational Health and Safety elements that are at times contradictory, misaligned, out of scope or extremely difficult to gauge, either on paper or in practice (Malhotra, 2019). Therefore, it seems that there is a necessity to formalise clearer regulations and standards regarding contract management and indirectly influence the overall health and safety in the mining sector through the relevant legislation.

This report provides a comprehensive summary of the Contractor Management research outcomes. The proposed Contractor Management Framework is informed by a contractor life cycle, comprising of the following five phases:

- Contractor pre-qualification and selection (Procurement).
- Pre-commencement and planning.
- Contractor onboarding and engagement.
- Contract execution and control; and
- Close-out and review.

ACCESS THE FULL REPORT HERE:

Link: CoE 180901 - Full Report or Scan the QR code.

PROJECT TITLE:	**STUDY ON GOOD LEDGING PRACTICES AND THE DEVELOPMENT OF VIRTUAL VIDEO TRAINING MATERIAL BASED ON GOOD LEDGING PRACTICES**
Project number:	**CoE 180201**
Research agency:	**Enterprises at the University of Pretoria**
Authors:	**Jennifer van der Walt, Keaton Philo, Eugene Preis, Dr Bertie Meyer, Jónatan Jacobs, Wolter de Graaf, Prof Francois Malan, Jaco Delport**
Date completed:	**July 2022**

SUMMARY

This project was initiated by the Mine Health and Safety Council (MHSC) to address the concerns about the current shortfalls in ledging-specific training content in the South African Mining Industry (SAMI) to improve the safety and productivity of the ledging process, existing practices and ledging-specific skills. The aim is to review industry best practices, "tricks of the ledging trade" and acquire inputs from ledging practitioners and experts to develop a ledging good practices guideline that can be used to develop comprehensive ledging training programmes or ledging-specific training content. It is important to emphasise that the purpose of this research is not to prescribe a Good Practices Guideline that should be implemented as a COP or SOP on active mining operations but to investigate the collective good practices already captured in existing COPs or SOPs as well as the 'unwritten' good practices developed in active operations.

This guideline can, therefore, be used to describe good ledging practices across various operations and commodities as well as create the foundation to develop comprehensive ledging-specific training material.

The main objectives of this research study were to:

- Identify, review and analyse good practices for ledging in the SAMI.
- Identify and address information gaps based on an assessment tool developed during the project.
- Propose good ledging practices and develop a Guidance Document.
- Develop proposed scope and plan, as a separate proposal, for how to develop animated training material based on the identified leading ledging practices.

(*Note that this project ends with a proposal for the next phase which will be the development of the training material, as such no material will be developed in this phase.)

This final project report summarises the main focus areas and outcomes for each of the individual sections (milestones) as completed through the course of this project leading up to the final deliverable, i.e. the Good Ledging Practices Guidance Document.

A good practice ledging guidance document is presented in the document. It was created from an amalgamation of industry good practices as well as expert knowledge on ledging practices. This guidance document consists of the following key guidelines for ledging practices:

- A decision-making flow diagram is intended to help select the best-suited ledging method for different mining environments.
- The importance of an ore reserve management plan and a development service strategy (DSS) plan is highlighted as the foundation of ledging and future stoping activities. Even if the environment is not ideal to implement a fully conceived ore reserve management plan, the principles behind ore reserve management can contribute significantly to the success of the ledging operation.
- Pre-ledging flow diagram and key considerations.
- Ledging flow diagram accompanied by ledging guidelines and considerations explaining good practices for down- and up-dip ledging as well as breast and wideraise ledging.
- Overstoping guidelines for ledging.
- Post-ledging guidelines along with enabling and supporting factors for ledging operations.

These guidelines are intended to add value to ledging operations by supporting organisations in their efforts to achieve zero harm during mining activities.

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Link: CoE-180201- Full Report or Scan the QR code.

PROJECT TITLE:	**WHAT ARE EMPLOYEES EXPERIENCES OF HEALTH AND SAFETY MEASURES IN THE SOUTH AFRICAN MINING INDUSTRY (SAMI)?**
Project number:	**CoE190901**
Research agency:	**Kudenga Investments**
Authors:	**L.N. Madondo; N Ncube; M Dlundu; L Motshwaiwa; M Nene; W Mutambu**
Date completed:	**August 2022**

SUMMARY

The research study was aimed at investigating the experiences of employees of the health and safety measures in the South African Mining Industry (SAMI). A literature review on the health and safety measures in the SAMI as well as the employees' experiences of these, was conducted. This was done by reviewing legislative, industry and organisational health and safety measures, systems and interventions in the SAMI, as well internationally. It was established in the literature review that human rights violation anteceded the legislative environment in South African and internationally. Thus, the health and safety laws (and other related laws) seek to advance human rights, social justice, transformation of health and safety cultures, drive compliance through enforcement of laws, bring about responsibility and accountability, regulate the industry as well as encourage collaboration and participation of various stakeholders in the management of health and safety.

It was established through the literature review that, there is an overlap between legal, organisational, technological and collaborative efforts in the management of occupational health and safety. The conceptualisation of the Bull's Eye Framework for Health and Safety Management was made from the synthesis of the literature reviewed, with the 'Bull's Eye' being the intersection point of the various health and safety measures, and a state of highest maturity of the interventions. Perspectives were obtained from the 229 survey respondents from the SAMI, which highlighted that employees across commodity type of mines, gender, years of experience, race, area of job deployment, and level of education categorizations, generally knew the OHS measures in the SAMI without significant differences in perspectives held. The Knowledge, Application and Practice findings obtained provided support for the Bull's Eye Framework for Health and Safety Management.

The employees demonstrated knowledge of the MHSA and its Section 22 in particular, as a legislative OHS measure in the SAMI. They also mentioned the OHSA and Mines Act in few

numbers. Confidence in union representation sharply declines with increase in employees' level of education, albeit, with increased standard deviation (differences of opinion) on the perspectives held by the survey respondents. Employees from conventional Gold and Platinum mines had neutral perspectives with high variability in perspectives, on the adoption of technology as an OHS measure than their counterparts from Coal, Diamond and Iron Ore, who agreed to mechanization as an OHS measure. A reluctance towards embracing technology as an OHS measure emerged particularly in the Gold and Platinum mines.

The outcomes sought to be attained in the study were:

Literature review report on the mine health and safety measures, systems and interventions employed in the organisations, the SAMI and internationally;

- Literature review report on the employees' experiences and perceptions on the mine health and safety measures, systems and interventions employed in the organisations, the SAMI and internationally;
- Draft research questionnaire used in the KAP study of mine health and safety measures, systems and interventions in the SAMI;
- Report on the workshop conducted as part of the development of the questionnaire including an updated questionnaire;
- Report on the pilot study conducted as part of the development of the questionnaire including an updated questionnaire;
- Report on the KAP study findings;
- Report on recommendations for improvement of employees' experiences of the mine health and safety measures, systems and interventions in the SAMI based on the KAP study findings and a
- Report on the recommendations on training requirements in the SAMI based on the KAP study findings.

Objective of the study

The research study sought to obtain perspectives of the employees on the various health and safety measures in the South African mining industry and abroad, as this group is often overlooked in the formulation of the various initiatives for enhancing occupational health and safety.

Recommendation

It is recommended that technology adoption task teams be set up in order to champion adoption of technology in organizations. This should be from conception to implementation and post implementation reviews, including the change management processes associated with it.

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Other research projects currently being finalised are:

a) **Project Title:** Is the current crystalline silica dust exposure medical surveillance system in the sami comprehensive to monitor all organs adverse health outcomes
Project no: CoE 190605

b) **Project Title:** Develop a welding fume sampling standard (standard operating procedure and guidance note) for the SAMI
Project no: CoE 190601

These two projects are being finalised and will be uploaded on the website in Quarter 1 of the Financial Year 2023/2024.