



MHSC

Mine Health and Safety Council

COMPLETED OCCUPATIONAL HEALTH RESEARCH PROJECTS

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Presentation Outline



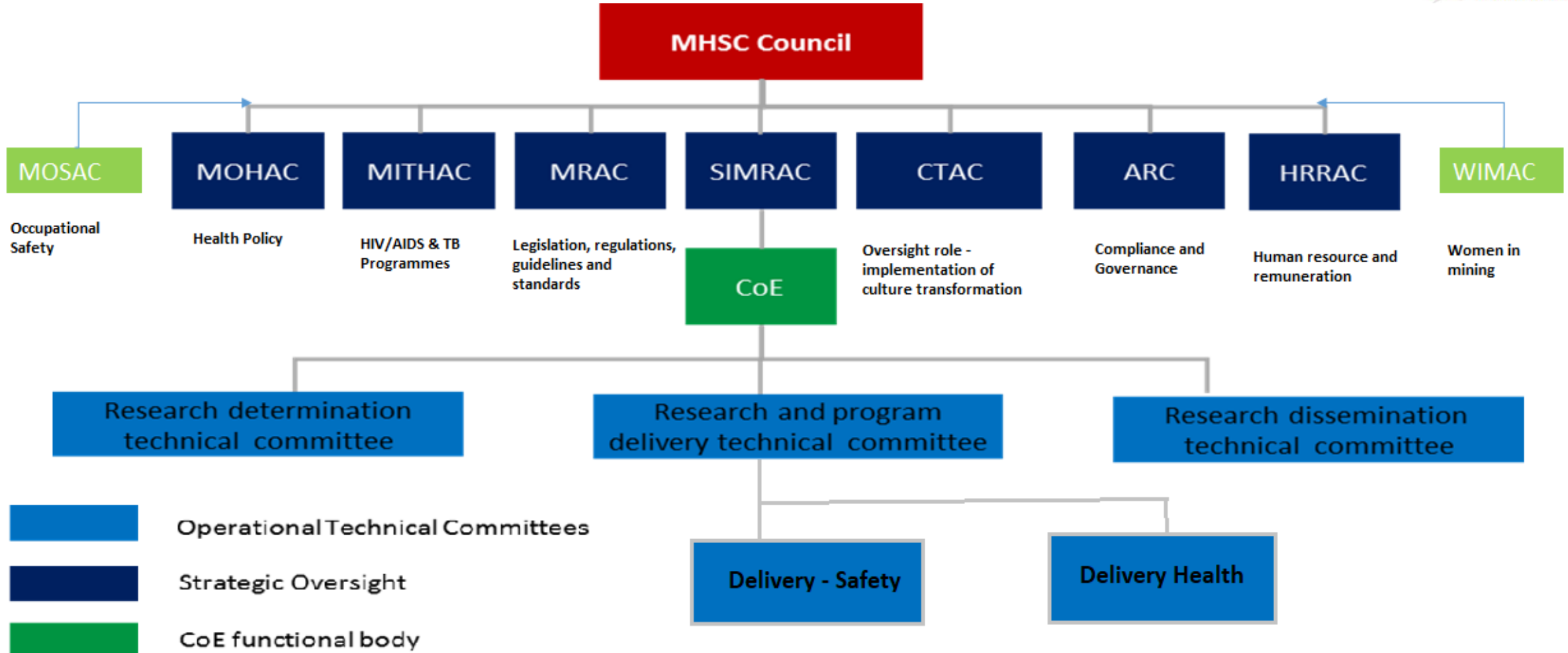
- 🌐 MHSC mandate and the Centre of Excellence
- 🌐 CoE 180607: Review of the airborne pollutants OEL – sch 22.9
- 🌐 CoE 180701: Review the current SAMI noise exposure limit and conduct a study on vibration OEL in relation to the SAMI
- 🌐 CoE 190601: Develop a welding fume sampling standard (SOP and guidance note) for the mining sector
- 🌐 CoE 190605: Is the current medical surveillance adequate to monitor all human organs for crystalline silica
- 🌐 CoE 180906: Capacity of mine health facilities to accommodate communities
- 🌐 CoE 180902: OHS risk management guidelines
- 🌐 CoE 190604: Klobbersbos analytical laboratory study for verification of
- 🌐 Seed-funded project CoE 15: Upgrade of CytoViva HSI System
- 🌐 Acoustic camera project

MHSC MANDATE



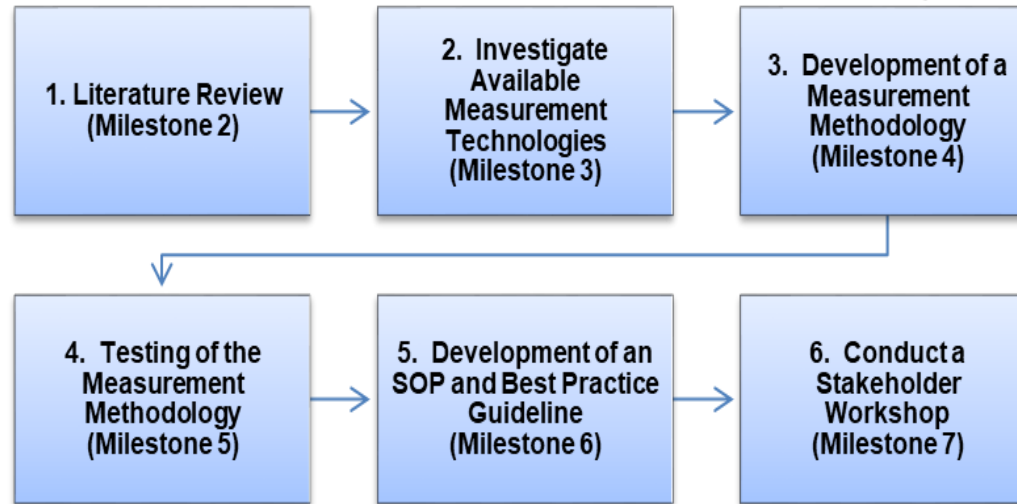
- Advise the Minister on all occupational health and safety issues in the mining industry relating to legislation, research and promotion.
- Review and develop legislation (regulations) for recommendation to the Minister
- Promote health and safety culture in the mining industry
- Oversee research in relation to health and safety in the mining industry
- Liaise with other bodies concerned with health and safety issues
- Host a biennial summit to review OHS performance in the mining industry

CENTRE OF EXCELLENCE



CoE 190601: WELDING FUME STUDY

- Develop a Welding fume Sampling Standard for the SAMI
- Welding fumes have been re-classified as carcinogenic (Group 1A) by IARC
- Methodology



- Limitations: single welder and a single location were utilised due to lockdown regulations. The research did not consider:
 - safe handling of compressed gases, electromagnetic radiation, electrical safety, fire prevention, explosion prevention or any other process-specific safety considerations.

CoE 190601: Welding Fume Study - Results



- The SOP describes the exposure measurements and sample analysis procedures when conducting welding fume exposure assessments
- Feedback from industry stakeholders during the workshop should support for the work completed
- main recommendation at the end of this study is to expand on the testing of the proposed methodology (given in the SOP) to reduce the current limitations and improve the overall SOP for use in the SAMI
- This SOP is useful to measure and analyse welding fumes and to monitor workers exposure
- Best practice identified from ventilation and exhaust control and information on PPE will assist in lowering exposures

CoE 180607: Review of the Airborne Pollutants OEL

– Sch 22.9

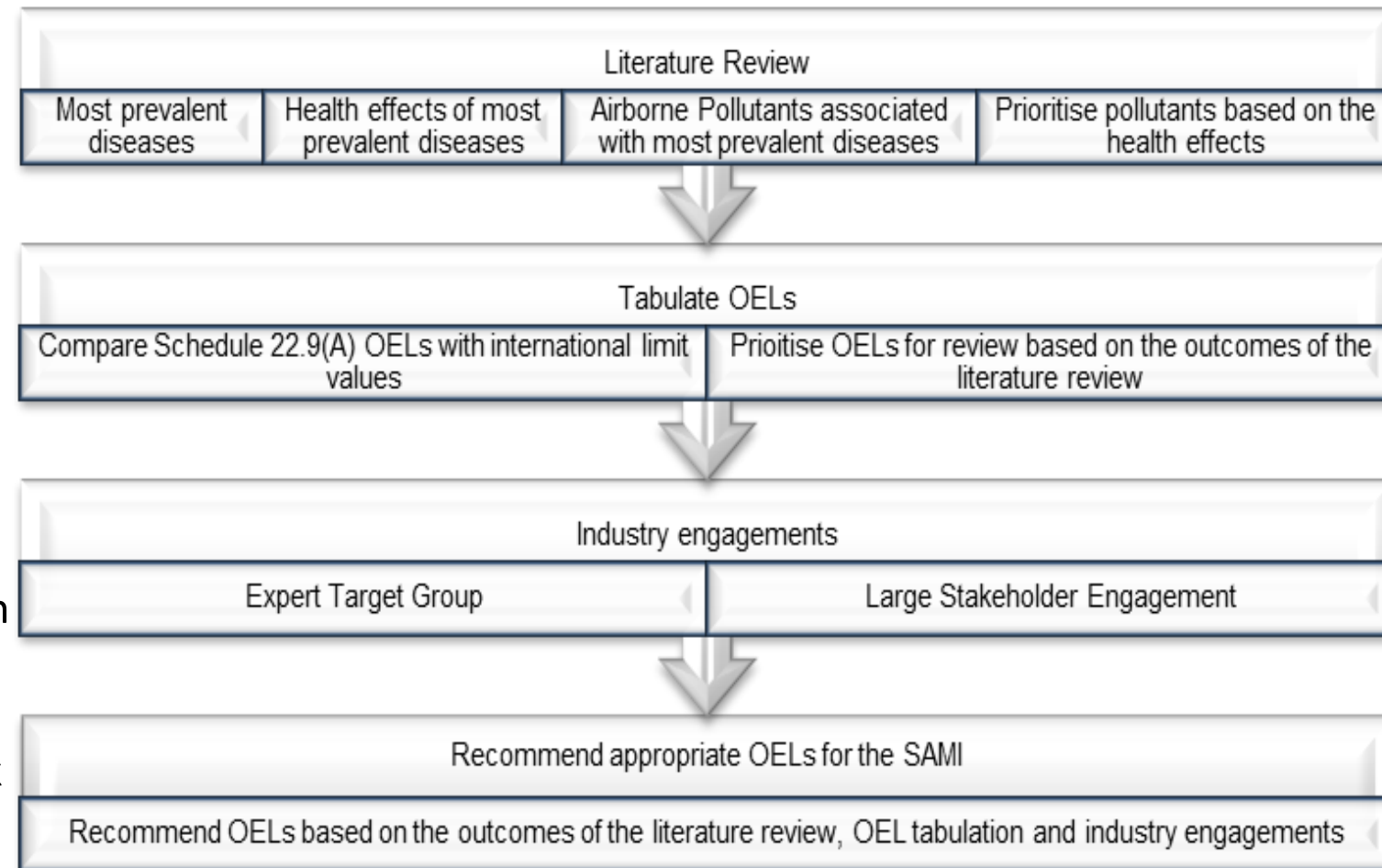


🌐 Airborne pollutants cause numerous occupational lung diseases and non-respiratory illnesses

🌐 Lack of scientific and evidence-based best practices and guidelines on OELs

🌐 3 Phases

- 🌐 1: Study the impact of the current OELs on employees' short- and long-term health
- 🌐 2: Prioritise and recommend appropriate OELs for the SAMI, including exposure risk classification bands
- 🌐 3: Stakeholder workshop with expert and industry stakeholders (tripartite)



CoE 180607: Review of the Airborne Pollutants OEL – Sch 22.9 (RESULTS)

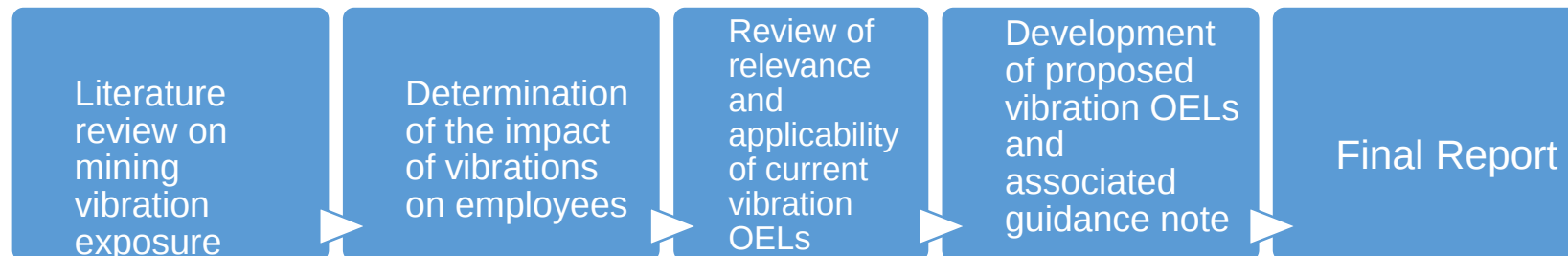


- 212 APs affecting 80% of target organs identified to be prioritised for review
- A financial framework & cost/benefit framework for a change to an OEL
- OELs recommended to adopt the TLVs®, notations and BEIs of the ACGIH
- When a lower OEL is proposed - keep the classification bands unchanged initially and then a phased-in pragmatic approach to the transition
- BM as part of medical surveillance for specific APs should be included in the MHSA and that a BEI® notation of the ACGIH is included in Sch 22.9(A)
- The stakeholder workshop supported the findings and suggestions of the study
 - Realistic phased-in approach between 3-5 or 5-7 years
 - coal dust and crystalline silica, the focus should remain on the 2024 milestones instead.

CoE 180701: Conduct a Study on Vibration OELs in the SAMI



- 🌐 Vibration levels in the SAMI are very high and specific categories of mining operations have increased risk associated with vibration exposure
 - 🌐 Hand-Arm Vibration (HAV): vascular, neurological, musculoskeletal disorders, HAVS
 - 🌐 Whole Body Vibration (WBV): musculoskeletal, impairment of vision/balance, respiratory, endocrine, metabolic, etc
- 🌐 Financial model for implementing the new OEL
- 🌐 Database of equipment vibration exposure levels created



CoE 180701: Conduct a Study on Vibration OELs in the SAMI - RESULTS



WBV

- WBV levels in the SAMI are generally not excessively high
- low back pain (LBP) is compensable but, internationally accepted criteria have not yet been established.
- WBV levels are not widely reported for the mining industry during normal operations
- No evidence of compensation worldwide

HAV

- HAV levels significantly exceed the EU limits in all cases and are excessively high
- HAVS is a compensable disease. Criteria to assess HAVS are internationally well-developed.

Financial Model: R1.16 Billion per annum

- Simple questionnaires must be developed to capture vibration related disorders for WBV and HAV, during MS
- Rock drills should receive special attention in any vibration control programme
- A simplified risk assessment database for vibration transmitting equipment should be developed, implemented and maintained for the SAMI
- It is proposed that a significantly increased temporary EAL be accepted for hand-arm vibration in the rock drill context, in order for the SAMI to adjust to the new regulated environment;

Vibration Directive.

Vibration	Exposure Action Value	Exposure Limit Value
Hand-arm vibration	2.5 m/s ² (A8)	5 m/s ² (A8)
Whole-body vibration	0.5 m/s ² (A8)	1.15 m/s ² (A8)
	9.1 m/s ^{1.75} VDV	21 m/s ^{1.75} VDV

CoE 190605: Medical Surveillance for Respirable Crystallin Silica (RCS)



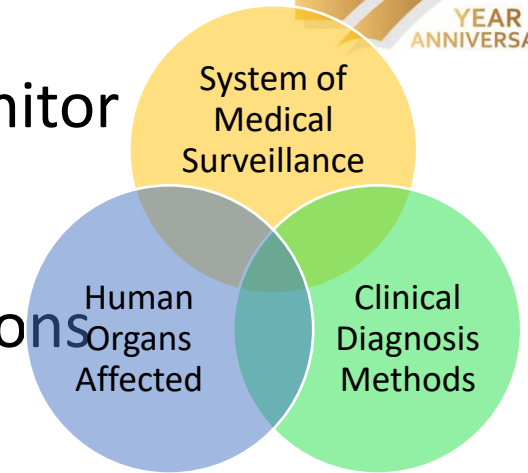
CoE 190605: Is the current medical surveillance adequate to monitor all human organs for Crystalline Silica

Medical surveillance gap identified in terms if medical examinations

- **Cardiovascular System (Heart)**
- **Renal System (Kidneys)**
- **Autoimmune System (Brain, Bones and the Skin)**

Regulation 11.7 of the MHSA and the mandatory COP for RCS exposure (DMRE 16/3/2/4-A1) should be updated to include the following examinations

The MCOP for RCS exposure should be updated to include tissue biopsy, DLCO test, bronchoscopy, CT scans, sputum & skin test to the existing cardiorespiratory tests for enhanced medical screening of pneumoconiosis



CoE 190605: Medical Surveillance for Respirable Crystalline Silica (RCS)

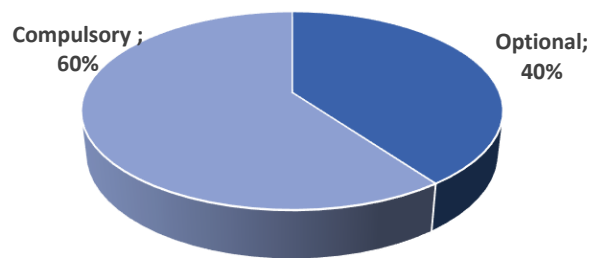


Human Organ	Literature Review	Clinical Diagnosis Methods used in the SAMI	Gaps Identified
Lungs	Full medical history, Cardiorespiratory questioning, Lung function test, Chest X-Rays, CT scans, Tissue biopsy, DLCO test, Bronchoscopy, Sputum test, Skin testing	Full medical history, Cardiorespiratory questioning, Lung function test, Chest X-Rays	Sputum test, Skin testing, Tissue biopsy, DLCO test, Bronchoscopy and CT scans
Heart	Cardiovascular questioning, Heart functionality tests, Chest X-Rays, CT	Cardiovascular tests not conducted for RCS exposure	Not included in the COP and regulation for RCS exposure
Kidneys	Renal functionality questioning, Urine tests, Physical examination	Renal tests not conducted for RCS exposure	
Skin	Clinical questioning, Skin tests	Skin tests not conducted for RCS exposure	
Bones	Clinical questioning and Physical examination	Physical examinations not conducted for RCS exposure	
Brain	Clinical questioning	Clinical questioning not conducted for RCS exposure	

CoE 180906: Determine the Capacity of Mine Health Facilities to Accommodate Surrounding Communities

Healthcare Service	Healthcare Provision		Model of Healthcare Delivery	
	Employees	Community	Onsite & Mobile	Outsourced
TB Screening and Diagnosis	94%	6%	93%	7%
TB Counselling and Treatment				
HIV Counselling, Testing and Prevention				
HIV /ART Treatment				
Hypertension Services				
Diabetes Services				
Chronic Medication**				
Emergency Services				
Mobile Services				

Medical Aid Cover



Laboratory Infrastructure

- Only available at 40% of the health facilities



CoE 180906: Determine the Capacity of Mine Health Facilities to Accommodate Surrounding Communities



Health services not provided

Child health care

Maternal health care

Surgery/high tech/specialised health services

Hospital admissions

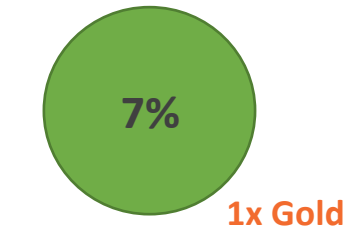
Generally, no excess healthcare resource capacity currently in the SAMI as the following resources are overutilised:

Medical and nursing staff

Consultation beds

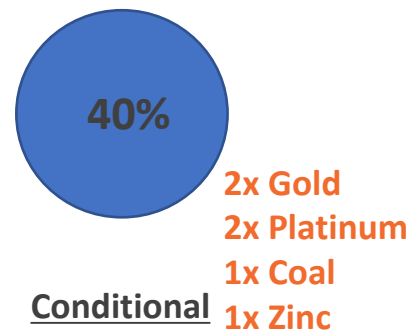
Lab and health facility infrastructure

Annual budget allocations to health



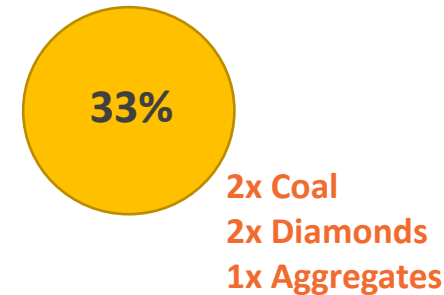
Absolute Willingness

Can use existing capacity available to extend healthcare service to the community



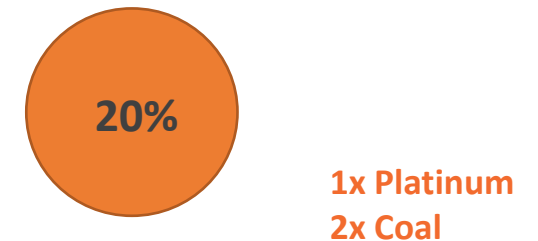
Conditional Willingness

Require capacity expansion in order to extend healthcare services to the community



Unwilling (Facility Type)

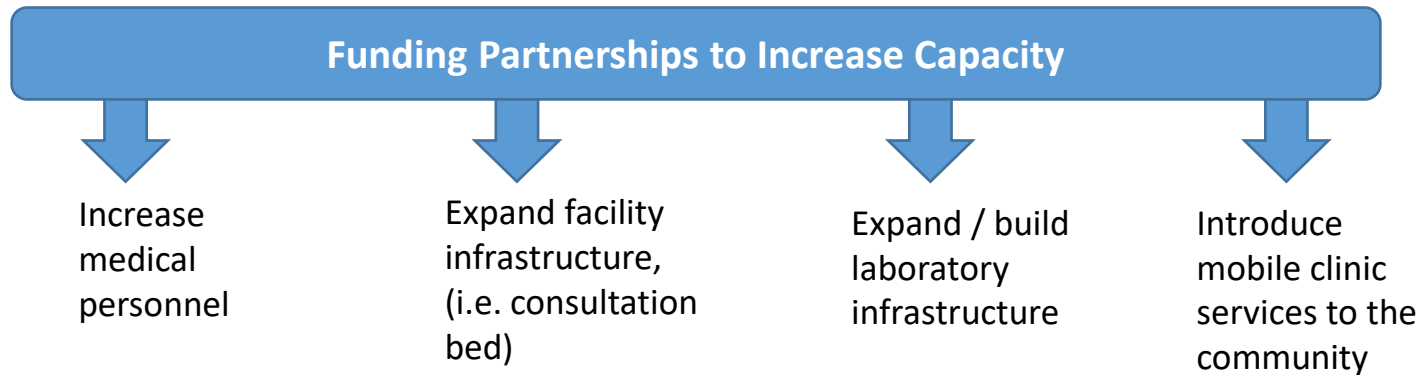
Health facility is outsourced and therefore out of scope for healthcare expansion



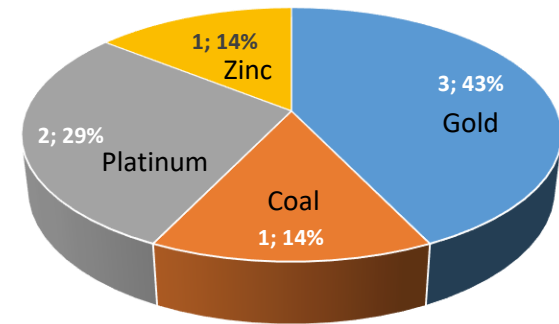
Unwilling (Strategic Plans)

Expansion of existing healthcare services is not in the strategic plans in the foreseeable future

CoE 180906: Determine the Capacity of Mine Health Facilities to Accommodate Surrounding Communities



Potential Expansion Opportunities



- 🌐 A co-funding partnership operating model between mining operations, the government and private investors
- 🌐 Adoption of a risk-based approach as an expansion strategy by prioritising mines with the highest impact on communities
- 🌐 Pilot healthcare service expansion to neighbouring communities by using existing capacity identified & provide it at cost
- 🌐 Use mobile clinics to expand healthcare service such as TB, HIV, diabetes & hypertension screening, counselling & prevention
- 🌐 Run scheduled programs to open health facilities to the community for selected screening, diagnosis & treatment periodically
- 🌐 Run health programs related to environmental impacts of mining operations to promote awareness of possible health effects

CoE 180902: Develop Occupational Health and Safety Risk Management Guidelines for the SAMI



- 🌐 Effective management of risks in the workplace is the cornerstone of a successful OHS management system
- 🌐 There are no standardised risk management guidelines for the SAMI
- 🌐 Methodology: The development of a Risk Management Assessment Tool (RMAT) to guide the interactions and explore the current practices at mining sites, which included gold, platinum, coal and a refinery
- 🌐 It is recommended that a formal learning program is developed to ensure in-depth understanding of the terminology and practices.
- 🌐 A workbook with additional resources can be made available for current and future generations.
- 🌐 Study tours to expose responsible managers and leaders to various benchmarks and practices would ensure an implementable solution.
- 🌐 A change management process should be adopted to drive the exposure and adoption of the guidelines.

CoE 180902: Development of Occupational Health & Safety Risk Management Guidelines for the SAMI



ANNEXURE 14: OHS RISK MANAGEMENT GUIDELINE



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THE GUIDELINE FOR RISK
MANAGEMENT IN THE SOUTH AFRICAN
MINING INDUSTRY

Research agency: NOSA (Pty) Ltd
Project number: CoE 180902

OHS Risk Management Guideline

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CoE 180902: Development of Occupational Health & Safety Risk Management Guidelines for the SAMI



Critical Control Guideline

ANNEXURE 15: CRITICAL CONTROL GUIDELINE



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GUIDELINE TO CRITICAL CONTROL
MANAGEMENT IN THE SOUTH AFRICAN
MINING INDUSTRY

Research agency: NOSA (Pty) Ltd
Project number: CoE 180902

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CoE 15: Upgrade of CytoViva HSI System

🌐 Dark-field **microscope**, with hyperspectral and fluorescent capabilities, was upgraded to enable **3-D representations** of nano-scale objects,

- Confirm the presence of particles within cells
- Investigation of the link between exposure and disease

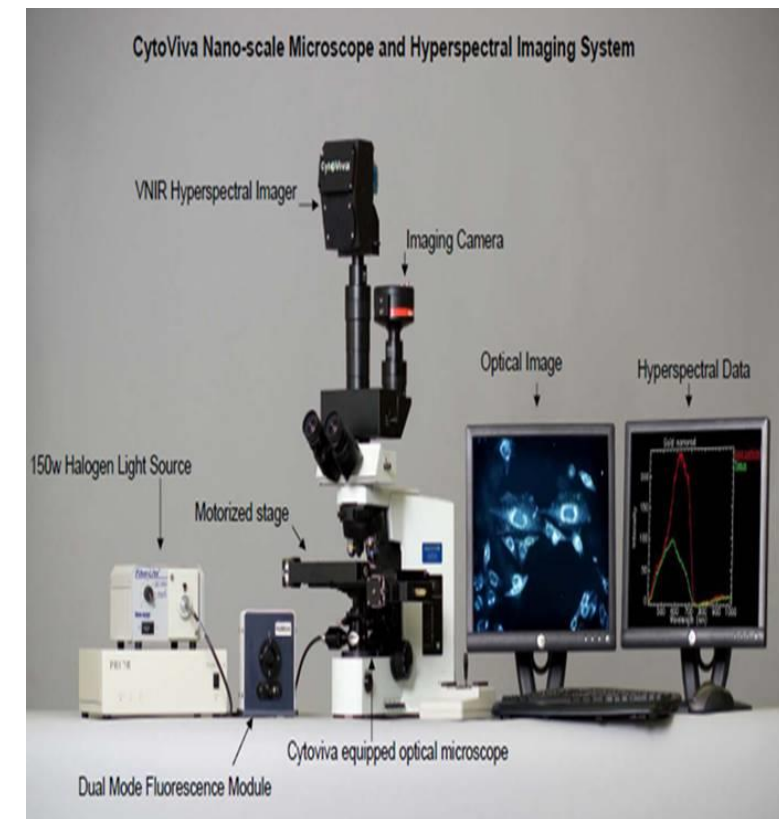
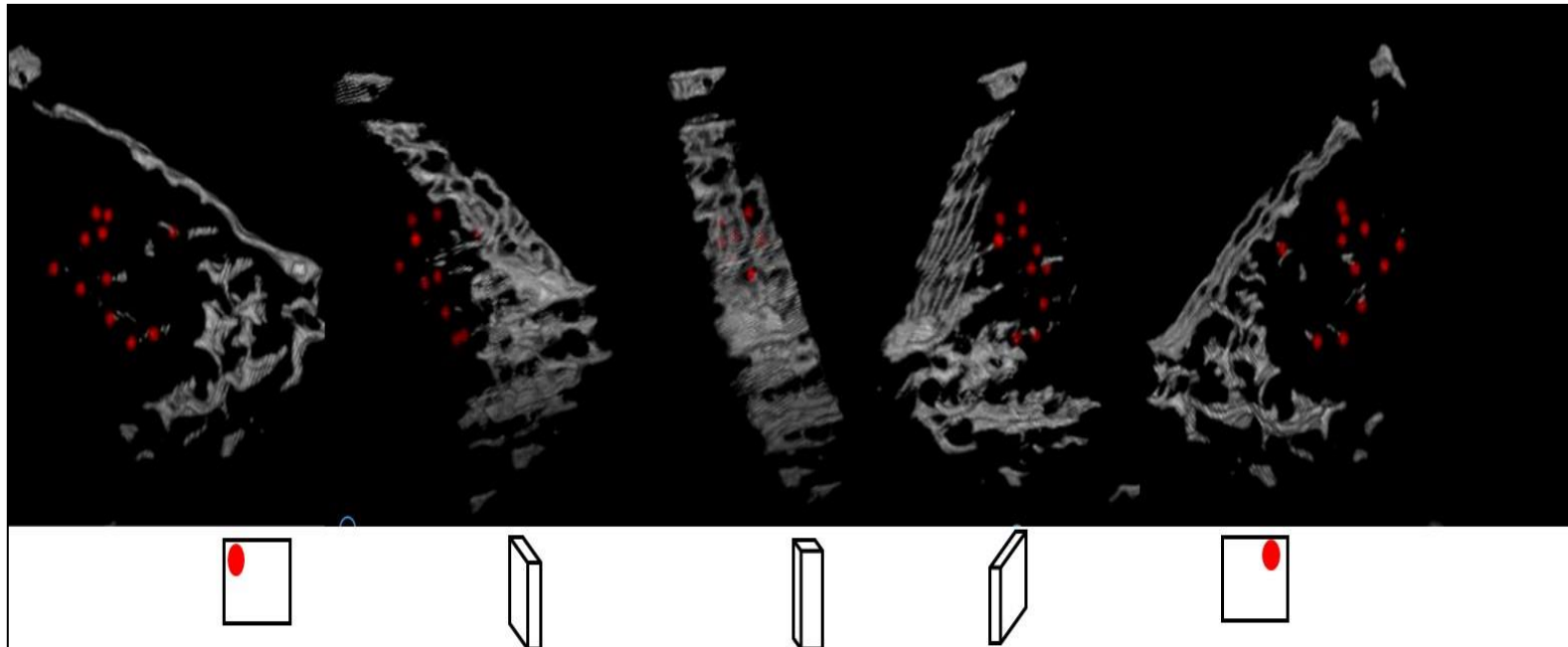


Figure: The 3D image of a bronchial cell with internalized silica particles, rotated at different angles, obtained via the CytoViva 3D-upgrade. No staining was necessary. System could identify cell (grey) and distinguish particles (red), thereby confirming presence of particles in cells.

CoE 15: Upgrade of CytoViva HSI System



Applications: Service to mining industry

-  Pathologists: Testing of postmortem lung samples to confirm the presence of dust,
-  OMPs and OHNs: Sputum samples may provide a relatively non-invasive confirmation of particles in cells, in conjunction with other biochemical or medical analyses
-  Researchers and OMPs: Those who are interested to determine the mechanism of toxicity and aid the understanding of disease onset and progression

 The use of the CytoViva system, may one day eradicate pneumonconiosis altogether if we can determine the association between exposure and disease and if we pick up clinical disease before symptomatic disease

 Assistance from Gold mines – Looking for a pilot site to test and validate the use of the CytoViva in the SAMI

Seed-funded Project: Acoustic Camera

🌐 Siemens LMS Sound Camera

🌐 The top 15 noise critical machines across all the commodities were identified for evaluation

- 🌐 the acoustic camera could successfully distinguish between multiple noise sources
- 🌐 Could quantify the noise level contribution of each individual noise source

🌐 Benefits

- 🌐 Significant time saving and improved accuracy
- 🌐 Moving machinery / multiple sources
- 🌐 Ranking of sources and ID worst offender NIHL machines
- 🌐 Start noise source technical database
- 🌐 Assess noise characteristics of these machines
- 🌐 Provide enough info in database for silencing strategy



Seed-funded Project: Acoustic Camera

Limitations

- Ⓜ Weighs 16 kgs
- Ⓜ Laborious to test underground
- Ⓜ Requires 220V electricity supply which is not always available
- Ⓜ The in-built battery packs are not intrinsically safe
- Ⓜ Camera is not robust
- Ⓜ Requires good illumination to produce good quality photos
- Ⓜ No IP ratings for dust and liquid

Conclusions

- Ⓜ many short-comings of the use of the camera
- Ⓜ Specific uses of the camera in mining
 - Ⓜ Open cast mining, OEMs
- Ⓜ There are newer and better cameras on the market

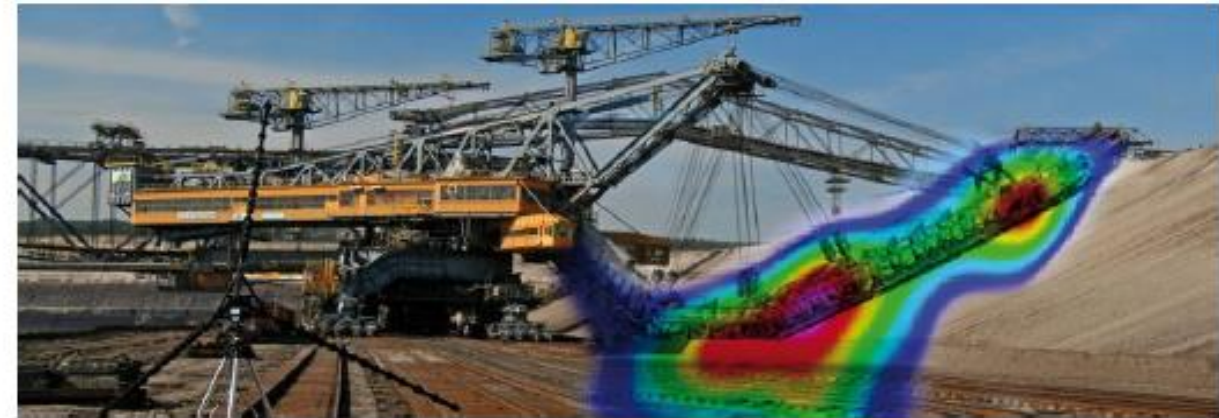


Figure 1: Analysis of a reclaimer with an acoustic camera (gfai tech GmbH, 2015)

New and Upcoming Health Research



- Continuation of project SIM 150801: Review of the SIMRAC Handbook for Occupational Health in the SAMI” OH Handbook
- CoE 190904: What are the safety risks and health hazards prevalent in the smelting and refining process of metals in the Sami?
- CoE 180605: Develop Standard Operating Procedure for measurement and reporting for Respirable Crystalline Silica
- CoE 210101: Effects of Cannabis on Occupational Health and Safety in the SAMI and benchmark for maximum allowable blood level of cannabis at the workplace
- CoE 210903: The Impact of Over-exertion on Women’s Health and Safety in the SAMI
- CoE 190908: Minimum medical and physical fitness to perform work for women in mining (WIM) in the SAMI.
- CoE 180801 Revision of the TB audit tool to include HIV, AIDS, Silicosis and other occupational lung diseases for the SAMI.
- CoE 200402 The Review of the Chamber of Mines Research Organisation (COMRO) Code: RES-Q-PACS- How to calculate safe travelling distances”
- CoE 180602 Feasibility Study on the Dust Exposure in the South African Mining Industry
- Post recovery health effects of COVID-19 on employees in the South African Mining Industry
- What is the cost(s)/benefit(s) of mining houses extending healthcare services to surrounding communities?
- Best practice training programs for: hazard identification and risk assessment
- Refinement of the underground equipment noise prediction model
- “Identification of prevalent biological hazards in the SAMI”

Acknowledgements



- 🌐 Our service providers undertaking this quality research for us
- 🌐 Our technical advisors reviewing and ensuring quality work is produced
- 🌐 Colleagues at the MHSC
 - 🌐 **RESEARCH IS A TEAM EFFORT!**
- 🌐 SIMRAC and MOHAC/MITHAC for also assisting with the research value-chain

The End

Every miner returning from work unharmed every day...