Measuring and controlling the mining environment for worker health and safety

4th Biennial Conference

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our future through science

CMI Human Factors Research Group

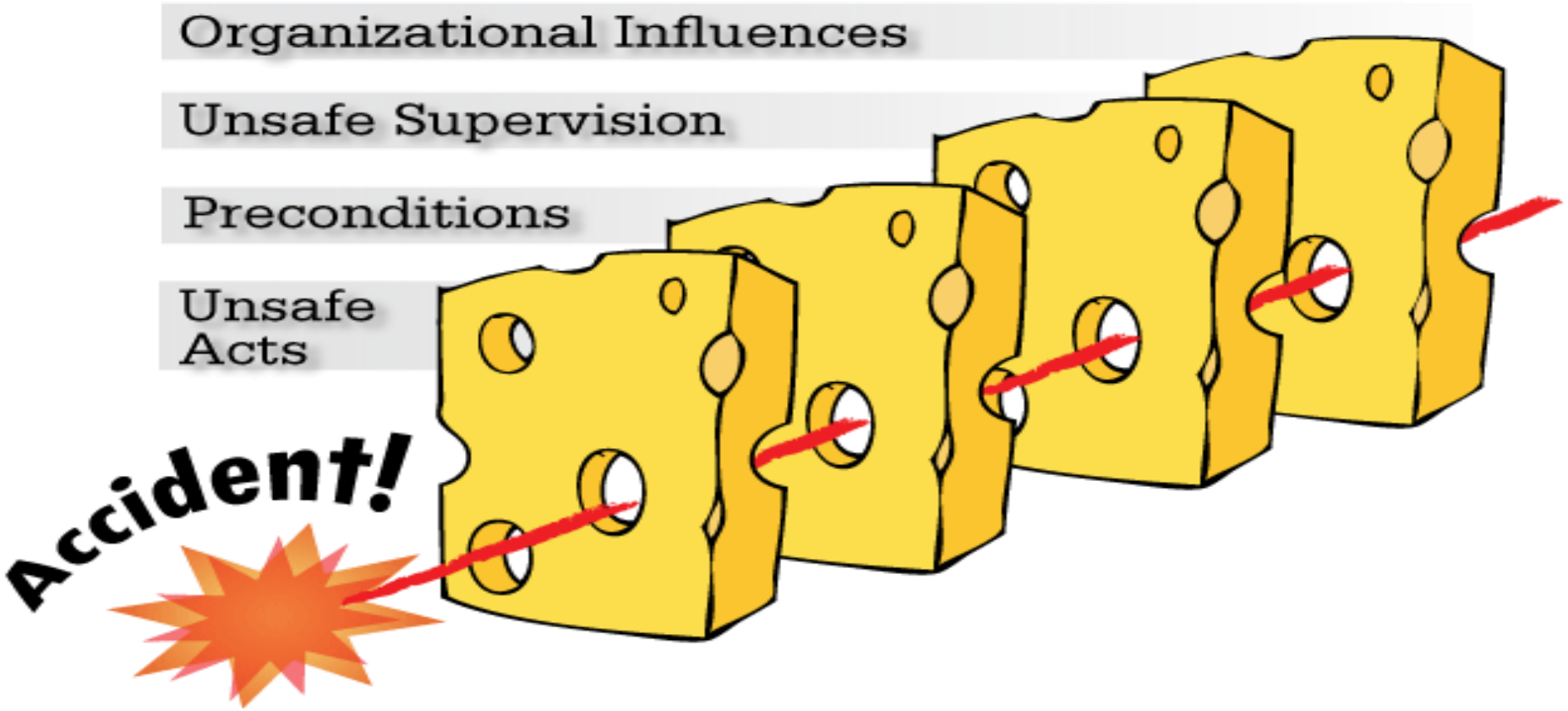
Recent statistics of the mining industry:

- 123 Fatalities in 2011
- 3299 Injuries in 2011
- Approximately 2000 fatalities from silicosis reported per annum
- Approximately 1500 workers diagnosed with Noise Induced Hearing Loss (NIHL)

➢ **Still room for improvement**

CMI Human Factors

1. HFACS: Accident Analysis



Swiss-Cheese Model illustrates how accidents occur

HFACS: Accident Analysis

Why do accidents happen?

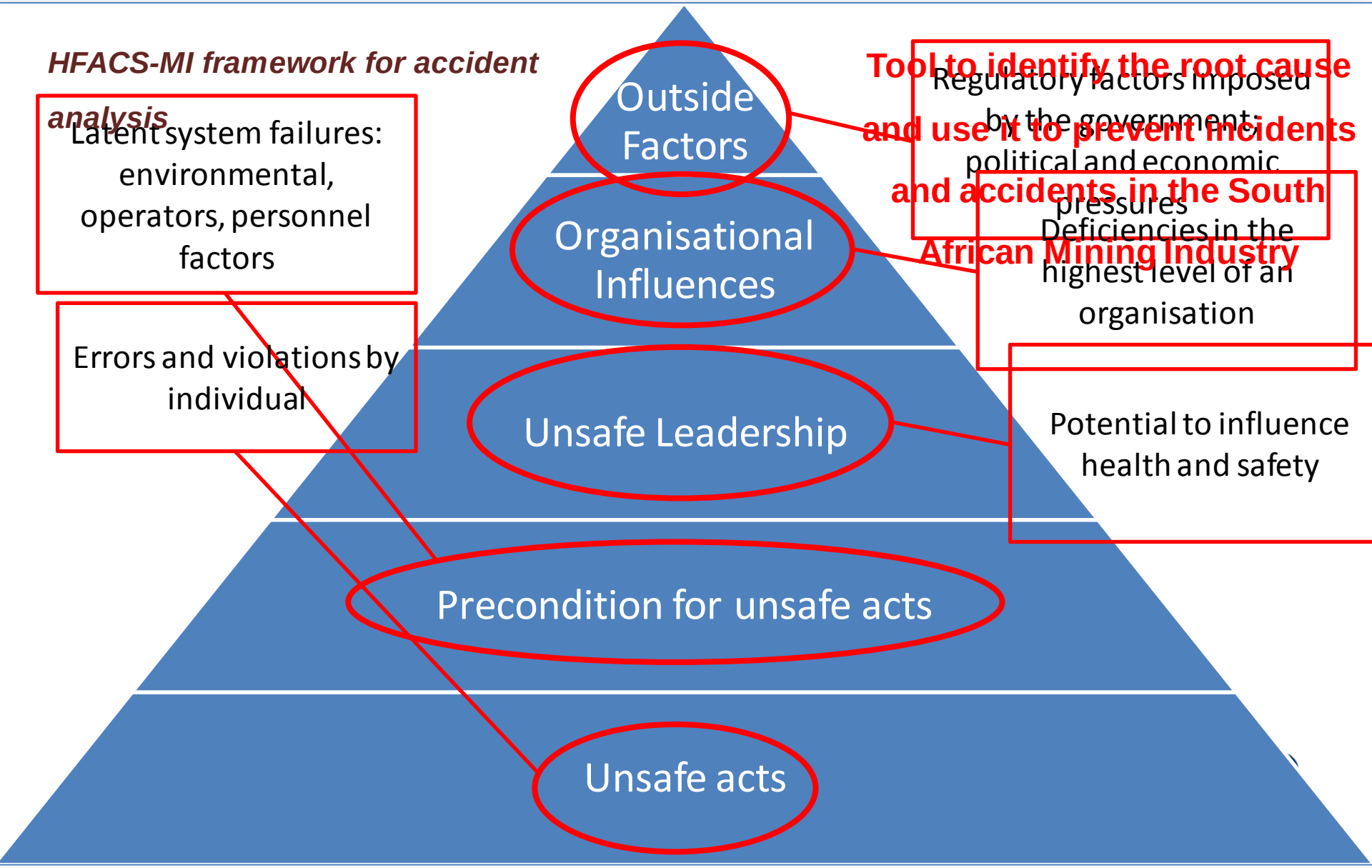
Current situation when accident occurs:

- Investigation
- Cause: Worker is usually blamed
- Solution: Training
- Problem: Recurrence of the same accident…

➢ **Improper investigation to get to the root cause of the problem**

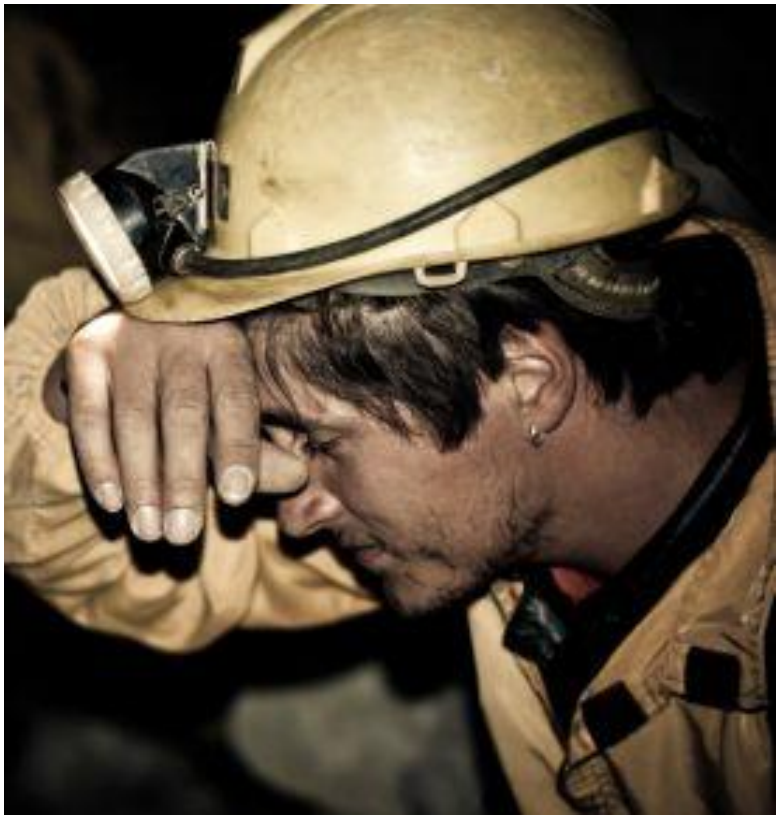
Human Factors Accident Classification System – Mining Industry

HFACS-MI framework for accident analysis



Tool to identify the root cause and use it to prevent incidents and accidents in the South African Mining Industry

2. Workplace stress

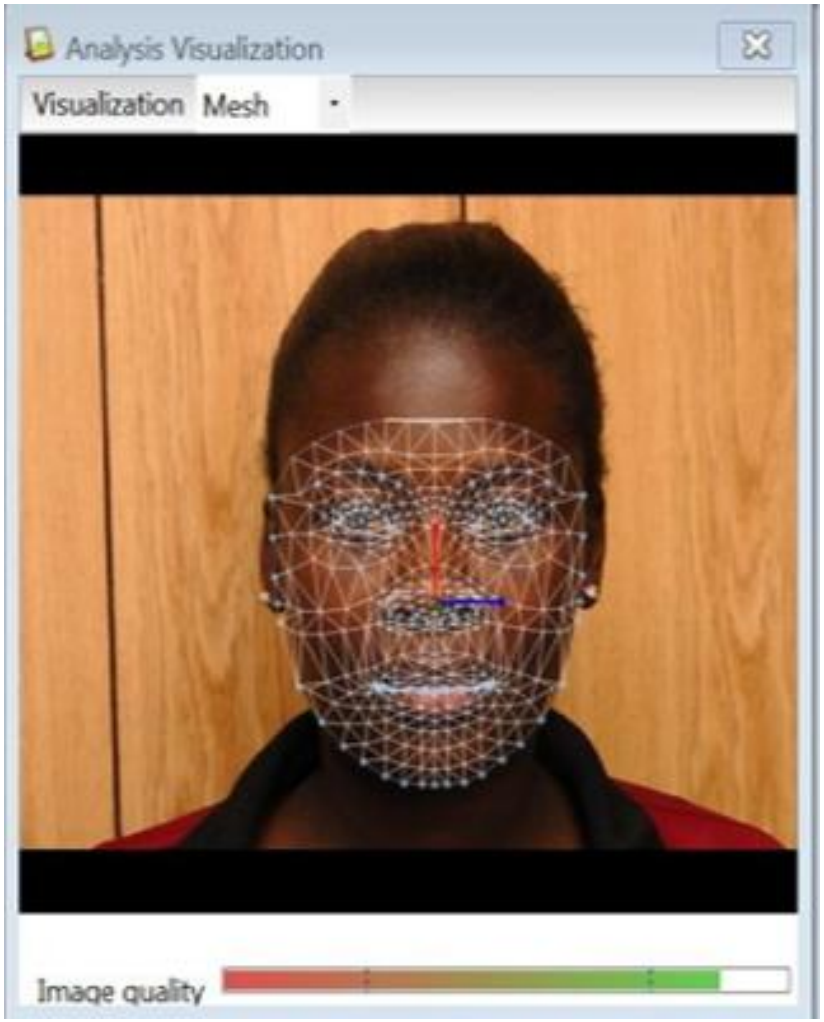


- Linked to increased risk of disease, mental disorders, increased absenteeism, reduced productivity, and a higher accident rate
- What is the impact of workplace stress on South African Mining Industry?

➢ ***CMI Research aimed at finding ways to prevent accidents caused by stress and fatigue***

Workplace stress: FaceReader™

FaceReader™ Analysis



- FaceReader™ reads facial expressions
- Objective tool to measure workplace stress
- Mining pilot study successful
- Further application: indicator of fatigue
- Screen workers prior to workplace entry

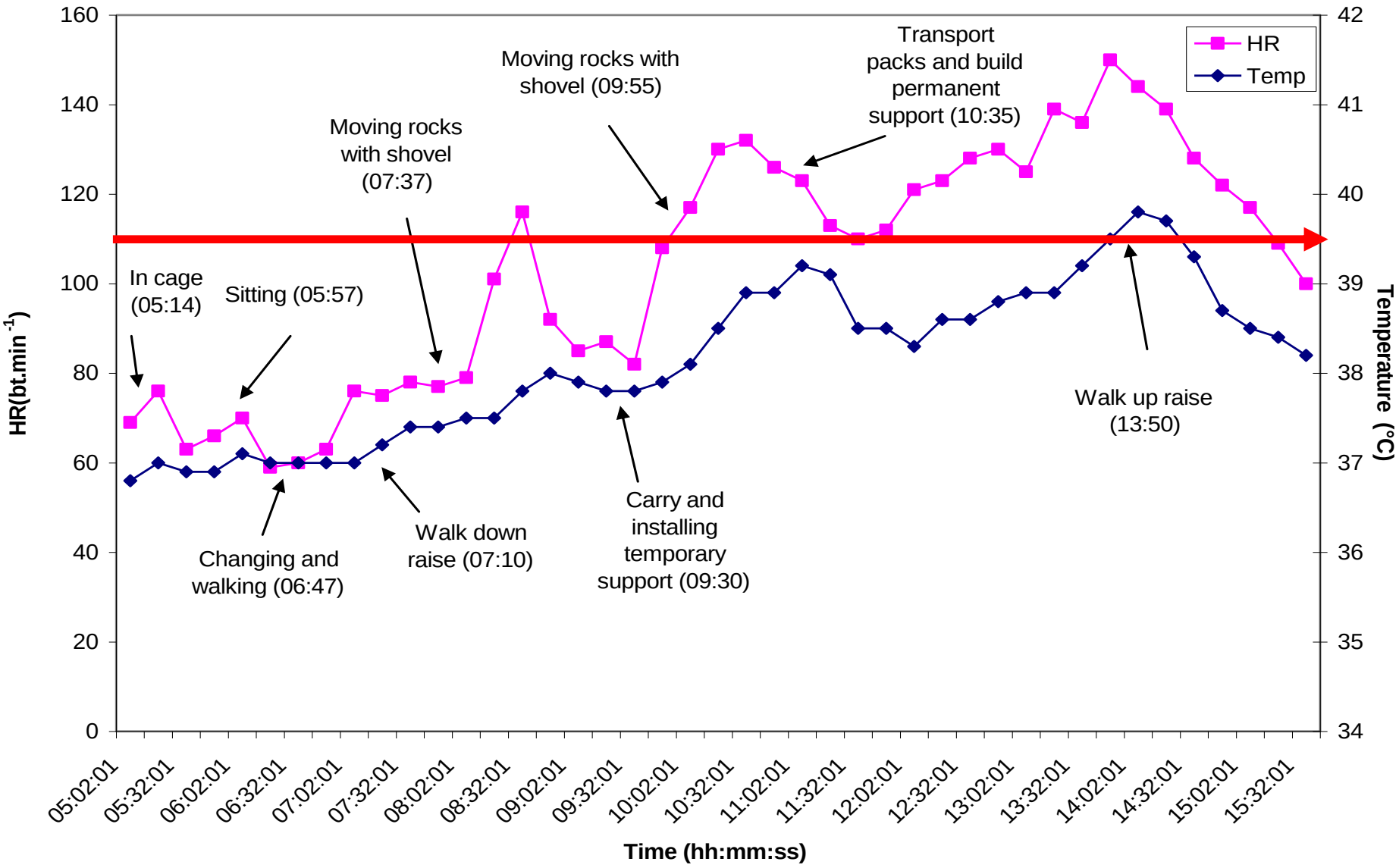
➢ **Monitor the well-being of workers**

3. Physiological Strain Index (PSI)

How hard do mine workers work?

- Aging, unhealthy workforce; more females
- What is the ***work capacity*** of the mine worker in the South African context?
- Correlate the heart rate and body temperature of the mine worker
- Initial results from gold mine indicates that workers are not exposed to excessive physiological strain (self-pacing takes place)
- Expanding research to platinum mines

Physiological Strain Index (PSI)



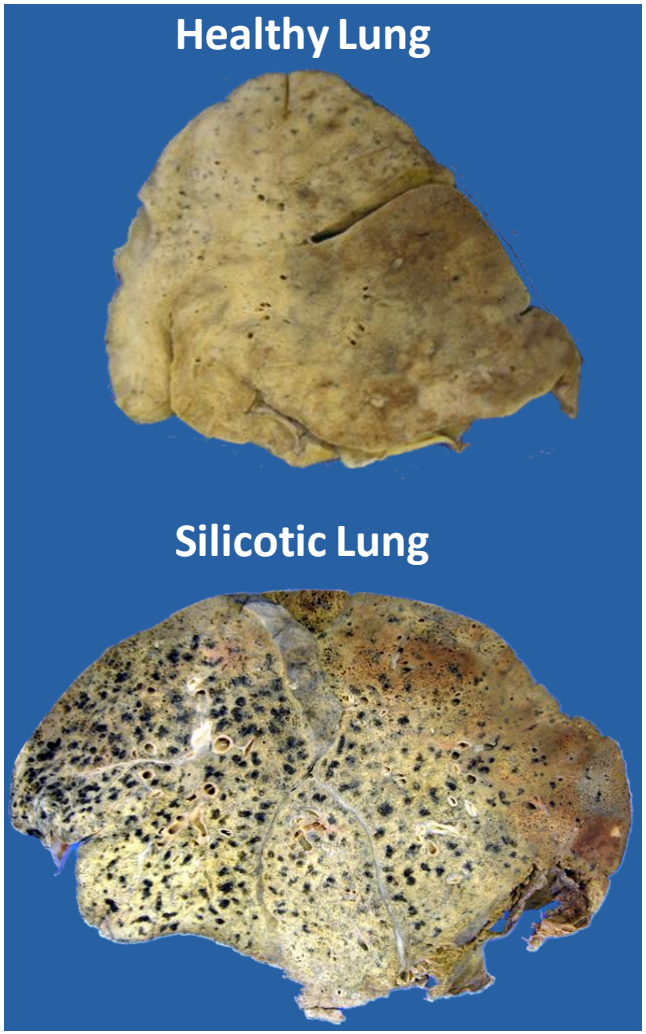
4. Planisa

Boer maak ’n plan…

- Improvise to cope with the inefficiencies and organisational constraints
- Either an instruction or self-initiated action
- CMI: Focus groups and questionnaires

➢ **How does making a plan impact on the health and safety of mine workers?**

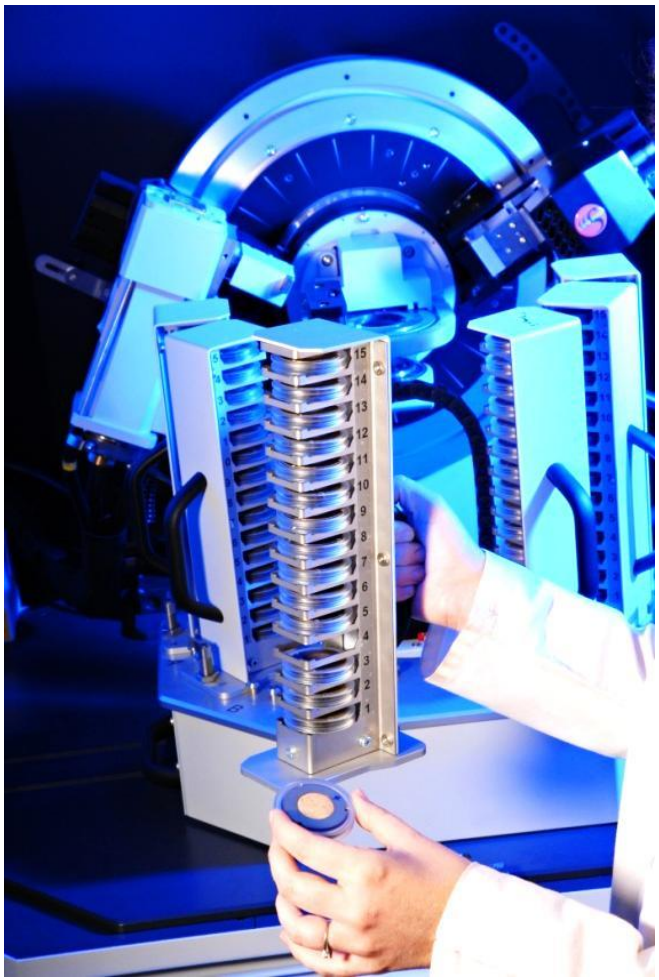
5. Airborne Pollutants



Respirable Crystalline Silica (RCS):

- Causes silicosis: debilitating lung disease
- International drive to eliminate silicosis
- Milestone 2013: No new cases of silicosis from previously unexposed individuals
- Approximately 2000 fatalities from silicosis per annum

Airborne Pollutants: Silica



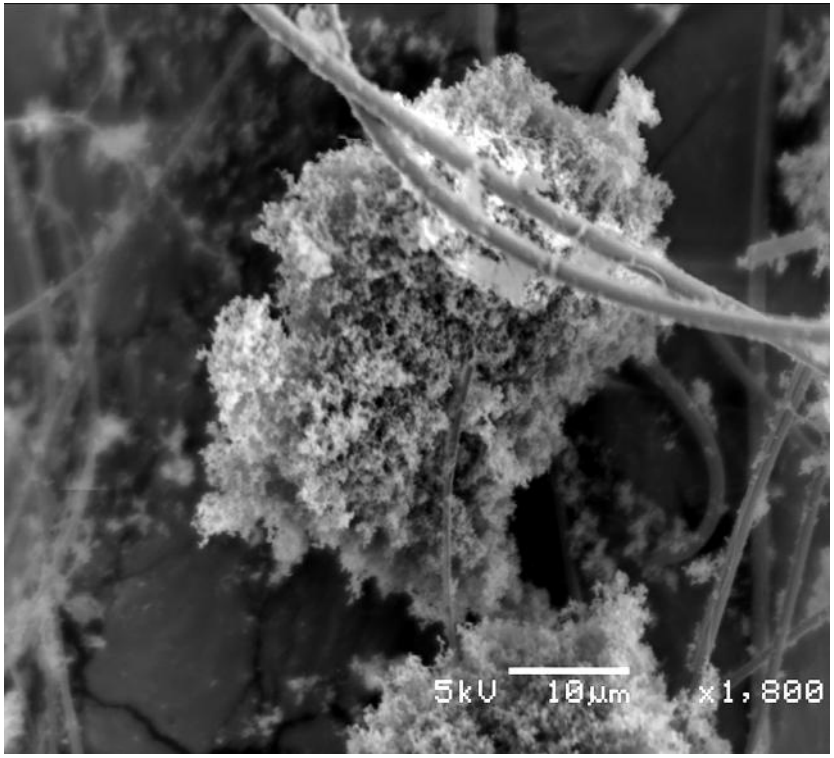
Silica analysis using X-ray Diffraction (XRD)

Respirable Crystalline Silica:

- MHSC projects to evaluate dust control measures
- Evaluating size-selective samplers
- Representative samples
- High speed and improved accuracy of silica analysis
- ISO Working Group on Silica measurements

➢ **Standardisation across the South African mining industry**

Airborne Pollutants: DPM



Scanning electron microscope image of DPM (10 µm magnification)

Diesel Particulate Matter (DPM):

- Classified as carcinogen in June 2012
- No occupational exposure limits in South Africa
- Use international limits as guideline

➢ ***Limitations: aging fleet of engines and poor quality fuel***

Airborne Pollutants: DPM

Source of DPM: diesel powered equipment

DPM research to fill knowledge gaps:

- Exposure model to assess health outcomes
- Engine deterioration in terms of DPM
- Organic Carbon fraction
- Correlation between tail gas and DPM emissions
- First DPM project of this nature

➢ **Determine current situation of DPM exposure in the South African mining context**

6. Air and Dust Laboratory: SANAS Accredited Facility

- Part of the Mega Lab within CSIR
- State of the art equipment
- Support to CSIR researchers **and** services to industry
- Silica (i.e. quartz) analysis using XRD and Infrared
- Only Laboratory in South Africa that can measure DPM
- Workplace and environmental air quality analysis
- Water testing, micro analysis etc.

CMI Human Factors Research Group

Measuring and controlling the mining environment for worker health and safety

Through our research we aim to :

- Eliminate silicosis
- Reduce DPM exposure
- Reduce accidents and incidents
- Monitor the physical well-being of mine workers
- Manage worker capacity

➢ **Provide relevant solutions for real problems within the mining industry**

Thank you

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