Mine Health and Safety Council
Research project SIM 140202

Project Title:	Identify opportunities to improve the safety of barring-down practices

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Category:		**Applied Research**	

Summary

Background of the Study

This study stemmed from the number of preventable rock related accidents that led to fatalities over a two and a half year period in South African Mines. Between 2009 to May 2011, 94 fatalities occurred. It was suggested that twenty four of these fatalities could have been prevented by remote barring. Mechanical barring had to be investigated as an alternative to intensive manual barring in areas where it could be practicably done. The task of barring is mostly completed manually, even in highly mechanised mining environments in South Africa. It remains an activity requiring considerable physical effort and skill and may be considered high-risk. This is verified by the number of accidents that have occurred during the act of barring.

Objectives of the Study

The objectives of this study were to report on root cause analysis of barring-down related accidents and incidents in the Platinum, Gold and Coal commodities. The analysis was categorised by ten key areas. These are Risk assessment, Skills, Training, Equipment Selection, Geotechnical Environment, Excavations less than 2m high, Excavations greater than 2m high, Leadership, Human Behaviour, and Communication. Other research outcomes included the identification of leading practices and the recommendation of feasible implementation solutions, the assessment of barring training material, and the development of innovative barring training material.

Methodology

The following activities were undertaken to collect barring relevant data for the study and complete the goals of the study:

1. Obtaining electronic data and/ or hard copies of barring related accidents from the various regional DMR offices
2. Sourcing barring incident and accident reports from the champion mines
3. Obtaining barring standards, COP's and training material from the champion mines
4. Observing and undergoing barring and strata control training, on surface, in mock-ups and underground
5. Observing barring in the underground environment in a range of mining environments
6. Interviewing mine personnel underground post barring activities to ascertain barring knowledge and competence
7. Social data collection on surface with focus group discussions and key informant interviews
8. Completing Root cause analyses
9. The assessment of barring training material, and
10. The development of an innovative barring training product in conjunction with Simulated Training Solutions (STS3D).

Results of the study

The root causes were found to be predominantly related to human behaviour factors that were similar across all commodities assessed. These factors appear to be prevalent across the South African Mining sector and not specific to any one commodity. These were inadequate leadership, inadequate training, and poor habits or personal preference.

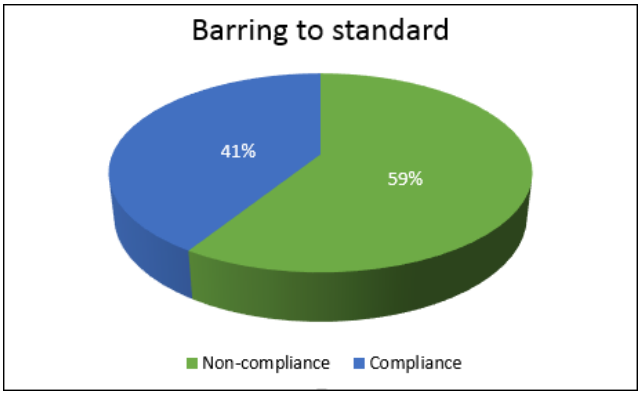

Figure 1: Percentage compliance to Barring Standards

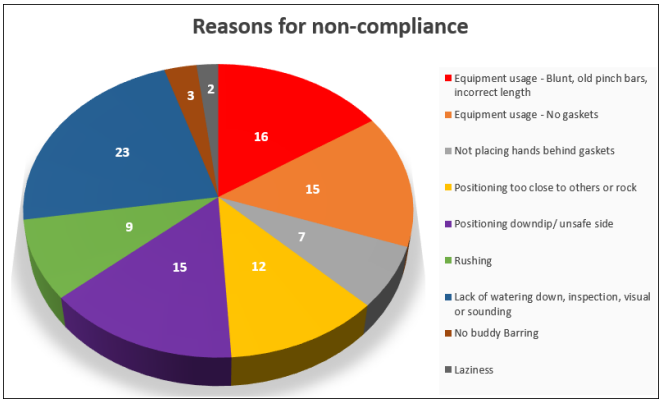

Figure 2: Reasons for non-compliance

Results from the social study across all commodities highlighted worker attitudes, incorrect barring procedures, training systems and lack of appropriate leadership as key issues which were most frequently reported. Generally, worker attitudes reflect an unmotivated, unsupervised, non-compliant and dissatisfied workforce across all

commodities. A lack of appropriate knowledge and experience when undertaking barring activities was clear. The most frequent reported worker attitude is complacency on the job where workers grow accustomed to the environment and job tasks that they are not vigilant when working in potential risk areas. Workers have expressed that they are overworked, stressed and fatigued which leads to lack of concentration and incorrect barring which increase the risk of incidents and injuries.

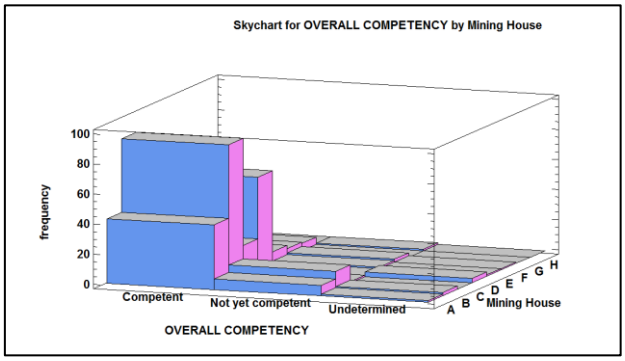

Figure 3: Frequency of Barring Competency per Mining House

The following general comments can be made in respect to barring training practices:

a) Barring is physical task and therefore requires a significant practical component. However knowing what, when, and why is key to making a workplace safe. The SAQA standard highlights the need for the person barring to be able to identify hazards and know the consequences however only a limited number of the barring training incorporated understanding of the theoretical components. The knowledge of the rules of barring without any knowledge for the reasoning behind the rules is not sufficient for being competent.
b) Barring rules should be unambiguous to prevent the misinterpretation by mine workers as this could lead to accidents.
c) More emphasis should be placed on the occupational health and safety hazards of the individual related to barring. E.g. Good posture.
d) Behaviour that is unsafe and safe should be included in the theoretical and practical components and re-iterated frequently. Essentially incorporate corrective behaviour techniques in barring training.
e) Transportation of the pinch bar and correct storage isn't always incorporated in the barring training.
f) The training methods employed do not satisfy all the critical cross field outcomes mentioned in the standard. Efforts need to be made to include them.

Leading practices for barring were identified during the underground assessment of the study. These include:

- The use of the 5P's to Safe Barring and the Barring Training Product.
- Adoption of the MOSH EE and TARP practices
- The use of Entry Examination LED lights for greater illumination in working places
- The issuing of barring licenses
- Buddy Barring
- Emphasis of the correct ergonomics
- The use of the CSIR/ UP Integrated Thermal Acoustic (ITA) device
- Soft skills training for all employees, and
- Culture change initiatives

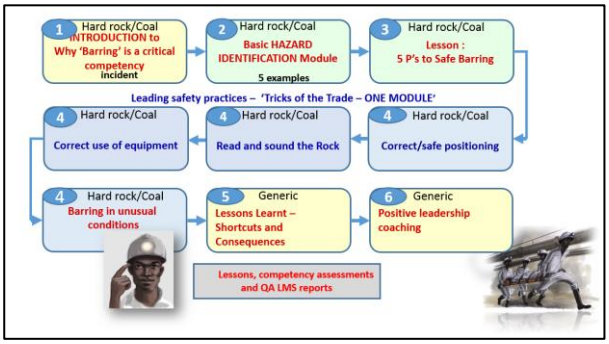

Figure 4: The complete Barring Training Product

Conclusions:

Training is an expensive undertaking and ineffective barring training practices are even more so hence the need for continual improvement of training practices. The beneficial training initiatives suggested for barring include the use of realistic mock mines on surface, "Training the Trainer" initiatives and the use of visual computer based training.

The reasons for technological advancements that assist with barring not being adopted could not be ascertained, but the practicality and cost of using some of these devices is a highly plausible reason for lack of adoption. It is clear that when additional items need to be carried, it is seen to be a hindrance to easy mobility through the underground environment. Individuals may also initially resist the usage of the new devices as it is often perceived to add to the workload for the employee.

Ultimately, the successful adoption of new technology is dependent on keen and motivated individuals who are willing to drive its usage. One has to continually implement adoption campaigns and reinforce the benefits of usage until individuals see the advantages themselves and no longer need to be driven to comply.

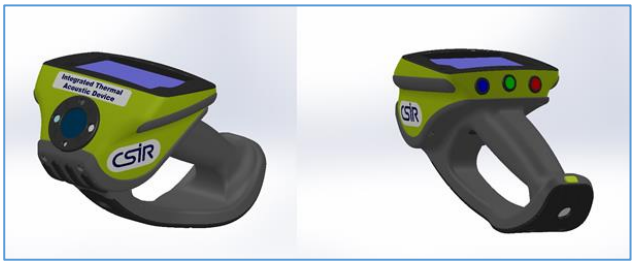

Figure 5: Preliminary design of the ITA device (Stefan Brink)

The three areas suggested for improvement from the social study are aspects of leadership, positive ways to change employee behaviour and specific recommendations for the training material to incorporate some of the recommendations derived from the study. The suggestions are to improve or change:

Leadership, by:

- Implementing situational leadership models. One example of this is by opening communication with employees by having informal one on one talks with employees in the leadership level directly below you.
- Visible felt leadership (VFL) for crews underground by increasing the presence of supervisors to the crews during a shift.
- Identifying specific areas of human behaviour that are problematic for successful barring that require change. Leaders may consider the perception findings of this

study and how they contribute to shaping the attitudes that cause negative behaviour at their own mines.

Employee Behaviour, by:

- Training leaders to provide more adequate support for workers by improving 'soft skills'.
- Understanding perception and attitudes about barring through communication and conversations there-on. Rapport with the teams and influencing positive barring behaviours may be the result of open communication.
- Creating more opportunities to influence employee behaviour through leading by example on barring, entry examination and other safety related tasks in the underground environment during early shifts.
- Addressing behavioural change through awareness workshops with crew members.
- Encouraging the use of coaches and mentors.
- Advocating employee assistance programs.
- Planning career paths with employees.
- The use of Behaviour Based Safety Training programmes where trainers look for external factors to understand and improve behaviour.
- In training, focus should be placed on positive consequences (not punishment) to motivate behaviour.
- Designing interventions that consider the feelings and attitudes of workers within the organization.
- Showing ideal barring standards in training material or in mock mine environments, as well as underground to influence the formation of positive barring behaviours.

Training Material, by:

- A storyline showing multiple occurrences of situational leadership examples showing supportive rather than directive leaders.
- Providing examples of good barring behaviours in the storyline between technical training modules.
- The positive example of a leader having a presence underground. This was explained by an older employee talking about his underground experience and capabilities.
- Showing coaching examples.
- Showing career development possibilities and growth potential for all mine employees.
- Increasing the frequency of refresher training and implementing practical training initiatives.

Recommendation:

The wide distribution and usage of the barring training product is recommended. Future project considerations that arose from this research include:

1. Further research into human behaviour studies (psychology of underground employees)
2. Further research and design of Entry examination LED lights in collaboration with manufacturers and suppliers.
3. Adoption of CSIR and/or UP Integrated Thermal Acoustic (ITA) Devices
4. Further research into non-compliance to MOSH initiatives, and the reasons why
5. Social studies per mine investigating mine specific themes
6. Ergonomics of tasks underground