Health risk assessment

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The aim of this paper is to explain the principles of the risk assessment process so that those developing their own approaches are aware of the key ingredients.
The following points are to be addressed in this presentation.

- *Background*
- *Health performance statistics*
- *Purpose of health risk assessment*
- *Risk assessment terms*
- *Introduction to risk assessment*
- *Scope of risk assessment*
- *Ten steps to effective risk assessment*
- *Reporting and recording*
- *Review*
- *Conclusion*

Background

During the 1990s, the Mining Industry Summit, was established. A strong recommendation was made to appoint a Commission of Inquiry to investigate all aspects of safety and health in the mining industry. In May 1994 the State President announced the formulation of a four man Commission of Inquiry with the Rt Hon Mr Justice RN Leon as Chairman.

One of the 4 major issues identified by the Leon Commission, which required immediate investigation was that of occupational health. This issue is now adequately covered in the MHSA for both disciplines comprising occupational health viz. occupational hygiene and occupational medicine.

The purpose of this paper is to provide advice on how suitable and sufficient assessments of risk can be carried out as required by Section 11(1) of the Mine Health and Safety Act 1996.

The way a risk assessment is carried out depends very much on its final use. In this case, the risk assessment has to be carried out with the purpose of satisfying the other requirements of Section 11 of the Act. That is, risk assessment shall be transparent and will be recorded in accordance with Section 11 (1) (c). The main purpose of the risk assessment is to enable mine managers to comply with the requirements of Section 11(2). The risk assessment must also 'loop back' to become a continuous process as required by Section 11 (4)(a).

Health performance statistics

The following tables indicate the compensation paid out by our industry

Noise Induced Hearing Loss

	No of Persons	Compensation paid
1997	6 131	R70 780 674
1998	5 395	R68 113 616
1999	6 106	R72 321 385

Actual Expenditure by one mining group for one annum

Health	Lung Disease	Treatment: R 38 million Compensation: R58 million Total : R 96 million
	Noise Induced hearing loss	R 21 million
	Total	**R 115 million**
Safety	Fatals and loss time injuries	Treatment: R 23 million Compensation: R 22 million Total : R 45 million

Mineral	Number of Mines	No of Occupationally exposed persons	No of persons Exposed to AQI>1	% Persons Exposed to AQI>1	Total Compensation Paid Jan-Sept 1998
Gold	50	25296	12450	4.92	49 118 250
Platinum	14	61625	672	1.09	757 678
Coal	59	33971	8527	25.10	1 563 620
Asbestos	4	271	0	0.00	9 915 686
Others	161	48116	2717	5.65	3 840 946
Total	288	396909	24366	6.14	65 196 180

Worker exposure as per gravimetric results and compensation paid in 1999

2. Purpose of HRA

A HRA is a systematic procedure to identify potential health hazards, evaluate the risks arising from those hazards, whilst taking into account the efficiency of existing control measures. Finally, it is also intended to prioritise potential health risks in order to facilitate the drafting of an action plan and occupational hygiene and medical surveillance monitoring programmes.

In an attempt to understand the nature of a HRA, it is important to be able to distinguish between the term "hazard" and "risk" as used in occupational health and safety

3. Health risk assessment terms

A "Hazard" is conditions, circumstances or objects with the potential to cause harm e.g. hazardous substances, noise, thermal conditions, ergonomic factors.

"Risk" is the likelihood that harm from a particular hazard will occur: i.e. "The chance of harm or loss"

The extent of risk depends on the severity of the harm, and also the number of people affected.

4. Introduction

Many people already carry out risk assessments on a day-to-day basis during the course of their work. Already they note changes in working practices, they recognise unsafe working conditions and practices as they develop and they take the necessary corrective action. The Act requires that this process should become more systematic and should be recorded so that the results and the analysis is complete. In particular, employers will have to undertake a systematic general examination of the work activities and then record the significant findings of the risk assessments conducted.

The risk assessment process at a mine should be continuous and should not be regarded as a one-off exercise. While it will be necessary to establish a baseline, the requirements of the Act will not be satisfied by the creation of a single risk assessment report, which stands for all time. Checklists will need to be developed following risk assessment exercises.

In general, a risk assessment involves identifying the hazards present in a work activity or the construction of machinery etc. This is followed by an evaluation of the extent of the risk involved taking into account those precautions already being taken. And finally developing systems to control exposures.

5. What is suitable and sufficient

Suitable and sufficient risk assessment:

a. means considering those risks which are likely to arise because of work and work activities
b. should enable development and implementation of action, where appropriate, of systems to manage the risk;
c. should be appropriate to the nature of the work so that it remains valid for a reasonable period of time.

This will enable the risk assessment process and the significant findings to be used positively, e.g., to change working procedures or to introduce medium to long-term controls.

6. Health risk assessments principles

There are no fixed rules about how the risk assessment process should take place. However, there are some general principles that should be followed to ensure that it is suitable and sufficient. The process needs to be very practical and involve management and all employees, whether or not advisors of consultants assist with the process

The following general principles should be followed when conducting a risk assessment:

1. All relevant risks and/or hazards should be systematically addressed;

- Be methodical and thorough; remember that risk assessment is a process.
- The aim is to identify the significant risks in the workplace and not obscure those risks with excess of information or by concentrating on minor risks.
- Consider aspects of the work such as the substances or equipment used, and the work process or organisation which have the potential to cause harm.
- Take into account, what controls and other measures already exist. The effectiveness of these controls needs to be carefully reviewed.
- Make sure all processes are in operation

There are three essential forms of risk assessment. All are one part of a management system and need to be carried out in mines under the new legislation. These are (not in order of priority):

- *Baseline Risk Assessments*
- *Issue Based Risk Assessments*
- *Continuous Risk Assessments*

1.Baseline Risk Assessments

In compliance with the Act, mines will have to assess where they are in terms of risk, identifying the major risks and thereby establishing their priorities and a programme for future risk control. This baseline risk assessment will need to be **comprehensive** and may well lead to further, separate more in depth risk assessment studies.

The methodology to be used to determine how many samples need to be taken must be based on internationally acceptable strategies such as NIOSH – OSSEM that have tables reflecting how many samples need to be taken to have 90 or 95 % confidence level.

The baseline risk assessment should be periodically reviewed, say every one to two years, to ensure that it is still relevant and accurate. Any other studies will need to be incorporated to achieve the 'complete picture'.

2. Issue based risk assessments

As circumstances and needs arise, separate risk assessment studies will need to be conducted. These will normally be associated with a **system for the management of change**. An additional risk assessment will need to be carried out when, for example:

- a new machine is introduced into a mine;
- a system of work is changed or operations are altered;
- after an accident or a 'near-miss' has occurred;
- new knowledge comes to light and information is received which may influence the level of risk to employees at the mine. An example of this is when the scientific knowledge about the toxicity of a substance changes, making previous risk assessment with regard to that substance, invalid.

3. Continuous risk assessments

This is the most important form of risk assessment which should take place continually, as an integral part of day-to-day management. It may not use the more sophisticated hazard identification and risk assessment tools which are set out in baseline and issue based risk assessments, but in terms of ensuring safety and eliminating health risks in the workplace, this form of risk assessment is most powerful and important, It will mainly be conducted by frontline supervisors and it is essential that formal training be provided to enable this process to be efficient.

Examples of continuous risk assessment include:

- audits;
- general hazard awareness linked to a suggestion scheme; and
- prework assessments using checklists.

The emphasis is on "hazard awareness through hazard identification".

7. Scope of risk assessment

The first task when establishing a risk assessment process will be to define the scope of the separate risk assessment exercises. The intention should be that, through the risk assessment process, all of the mine and its activities are comprehensively reviewed and assessed. Some care is therefore needed in laying down the scope of the separate risk assessment exercises to ensure that no areas or activities are missed. In general, risk assessments are scoped in different ways:

1. Geographically based, such as looking at shafts, haulage's, workshops, etc.;
2. Functionally based, such as drilling, blasting, milling, etc.;
3. Hazard or issue based, such as the hazardous substances, noise etc,;

It is normally found that the first two of the above-mentioned scopes are most effective in ensuring a comprehensive and complete risk assessment. of an operation or activity

8. Team selection

Before any risk assessment can proceed, a team has to be selected, background information has to be gathered and processed and the team has to be prepared for the task ahead. It is vitally important that all these, and the subsequent hazard identification and risk assessments are carried out within a participative framework by involving all stakeholders and their representatives.

It is normal to select a team from the workplace being reviewed by taking a vertical slice through the management structure to the lowest levels in the organisation. Practically, this will mean the front line supervisor and the team from the workplace being assessed.

Specialist expertise should also be brought in example, with regard to psycological factors or ergonomics.

The creation of a team for risk assessment is essential to ensure their "ownership" of the work and to help bring about a culture change.

9. Ten steps to effective health risk assessment

Risk assessment process

The following ten steps provide a systematic procedure to identify, evaluate and analyse potential health risks in the workplace.

Step 1

Subdivide the mine into sampling areas.

Example

- Surface
- Underground Section 1
- Underground Section 2
- Underground Section 3 and 4

Subdivide the sampling areas into activities

Example

- Shafts
- Workshops
- Stoping
- Development
- Raise boring
- Roving

Step 2

The gathering and analysis of information from on-mine sources and from external sources about the activities and workplace is an essential task before the risk assessment can start.

- Plans of workplace, process-flow diagrams

- Inventory of job categories, shifts, tasks
- Material data sheets
- Hygiene environmental reports
- Relevant legislation and standards etc

Step 3

This is the most important stage in the risk assessment process, the identification of hazards, in other words, the adoption of some systematic way of allowing us to 'see' the hazards present in the workplace. If the hazard identification is not carried out carefully, the subsequent analysis of risk and the development of risk control measures become pointless. The identification of hazards is not only an essential part of the risk assessment process, but also acts very effectively to change the way people think, causing them to act more safely and to become more proactive in hazard awareness.

Firstly Identify hazards that may pose a potential health risk to the worker during each task. Simultaneously, also assess any other workplace hazards that may be relevant.

To facilitate this step, an inventory/checklist of each hazard type can be used as a means to be thorough. An example of hazard inventories is reflected in the following table.

NOTE: Remember that this step already makes a distinction between hazard and risk- therefore discard trivial hazards by answering the first question in the inventory. If in doubt, a measurement or sample may be taken as confirmation. Also, make use of findings in previous monitoring reports.

Example:

- Drill Operator

Potential risks identified

Hazardous Substances /airborne pollutants	Noise	Thermal conditions /Radiation	Ergonomic Factors
Silica dust	Continuous noise	Heat stress	•Vibration from drilling •Poor illumination, glare

Step 4

Note the frequency of exposure

Example:

- Drill Operator

Frequency of exposure

Health Hazard	Frequency of exposure
Silica dust	Full shift exposure
Continuos noise	Full shift exposure
Heat stress	Full shift exposure
Vibration	Spend 3 hours per shift
Poor illumination	Entire shift

NOTE: The frequency of exposure obtained during the assessment is important

And will be applied in the risk score calculation (step 8)

Step 5

Establish the health effect and route of entry associated with potential exposure.

Inventory of hazard types

Hazardous substances/ airborne pollutants	Noise	Thermal conditions/ Radiation	Ergonomic Factors
Exposure Levels Is potential Exposure possible?	Noise Exposure Levels May excessive noise levels be present	Temperature/ Radiation Extremes Are excessive exposures likely?	Ergonomic Deficiencies Are deficiencies present?

What Substance
Product produced
Raw materials used
Materials added
By-products liberated
Cleaning materials
Biological contaminants
 	
What Form
Dust or fume
Mist
Gases
Vapours
	Type of Noise
	Constant
	Continuous
	Internittent
	Fluctuating
	Periodic
	Non-periodic
	Impulse
	Repeated
	Single
	
	Sources and cycles
	• Noise sources
	• Cycles per shift
		Type of condition
		• Health/Cold stress
		  • Temperatures
		  • Radiant heat
		  • Humidity
		  • Wind speed
		• Radiation
		  • Ionising
		  • Non-ionising
		
		Sources and cycles
		• Sources in each instance
		• Continuous or periodic cycle
			Type of condition
			• Ergonomics
			  • Seating
			  • Accessibility
			  • Material/handling
			  • Displays
			• Illumination
			  • Levels sufficient
			  • Glare
			  • Stroboscopic effect
			  • Contrast
			
			• Ambient conditions
			  • Thermal comfort
			  • Noise and annoyance masking effect

NOTE: Information obtained during this step will be applied in the Risk score calculation, i.e. consequence index (step 8)

Example
• Drill Operator
Associated health effects/route of entry

Health Hazard	Health Effects	Route of Entry
Silica dust	Silicosis of the lung (chronic effects)	inhalation
Noise	Noise induced hearing loss	N/A
Heat Stress	Heat disorders	N/A
Vibration	White finger	N/A
Poor Illumination	Reduced visual acuity, eye strain & fatigue, accident risk	N/A

Step 6

Evaluate the workplace and work practices for any conditions that may have an impact on the extent of exposure, taking into account existing control measures, their efficiency safe work procedures, housekeeping, etc. With this information the assessor must be able to predict the probability that exposure will result in a health effect, or incident will follow through to completion.

NOTE: Information obtained during this step is essential to allocate an appropriate "probability index" in step 8

Example
• Drill Operator
Workplace and work practices

Health Hazard	Existing and /or lack of control measures and general comments
Silica dust	• Ventilation systems insufficient to remove dust liberated (vent column leaking)
Noise	• Operator wearing hearing protectors with sufficient attenuation factor • No silencers on fan
Heat Stress	• Engineering controls insufficient e.g. cooling • Drinking water not available in vicinity • Work load high
Poor illumination	• Illumination not uniform – dark areas • Lamp reflectors dirty

Step 7

The OHSC has identified when occupational hygiene measurement systems need to be established. The regulation is as follows:

System of occupational hygiene measurements

The employer must establish and maintain a system of occupational hygiene measurements, as contemplated in section 12, of all working places where the following hazard limits prevail:

airborne pollutants:
- particulates ≥ $^1/_{10}$ of the occupational exposure limit;
- gases and vapours ≥ ½ of the occupational exposure limit;

thermal stress:
- heat >25,0°C wet bulb and/or >32,0°C dry bulb and/or >32,0°C radiant heat;
- cold <10°C equivalent chill temperature; and

noise:
- ≥ 82dBL$_{Aeq,8h}$.

The tables below indicate the classification bands and the frequency of monitoring to be used when a system of occupational hygiene measurements is to be implemented.

Classification Band Table

Pollutants (Excluding Toxic Gases &Vapours)

	CLASSIFICATION BANDS
CATEGORY	**PERSONAL EXPOSURE LEVEL**
A	Exposures≥ the OEL or mixtures of exposures ≥1
B	Exposures ≥ 50% of the OEL and < OEL or mixtures of exposures [3] 0,5 and <1
C	Exposures ≥ 10% of the OEL and < 50% of the OEL or mixtures of exposures ≥ 0,1 and < 0,5

Toxic Gases & Vapours

	CLASSIFICATION BANDS
CATEGORY	**PERSONAL EXPOSURE LEVEL**
A	Exposures ≥ the OEL or mixtures of exposures ≥1
B	Exposures ≥ 50% of the OEL and the OEL or mixtures of exposures ≥ 0,5

Step 8

Where there is no stipulated hazard levels set out for certain health hazards then the risk index as is depicted below must be used.

• Determine the extent of exposure.
• Calculate the risk score

For this purpose, standard indices for each factor may be used as reflected in the tables below. The following equation can be used:

Risk = Consequence (C) x Frequency (F)

Frequency (F) = Exposure (E) x Probability (P)

Consequence = "the degree of harm" The potential severity of the injuries or ill health and/or the number of people affected

Frequency = frequency of occurrence

Exposure = How often and for how long the workers are exposed to the hazard

Probability = The chance that a person, or persons, will be harmed during the exposure period

Frequency Scale

Frequency index	Description
5	Hazard permanently present
4	Hazard present once or periodically per shift, less than 6 hours
3	Hazard present once or periodically per shift, less than 4 hours
2	Hazard arises once a week
1	Hazard arises once a year or very rarely

Consequence Scale

Consequence index	Description
5	Death
4	Permanent incapacity
3	Considerable discomfort with subsequent recurring incapacity
2	Reversible health conditions with short term health effects
1	No human injury expected during normal exposure

Probability Scale

Probability index	Description
5	Inevitable (100% chance)
4	Very likely (80 % chance)
3	More than even chance (60%chance)
2	Less than even chance (1-50%chance)
1	Practically impossible(<1%chance)

Example:

• Drill Operator

Calculate risk rating

Health Hazard	Frequency	Consequence	Probability	Risk score
• Vibration	5	4	2	40 (medium)
• Illumination	5	2	2	20 (low)

Remember:

This step requires a decision process of a subjective nature – especially the probability index. Try to think objectively and judge the scenario holistically. Remember – the probability index will be higher with a risk where PPE is used compared to a risk controlled by sufficient engineering control measures.

Step 9

Quantify and list the priority of action. All the significant risks in the table shown in Step 8 can be prioritised according to risk scores calculated.

The urgency or priority of action required in respect of a particular risk can be quantified as shown in the table below.

Risk score	Actions
60 - 125 (High)	Immediate action required. Monitoring should be conducted immediately to introduce interim control measures
30 - 59 (medium)	Risk requires urgent attention as soon as possible Monitoring of risks required.
< 30 (low)	No immediate action necessary. Risk currently under control, but requires regular revision. Monitoring not a requirement

Compile a prioritised list of risks by using the above table, which will show the highest numbers and most important priorities to be considered first.

Example:

• Prioritise risks

Drill Operator

Prioritise Risks

Health Hazard	Risk Rating
Vibration	Medium
Illumination	Low

One can also calculate a composite score for each work area and department to establish which departments have the highest significant heath risk.

NOTE: Remember that this method is only a key to facilitate the process and to allocate an appropriate risk rating. For example, the decision making process of the assessment team still depends on their discretion, and risks with borderline cases (e.g. low to medium) may be changed in order to be included in the monitoring programme.

Step 10

Compile occupational hygiene monitoring and medical surveillance programmes based on steps 7, 8 and 9, as well as an overall action plan that incorporates all actions to be taken.

Proposed monitoring programmes and action plans will be determined by findings obtained during the assessment and by relevant legislation and standards applicable for each significant health risk.

Example 1

• Drill Operator

• Proposed occupational hygiene monitoring programme.

Activity Area	Occupational Category	Proposed Monitoring
Stoping	Driller	• Gravimetric sampling (∝- quartz) • Noise Survey for hearing conservation • Vibration Survey • Illumination Survey

Example 2

• Dill Operator

• Proposed medical surveillance programme

Activity Area	Occupational Category	Proposed Surveillance
Stoping	Driller	1. Baseline Medical surveillance to include • Medical and occupational history • Physical examination • Lung function test • Audiometric examination • Vision test • Urinalysis 2. Continuing medical surveillance, e.g. • Annual audiomerty • Chest X-rays 2 yearly • 2 yearly lung function test • Physical examination with emphasis on muscle-skeleton system, spine and back

10. Reporting and recording

It is vitally important that the risk assessment is recorded so that there is a reliable statement and evidence of what appropriate actions management is taking to protect health and safety. The risk assessment need to be an integral part of an employer's overall approach to health and safety, and its results need to be linked to other health and safety records and documents, such as the statement of health and safety policy. Ultimately, it should become an integral part of a company's overall management system.

Whatever the format of the risk assessment report, it should be easily accessible to employees, their representatives and inspectors. The record of the risk assessment may consist of several documents, which describe procedures and safeguards, the approach used and the results of the exercise. Although recording of the risk assessment process is important, the generation of a system on paper alone is not sufficient to ensure compliance with section 11 of the mine health and safety act. Producing documentation should not detract from the major purpose of risk assessment; that is, to improve the management of risks and thereby to ensure the health and safety of employees.

It is vitally important that the recorder of the risk assessment reports those findings, which are judged to be significant. These include:

1. The major hazards identified in the assessment. That is, those hazards which, if the are not properly controlled pose serious risks to employees or others who may be affected.
2. A review of the existing safety measures and the extent to which they are effective in controlling the risks.
3. Those who may be affected by the significant risks or major hazards including those groups and employees who are especially at risk

11. Review

Section 11(3) (a) of the Act requires managers to review and, if necessary, modify their risk assessments since they should not be a one-off activity. Risk assessment is a continuous process and as work changes, the hazards and risks may change and therefore the risk assessment process must also change.

- If changes occur the risk may change.
- Need to use risk assessment; to manage change.
- Part of good management/business practise
- If knowledge changes, the risk may change.
- Particularly after an accident, ill health accident need to revisit risk assessment.

12.Conclusion

The first and foremost purpose of a HRA is to identify potential health hazards and protect the health of all employees in every work area. Unfortunately, the person responsible for HRAs is mostly guided by only vague requirements set out in the legislation and regulations. If the guidelines in this presentation are followed and the assessment procedure is conducted thoroughly and methodically, most obstacles associated with the risk assessment process will be overcome and all significant risk will be targeted from the start.