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STUDENT STUDY GUIDE

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Table of Contents

This Study Guide provides learners with content information, references to readings, questions, and exercises.

These are designed to provide the learner with the knowledge to understand the subject matter of this unit.

After successfully completing the Study Guide, the learner should be able to demonstrate competency in the
performance criteria, as determined in the competency standard.

Highly Recommended Texts

- Queensland Government, 1999, Coal Mining Safety and Health Act, 1999
- Queensland Government, 2001, Coal Mining Safety and Health Regulation, 2017
- Queensland Government, 1999, Mining and Quarrying Safety and Health Act, 1999
- Queensland Government, 2001, Mining and Quarrying Safety and Health Regulation, 2017
- Queensland Government, 2011 Workplace Health & Safety Act, 2011
- Queensland Government, 2011 Workplace Health & Safety Regulation, 2011
- Standards Australia, 1999, AS 4360 / ISO31000 – Risk Management, Standards Australia.

Suggested Texts

- CCH Australia Ltd, 1991, Planning Occupational Health and Safety, CCH Australia Ltd, Sydney.
- CCH Australia Ltd, 1996, Safe Mining: Practical Guidelines for Managing Safety and Health in the Mining and Extractive Industries, CCH Australia Ltd, Sydney.
- Department of Mineral Resources (NSW), 1996, Guidelines for Safe Mining, Government Printer, Sydney.
- Department of Mineral Resources (NSW), 2011, Risk Management Handbook for the Mining Industry MDG1010, Government Printer, Sydney.
- Department of Minerals and Energy, 1999, Safeguard, Brisbane.
- Mathews, J., 1993, Health and Safety at Work, Pluto Press, Sydney.
- Queensland Government, 1998, Risk Management Workbook, Department of Employment, Training and Industrial Relations, Brisbane.
- Standards Australia, AS/NZS 4804 /31000 – Occupational Health and Safety Management Systems, Standards Australia
- Taylor, G., Easter, K., Hegney, R., 1996. Enhancing Safety – An Australian Workplace Primer., Technical Publications, Perth

1.0 Introduction

In Australia, many laws control how we (as individuals, groups, or organisations) act during our daily lives, whether at home, at work, on the road or at play. We are expected to abide by these laws; if we do not, we may be penalised. In a court of law, ignorance of those laws is not accepted as an excuse.

This applies to how persons or organisations conduct themselves in the workplace. To this end, Governments have enacted or supported laws intended to prevent injury or illness at the workplace and compensate those who have suffered such injuries or illnesses. The following table provides examples of those laws which affect health and safety.

PREVENTION:

- Coal Mining Safety & Health Act 1999
- Coal Mining Safety & Health Regulation 2017
- Mining and Quarrying Safety and Health Act 1999
- Mining and Quarrying Safety and Health Regulation 2017
- Petroleum and Gas (Production and Safety) Act 2004
- Petroleum and Gas (Production and Safety) Regulation 2004
- Work Health and Safety Act 2011
- Work Health and Safety Regulation 2011
- Electrical Safety Act 2002
- Electrical Safety Regulation 2013
- Radiation Safety Act 1999
- Radiation Safety Regulation 2021

COMPENSATION:

- Common Law Judgements
- Worker's Compensation Payments

The above laws can be divided into two broad classifications: "common law" and "statute law". The term "common law" refers to the body of legal principles that evolve through the interpretation of the law by judges, as distinct from the body of law created through legislation, which is referred to as "statute law".

These two classifications are discussed in greater detail in the following sections of these notes.

2.0 Common Law

Common law consists of a body of traditional legal principles that have evolved by judges' decisions in Courts of Law. These judge-made laws are decided based on the particular set of facts presented to the court. Such decisions then become the precedent or general rule that is applied to cases with a similar set of facts or circumstances.

Whilst breaches of statutory law can result in the offences being dealt with in an industrial magistrate's court, common law cases are dealt with in civil courts. The most frequent cases of common law action are those for damages and compensation following a workplace injury.

Generally, common law action is taken when a person believes that another party has wronged him or her and seeks compensation for the damages and/or losses resulting from that wrongdoing.

Based on these precedents, there are three elements that need to be established for such a common law action to be successful being:

a) That one party owes a duty of care to the other, and
b) That the duty of care has been breached, and
c) That the breach of duty has resulted in damage.

2.1. Duty of Care

When does one party owe a duty of care to another party? Lord Aitken, in his judgement of *Donoghue v Stevenson* (AC 562 [1932]), said:

"The answer seems to be - persons who are so closely and directly affected by my acts that I ought reasonably to have had them in contemplation as being so affected when I am directing my mind to the acts or omissions which are in question."

A person has a duty to care for others in how they conduct themselves. This case is currently accepted as the basis of the modern law of negligence, including the concept of Duty of Care.

In relation to the duty of care owed by an employer to his employees, this issue was settled in the matter of *Wilsons & Clyde Coal Co v English* (AC 57 [1938]), which established that employers undoubtedly owed a duty of care to their employees (Brooks 1993). Since this case, there have been numerous similar cases that support these findings.

The courts have determined the common law duty of care to mean that all employers must take reasonable care for the safety of their employees and others who may be affected by the employer's business or work activities. Sometimes, this common law duty of care is described in terms of providing.

- Safe systems of work
- A safe place of work
- Safe plant and equipment
- Competent staff

Safe Systems of Work

Employers must ensure the coordination and conduct of work activities so that the activity does not endanger the health and safety of the person carrying out the activity or others working in, on or around the activity.

Examples of safe systems of work are:

- Standard work practices include instruction on how work should be performed to eliminate or minimise the risk of injury or illness.
- Instruction of workers in standard work procedures
- Instruction and assessment of competency in the use of plant and equipment.
- Coordination of different work groups and activities.
- Emergency and first aid procedures.
- Health and safety-specific work practices, including isolation and confined space entry and hazard reporting procedures.
- Manual handling procedures.

Safe Place of Work

It is incumbent upon every employer to ensure that reasonable care has been taken to provide a safe place of work for all their employees. A safe workplace includes the premises, plant and equipment used at the workplace, and substances used or stored at the premises.

Examples of those things included in a safe workplace are:

- Access areas, stairways, and work areas are constructed properly and do not present a hazard.
- The work environment includes noise, lighting, air quality and temperature.
- Location of plant and equipment.
- Suitable and adequate amenities are provided.
- Hidden hazards such as electrical wiring and storage or use of substances do not present a hazard.

Safe Plant and Equipment

It is also incumbent upon every employer to ensure that reasonable care has been taken to provide proper, safe plant and equipment. Further, the employer must ensure that the plant is maintained in a condition that will not endanger a person when used correctly.

Examples of those things that must be considered to ensure the provision and maintenance of safe plant and equipment include:

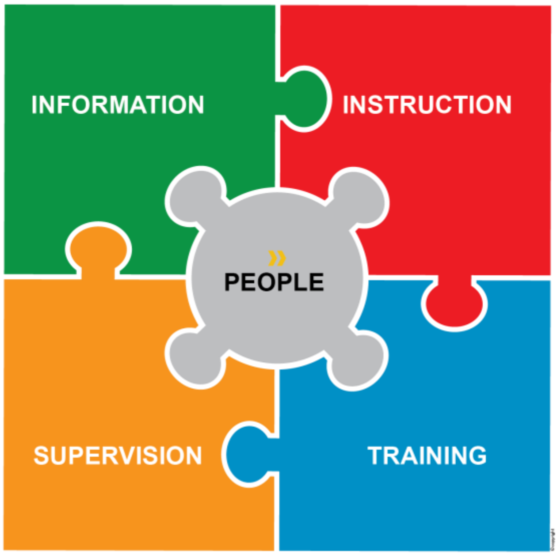
- The plant is suitable for the purpose for which it is being used.
- Where possible plant meets appropriate standards for design, manufacture and use.
- Employees are instructed in its correct use.
- Plant and equipment are maintained. Where manufacturers' instructions exist, maintenance must follow those instructions.

Competent Staff

The discussion on competent staff leads us to the doctrine of *vicarious liability,* which arises when a person is held responsible for the negligent acts or omissions of another. This is particularly applicable in the employer/employee relationship, where the employer is held responsible for the acts or omissions committed by an employee in the course of his or her employment. In other words, the employer has a duty of care to others for the acts and omissions of his or her employees.

Therefore, an employer must provide competent staff to maintain the employer's duty of care. The provision of competent staff is closely allied to the above as without competent staff, an employer would have difficulty maintaining safe systems of work, a safe place, and safe plant & equipment.

The National Occupational Health and Safety Commission (2003) likens the duties of care to a jigsaw puzzle. If the jigsaw is complete and one or more of the pieces are missing, then it is likely that the workplace is safe, and an employer still needs to meet their duty of care. Consider the following.



Source: National Occupational Health and Safety Commission

2.2. Breach of Duty of Care

The standard of care owed by one person to another is based on the question of what a "reasonable man" would have done in the same situation. This is supported by the findings of Anderson in *Blyth v Birmingham Waterworks Co* (11 Exch781 at 784[1856]), which states:

> *"Negligence is the omission to do something which a reasonable man, guided by those considerations, which normally regulate the conduct of human affairs, would do or something a prudent and reasonable man would not do."*

In establishing a breach of the duty of care, Brooks (1993) suggests an approach by Glass, McHugh and Douglas in their book *The Liability of Employers*. Brooks (1993) states:

> *"First, it must be established with the requisite degree of certainty what caused the accident or illness. Second, it must be determined whether the risk of such an accident was foreseeable. Third, it must be decided whether it could have been prevented by practical precautions. Finally, one must decide whether, given the likelihood and the seriousness of the risk, a reasonable and prudent employer would have taken those precautions."*

Causation

What caused the accident? In this area of law, it is legitimate to approach the cause of the accident or illness as simply a question of fact (Brooks 1993, p40). That is, the facts of how an accident occurred must be established, including where the person was working, what the worker was doing at the time and what happened to cause the injury or loss to the worker.

Foreseeability

Is the accident foreseeable? The question of whether the risk of the accident that happened was foreseeable is largely a matter of evidence. (Brooks 1993, p 51). Evidence is needed to show that such an accident was foreseeable. Evidence would include showing that the type of accident has been caused by similar events before (either internally or externally) through industry practice and technical references as an example.

Preventability

Was the accident preventable? The determination of whether there are available precautions is not a matter of legal principle but, in large measure, a pure question of fact. More precisely, it is a question of evidence (Brooks 1993). Establishing that the accident was preventable is not adequate; it must also be established that the preventative action is also reasonable and practicable.

Reasonableness

Would the reasonable person have taken the precautions given the likelihood and seriousness of the risk? Again, evidence from previous cases and industry practice would be brought to show that a reasonable person would or would not have taken those precautions.

Therefore, when establishing a breach of duty of care, the courts apply the concepts of causation, foreseeability, preventability and reasonableness to the case in question.

2.3. Damages at Common Law

Finally, as a common law action is generally for compensation, it must be established that the breach of duty resulted in the injury, loss, or damage. In establishing damages, some of the areas that may be considered in the calculation include loss of income (both past and into the future), medical and hospital expenses and general damages (e.g., pain and suffering, disfigurement).

2.4. Defences at Common Law

Where an employer is sued by an injured worker, the employer has certain defences available to them where they may defend such an action.

Firstly, the employer can illustrate that they have, in fact, met their duty of care by establishing that they have provided a safe place of work, safe plant and equipment, safe systems of work and competent staff. In addition to this general defence, an employer has specific defences available, the most important being the following.

a) *Novus Actus Interviens*

Issues of causation can become complicated in circumstances where an intervening event occurs between the employer's conduct and the sustaining of the injury or loss. That is when the chain of an accident is broken by a new and independent cause. Where this can be proven, and it could not have been reasonably foreseeable, the employer may endeavour to escape liability.

b) *Volenti non fit injuria*

The philosophy behind this doctrine is that no person should recover damages where he or she has consented to the risk. For example, a boxer cannot claim damages from the boxing promoter for injuries inflicted by their opponent.

c) *Contributory Negligence*

Contributory negligence involves the person’s failure to take precautions, thereby contributing to the injury or loss.

Many Australian states have enacted legislation that allows negligence to be apportioned between the defendant and the plaintiff.

d) *Act of God*

A defendant may endeavour to escape liability by claiming that the event and subsequent damage or loss was caused by an “Act of God”. That is, it resulted from some violent natural occurrence (e.g., earthquake or lightning strike).

3.0 WH&S / Mining Statute Legislation

3.1. WH&S Legislation and Information

It is essential that an organisation keep up to date on legislation and other health and safety information, and there are a number of ways this can be achieved, including the following.

Internet - Regularly visit the **Workplace Health and Safety Queensland** web site at https://www.worksafe.qld.gov.au/ and check for changes and other guidance notes and general information.

Queensland Legislation Website - A good site for obtaining up-to-date legislation for all areas of Queensland law, including those affecting workplace health and safety, is the Queensland Government legislation website at www.legislation.qld.gov.au/OQPChome.htm.

The **Minerals Industry Safety & Health Centre**, supported by ACARP and industry funding, has developed a range of information resources designed to assist the management of safety & health risks. The 'GATES' listed below provide free access to comprehensive health and safety information about key issues that concern the minerals industry, including a Compliance Gateway which lists the key Mining Laws, Acts, Regulations, and standards for each jurisdiction and can be located at http://www.mirmgate.com.au/index.php?gate=compliancegate

The **Department of Natural Resources and Mines QLD** has the key mining legislation also listed on its site at https://www.business.qld.gov.au/industries/mining-energy-water/resources/safety-health/mining/legislation- standards

The **Australasian Legal Information Institute** (AustLII) provides free internet access to Australasian legal materials. AustLII's broad public policy agenda is to **improve access to justice** through better access to information. AustLII publishes **public legal information** -- that is, primary legal materials (legislation, treaties and decisions of courts and tribunals); and secondary legal materials created by public bodies for purposes of public access (law reform and royal commission report for example) and a substantial collection of law journals. AustLII is Australia's most popular online free-access resource for Australian legal information. AustLII is a joint facility of the UTS and UNSW Faculties of Law and can be accessed at http://www.austlii.edu.au/

External Consultants – Where appropriate assistance can be sought from external consultants.

Other sources – Other workplace health and safety information can be obtained from other state and national health and safety authorities, unions, libraries and employee or employer organisations

WH&S Legislation in Queensland

The workplace health and legislation in Queensland are as follows:

- *Coal Mining & Safety Act 1999 & Regulation 2017 Qld*
- *Mining & Quarrying Safety Health Act 1999 & Regulation 2017 Qld*
- Petroleum and Gas (Production and Safety) Act 2004 & Regulation 2004 Qld
- *Work Health and Safety Act 2011 & Regulation 2011 Qld*

Other legislation an organisation should be aware of includes:

- *Electrical Safety Act 2002*
- *Radiation Safety Act 1999*

3.2. Coal Mining Safety & Health Act 1999 (Qld)

Structure

Coal Mining Safety & Health Act 1999 (Qld) (Qld)

The Coal Mining Safety & Health Act 1999 (Qld has logical chapters, which are referred to as ***Parts***. Each of these parts may then be further subdivided into **Divisions** and **Subdivisions**.

The fundamental component of the Act is the Section, which also can be divided into subsections. The Act outlines these Parts, Divisions, Subdivisions and sections in the Table of Provisions.

Application of the Act

Coal Mining Safety & Health Act 1999 Sections 3 – 5

The Act applies to all persons at coal mines or coal mining operations.

3 Act binds all persons.

(1) This Act binds all persons, including the State and, so far as the legislative power of the Parliament permits, the Commonwealth and all the other States.
(2) Nothing in this Act makes the State liable to be prosecuted for an offence.

4 What does this Act apply to

This Act applies to coal mines and coal mining operations.

5 Who does this Act apply to

This Act applies to—
(a) everyone who may affect the safety or health of persons while the persons are at a coal mine; and
(b) everyone who may affect the safety or health of persons as a result of coal mining operations; and
(c) a person whose safety or health may be affected while at a coal mine or as a result of coal mining operations.

The objective of the Act

Coal Mining Safety & Health Act 1999 Section 6&7

The objective of the Act is to:

6 Objects of Act

The objects of this Act are—

(a) to protect the safety and health of persons at coal mines and persons who may be affected by coal mining operations; and

(b) to require that the risk of injury or illness to any person resulting from coal mining operations be at an acceptable level.

7 How objects are to be achieved

The objectives of this Act are to be achieved by:

(a) imposing safety and health obligations on persons who operate coal mines or who may affect the safety or health of others at coal mines; and

(b) providing for safety and health management systems at coal mines to manage risk effectively; and

(c) making regulations and recognised standards for the coal mining industry to require and promote risk management and control; and

(d) establishing a safety and health advisory council to allow the coal mining industry to participate in developing strategies for improving safety and health; and

(e) providing for safety and health representatives to represent the safety and health interests of coal mine workers; and

(f) providing for inspectors and other officers to monitor the effectiveness of risk management and control at coal mines and to take appropriate action to ensure adequate risk management; and

(g) providing a way for the competencies of persons at coal mines to be assessed and recognised; and

(h) requiring management structures so that persons may competently supervise the safe operation of coal mines; and

(i) providing for an appropriate coal mines rescue capability; and

(j) providing for a satisfactory level of preparedness for emergencies at coal mines; and

(k) providing for the health assessment of coal mine workers.

Interpretation of Works and Terms Used

Coal Mining Safety & Health Act 1999
Sections 8 - 28
Schedule 3 Dictionary

Some of the expressions, terms and words used in the Act can be complex and an understanding of these is fundamental to an understanding of the Act.

The Act provides a dictionary that contains definitions relevant to the whole Act. For the more complex expressions, the dictionary may refer you back to the appropriate section for a detailed explanation.

The following are some of the terms defined in Schedule 3 Dictionary.

- 9 Meaning of *coal mine*
- 10 Meaning of *on-site activities*
- 11 Meaning of *safety and health*
- 12 Meaning of *competence*
- 13 Meaning of *consultation*
- 14 Meaning of *standard operating procedure*
- 15 Meaning of *accident*
- 16 Meaning of *serious accident*
- 17 Meaning of *high potential incident*
- 18 Meaning of *risk*
- 19 Meaning of *hazard*
- 20 Meaning of *principal hazard*
- 21 Meaning of *coal mine operator*
- 22 Meaning of *geographically separated*
- 23 Meaning of *physical overlapping of coal mining operations*
- 24 When is a coal mine operator not in control
- 25 Meaning of *site senior executive*
- 26 Meaning of *supervisor*
- 27 Meaning of *industry safety and health representative*
- 28 Meaning of *site safety and health representative*

Control & Management of Risk

What are the requirements for managing risk?

Coal Mining Safety & Health Act 1999
Sections 29-32

The Act imposes obligations that risk must be controlled to an acceptable level through management systems.

Part 2 The Control and Management of Risk and Other Basic Concepts Division 1 Control and Management of Risk

29 What is an acceptable level of risk?

(1) For a risk to a person from coal mining operations to be at an ***acceptable level***, the operations must be carried out so that the level of risk from the operations is—
(a) within acceptable limits; and
(b) as low as reasonably achievable.
(2) To decide whether risk is within acceptable limits and as low as reasonably achievable regard must be had to—
(a) the likelihood of injury or illness to a person arising out of the risk; and
(b) the severity of the injury or illness.

30 How is an acceptable level of risk achieved?

(1) To achieve an acceptable level of risk, this Act requires that management and operating systems must be put in place for each coal mine.
(2) This Act provides that the systems must incorporate risk management elements and practices appropriate for each coal mine to—
(a) identify, analyse, and assess risk; and
(b) avoid or remove unacceptable risk; and
(c) monitor levels of risk and the adverse consequences of retained residual risk; and
(d) investigate and analyse the causes of serious accidents and high potential incidents with a view to preventing their recurrence; and
(e) review the effectiveness of risk control measures, and take appropriate corrective and preventive action; and
(f) mitigate the potential adverse effects arising from residual risk.
(3) Also, the way an acceptable level of risk of injury or illness may be achieved may be prescribed under a regulation.

31 What happens if the level of risk is unacceptable?

(1) If there is an unacceptable level of risk to persons at a coal mine, this Act requires that—
(a) persons be evacuated to a safe location, and
(b) action be taken to reduce the risk to an acceptable level.
(2) Action to reduce the risk to an acceptable level may include stopping the use of specified plant or substances.
(3) The action may be taken by the coal mine operator for the mine, the site senior executive for the mine, industry safety and health representatives, site safety and health representatives, coal mine workers, inspectors or inspection officers.

Workplace Health and Safety Obligations

What is the person's or organisation's obligations?

Coal Mining Safety & Health Act 1999
Sections 33-48

The Act imposes obligations on all persons who may affect the workplace health and safety of others by their actions or lack of action. An obligation can be defined as "a binding requirement as to action or duty". A person can have more than one set of obligations. For example, a person may be a coal mine operator, contractor and supplier of plant at the same time for a single coal mine and be subject to obligations in each of the capacities.

s33 Obligations for safety and health

Coal mine workers or other persons at coal mines or persons who may affect safety and health at coal mines or as a result of coal mining operations have obligations under division 2 (safety and health obligations).

The following are listed as holding specific obligations under the Act.

40 Obligations of holders
41 Obligations of coal mine operators
42 Obligations of site senior executive for coal mine
43 Obligations of contractors
44 Obligations of designers, manufacturers, importers and suppliers of plant etc. for use at coal mines
45 Obligations of erectors and installers of plant
46 Obligations of manufacturers, importers and suppliers of substances for use at coal mines
47 Obligation of provider of services at coal mines

39 Obligations of persons generally

A coal mine worker or another person at a coal mine or a person who may affect the safety and health of others at a coal mine or as a result of coal mining operations has the following obligations—
to comply with this Act and procedures applying to the worker or person that are part of a safety and health management system for the mine;
if the coal mine worker or other person has information that other persons need to know to fulfil their obligations or duties under this Act, or to protect themselves from the risk of injury or illness, to give the information to the other persons;
to take any other reasonable and necessary course of action to ensure anyone is not exposed to an unacceptable level of risk.
A coal mine worker or other person at a coal mine has the following additional obligations—
to work or carry out the worker's or person's activities in a way that does not expose the worker or person or someone else to an unacceptable level of risk;
to ensure, to the extent of the responsibilities and duties allocated to the worker or person, that the work and activities under the worker's or person's control, supervision, or leadership are conducted in a way that does not expose the worker or person or someone else to an unacceptable level of risk;
to the extent of the worker's or person's involvement, to participate in and conform to the risk management practices of the mine;
to comply with instructions given for the safety and health of persons by the coal mine operator or site senior executive for the mine or a supervisor at the mine;
to work at the coal mine only if the worker or person is in a fit condition to carry out the work without affecting the safety and health of others;
not to do anything wilfully or recklessly that might adversely affect the safety and health of someone else at the mine.

The obligations of the site senior executive for coal mines, contractors and provider of services at coal mines are listed here below.

42 Obligations of site senior executive for coal mine

A site senior executive for a coal mine has the following obligations in relation to the safety and health of persons who may be affected by coal mining operations—
to ensure the risk to persons from coal mining operations is at an acceptable level;
to ensure the risk to persons from any plant or substance provided by the site senior executive for the performance of work by someone other than the site senior executive's coal mine workers is at an acceptable level;
to develop and implement a safety and health management system for the mine;
to develop, implement and maintain a management structure for the mine that helps ensure the safety and health of persons at the mine;
to train coal mine workers so that they are competent to perform their duties;
to provide for—
adequate planning, organisation, leadership and control of coal mining operations; and
the carrying out of critical work at the mine that requires particular technical competencies and
adequate supervision and control of coal mining operations on each shift at the mine; and
regular monitoring and assessment of the working environment, work procedures, equipment, and installations at the mine; and
appropriate inspection of each workplace at the mine, including, where necessary, pre-shift inspections.

43 Obligations of contractors

A contractor at a coal mine has an obligation to ensure, to the extent that they relate to the contractor's work, that this Act's provisions and any applicable safety and health management system are complied with.

47 Obligation of the provider of services at coal mines

A person who provides a service at a coal mine has the following obligations—
to ensure the safety and health of coal mine workers or other persons is not adversely affected as a result of the service provided;
to ensure the fitness for use of plant at the coal mine is not adversely affected by the service provided.

How do we meet our obligations?

Coal Mining Safety & Health Act 1999 Sections 36-38

Any person who has a workplace health and safety obligation under the Act must fulfil (that is meet, or discharge) that obligation.

a) Where there is a Regulation or Ministerial Notice

A regulation or ministerial notice prohibits exposure to a risk or prescribes a way to prevent or minimise exposure to a risk. Where a regulation or a ministerial notice exists for a specific risk or hazard, then the only way an obligation can be met is by following that prohibition or prescribed way.

N.B. - Regulations or Ministerial Notices Must Be Followed

b) Where there is a Code of Practice / Recognised Standard or Guideline

Codes of Practice state ways to manage exposure to risks in the workplace.
Where a Code of Practice / Recognised Standard / Guideline exists for the hazard, risk or industry, then it should be followed, however, a person may select an alternate method provided that the alternate method provides equal or better protection.

N.B. – A Code of Practice / Recognised Standard / Guideline should be followed or another way that provides equal or better control.
DOING NOTHING IS NOT AN ALTERNATIVE!!!!!

c) Hazards where no Regulation, Ministerial Notice or Code of Practice exists

If there is no regulation or code of practice about the hazard, then a person may choose any appropriate way to manage exposure to the risk. However, the person can fulfil their workplace health and safety obligations only if it takes reasonable precautions and exercises proper diligence.

To assist in establishing reasonable precautions and proper diligence, we need to refer to Section 30 of the Act, which specifies the way in which acceptable risk can be achieved. This can be summarised as managing health and safety through the Risk Management Process.

Therefore, where there is no regulation or code of practice about the hazard then a person should manage such hazards through the risk management process.

38 How obligations can be discharged if no regulation or recognised standard made

(1) This section applies if there is no regulation or recognised standard prescribing or stating a way to discharge the person's safety and health obligation in relation to a risk.
(2) The person may choose an appropriate way to discharge the person's safety and health obligation in relation to the risk.
(3) However, the person discharges the person's safety and health obligation in relation to the risk only if the person takes reasonable precautions, and exercises proper diligence, to ensure the obligation is discharged.

Failure to meet obligations

Coal Mining Safety & Health Act 1999 Section 34

34 Discharge of obligations

A person on whom a safety and health obligation is imposed must discharge the obligation. Maximum penalty -
if the contravention caused multiple deaths—3000 penalty units or 3 years imprisonment; or
if the contravention caused death or grievous bodily harm—1500 penalty units or 2 years imprisonment; or
if the contravention caused bodily harm—750 penalty units or 1 year's imprisonment; or
if the contravention involved exposure to a substance that is likely to cause death or grievous bodily harm—750 penalty units or 1 year's imprisonment; or
otherwise—500 penalty units or 6 months imprisonment.

Example of a prosecution

On 20 August 2020, a quarry supervisor pleaded guilty and was sentenced in the Mackay Industrial Magistrates Court for breaching s 31 of the *Mining and Quarrying Safety and Health Act 1999* ('the Act'), having failed to discharge his obligation under s. 36(2)(b) of the Act to ensure that the risk of injury to any person who was managed in the work and activities under his control, supervision or leadership, so that the risk was at an acceptable level. The defendant was convicted and fined $3,000. A conviction was not recorded.

The defendant was employed as a supervisor at a quarrying company in Clermont and had been employed there since 2013. His responsibilities as supervisor included conducting induction training and competence assessments for new employees. A 21-year old male commenced employment with the company as a loader and excavator operator on 24 October 2018. The worker later died on 15 November 2018 as a result of a fatal incident at a quarry near Clermont.

On 24 October 2018, the defendant conducted the worker's induction training and competence assessments. The worker completed and signed two assessment forms relating to the operation of machinery at the Fairfield quarry. Both forms contained a theoretical and a practical component. The latter required the trainee to demonstrate competence by operating the machinery. The defendant signed the two assessments in his capacity as the 'Assessor' and marked the worker as 'competent' for each assessment.

The worker's answers to the theoretical assessment questions were verbatim to specimen answer sheets, indicating that he had copied from the answer sheets. The defendant facilitated this by allowing him access to the answer sheets. In relation to the assessment's practical component, the defendant did not conduct any skills or proficiency testing by observing the worker operating the loader or excavator as required by the assessment forms prior to marking him as 'Competent'. The defendant made admissions in a voluntary interview with investigators from the Department of Natural Resources, Mines and Energy ('DNRME').

In the absence of a genuine test of the worker's proficiency in the operation of loaders and excavators, there was a risk of injury either to the worker or other workers at the quarry.

In sentencing, Magistrate James Morton took into account the defendant's early guilty plea, good character, his youth, and full cooperation with the administration of justice. His Honour noted that the defendant's employment was terminated after his voluntary participation in an interview with DNRME investigators.

His Honour also acknowledged that the defendant's management may have contributed to the conduct, noting that both the defendant's and his supervisors' contributory conduct appeared to be an industry norm. However, His Honour determined that the defendant's conduct was still a flagrant disregard for the safety of workers.

OWHSP contact: enquiries@owhsp.qld.gov.au

https://www.owhsp.qld.gov.au/court-report/quarry-supervisor-fined-3000-falsifying-workers-competency-assessment

Miner runs over underground.

ADRIAN Morrissey was a 40-year veteran miner who lost his career when he accidentally ran over a co-worker in the underground Bundoora Mine near Middlemount.

Morrissey, pictured right, worked at the Anglo Coal-owned mine as an explosive risk zone controller and was a contractor with Mastermyne. He was operating a 32-tonne shuttle car on November 8, 2009, when he ran over 51-year-old Ian Girle, who suffered horrific injuries.

The accident had remarkable similarities to the accident that killed Andergrove miner Jason Blee in 2007.

Morrissey, 61, pleaded guilty in the Industrial Magistrates Court in Mackay yesterday to failing in his workplace, health and safety obligations by causing grievous bodily harm.

Mr Girle was working underground, conveying mud from a sump to the mine surface. Morrissey was operating a shuttle car when Mr Girle approached him on foot and verbally asked him to move the shuttle car backwards. Mr Girle then walked to the back of the shuttle car and remained within a metre of the side of it. Morrissey expected Mr Girle to walk forwards and not to walk to the back and he drove backwards and ran over him. Mr Girle suffered compound fractures of his left leg and fractures to both sides of his pelvis. He lost a significant amount of skin and required a skin graft. His fractures needed a pin to be inserted in his leg. He remained in the Rockhampton Base Hospital for one month. Mr Girle still requires painkillers and faces further surgery and is restricted to administration duties.

Solicitor Patrick Heilmeier, of S.R. Wallace and Wallace, said as a result of the accident, Morrissey had lost his job and his underground deputy's licence. There was no intentional disregard of the safety procedures by Morrissey who was trying not to drive over an 11,000-volt cable which could have had serious consequences if it was broken.

Morrissey worked in mines for 40 years, held numerous licences and tickets, and was highly regarded. He had extensive community service with schools, sports clubs and services to the elderly, Mr Heilmeier said.

The prosecution asked for a fine in the $10,000 to $15,000 range, but Mr Heilmeier said Morrissey did not have the capacity to pay a large fine, and the defence sought a penalty in the range of $1000.

Magistrate Damien Dwyer adjourned sentencing to May 13 to allow for more submissions to be prepared on the issue of penalty.

Source: Daily Mercury Mackay http://www.dailymercury.com.au/story/2011/04/16/miner-run-over-underground-misjudgment-badly-injur/

Townsville Bulletin

http://www.townsvillebulletin.com.au/article/2010/06/05/144165_news.html

June 5th, 2010

AN underground worker at BHP Billiton's Cannington mine has been found guilty of breaching health and safety rules, resulting in a fellow worker's death two years ago.

Niu Rabuka was working underground at the mine in January 2008 when Michael Auld, a 51-year-old man from Tin Can Bay, died after being caught between a light vehicle and a tool carrier.

The accident happened 375m underground, and BHP Billiton and mines contractor EROC were criticised at the time for not allowing government investigators to speak to witnesses or inspect the scene of the accident until 24 hours after the tragedy.

The prosecution was brought by the Department of Mines and Energy for breaching safety rules. During the hearing over the past six months, Magistrate Brian Smith made an on-the-spot inspection of the accident site and heard detailed evidence about mining operations.

Timothy Paul Westendorf, the then training safety manager for EROC, the company contracted to the mine owners, explained the induction processes which all new employees must undertake before operating machinery without supervision.

He said he had taken part in the training of Rabuka, and when the training had been completed under the guidance of more experienced workers, he had signed a Full Competency Permit for him.

Throughout the proceedings, it was noted that Rabuka struggled with English from time to time. Rabuka was operating a tool carrier at the time of the accident.

Yesterday, Mr. Smith found Rabuka guilty of causing Mr. Auld's death, concluding that Rabuka had shown lack of judgment and attention and he had been aware of the risks.

The magistrate accepted Rabuka's extreme remorse at the death of a work colleague, a tragedy ''you will suffer for years to come''.

Submissions from Rabuka's counsel Tui Savu, that the penalty be a fine, were rejected as not appropriate and unjust. Mr Savu said in that case, he asked that any jail term be wholly suspended.
''The seriousness of this matter limits the options, and a custodial sentence is called for,'' Mr Smith said. Under the circumstances in this court, the maximum was two years and/or a $75,000 fine.
Mr Smith said it would be unrealistic to impose a fine, and sentenced Rabuka to eight months jail, the term wholly suspended for 15 months. He was also ordered to pay $13,437 to cover the costs of both the investigation and the court.

Safety Information, Alerts & Bulletins

Serious accident and high-potential incident reports

The Queensland mining and quarrying industries are required to provide the Mines Inspectorate with reports of serious accidents and high-potential incidents in accordance with the mining safety legislation.
Summary statements briefly describing some of the accidents and incidents are extracted from the reports and are provided to the industry as a reminder of what can go wrong.

These summary statements do not provide all the facts about the incidents nor indicate blame on any person or company. They are provided in good faith to help improve safety and health in our industries. Summary statements from September 2004 are available.

Mine safety alerts

Mine safety alerts are single-page documents that warn of accidents in which injury and/or equipment damage occurred, incidents in which no injury or equipment damage occurred but where potential existed for it to occur, and hazards or significant risks which, if left untreated, could result in injury to a person. An alert is developed when it is considered that the matter is of considerable urgency.

Mine significant incident reports

Mine significant incident reports are single-page documents that warn of accidents in which serious injury or a fatality resulted and incidents in which no injury occurred but where potential existed for serious injury or a fatality.

Mine safety bulletins

Mine safety bulletins are multiple-page documents that discuss particular risks or hazards associated with machinery, mining methods or tasks, and repetitive incidents that require analysis of root cause. All discussions are based around the hazards and advocate and facilitate a risk management approach to problem-solving.

Other Safety Information

Explosive Safety Alerts/Bulletins and Petroleum & Gas Safety Alerts may also be beneficial in addressing specific issues in the mining industry.

Recognised Standards

Section 72(1) of the Coal Mining Safety and Health Act 1999 provides that the minister may make recognised standards, and section 72(2) requires that the recognised standard be notified in the gazette.

- RS1: Underground electrical equipment and electrical installations (PDF, 392.9KB)
- RS2: Control of risk management practices (PDF, 323.6KB)
- RS3: Explosion protection of diesel engines (PDF, 298.8KB)
- RS4: Underground non-flameproof diesel vehicles (PDF, 290.1KB)
- RS5: Quality of incombustible dust, sampling and analysis of roadway dust in underground coal mines (PDF, 391.9KB)
- RS6: Inspections for underground coal mines (PDF, 470.4KB)
- RS7: Criteria for the assessment of drugs in coal mines (PDF, 189.4KB)
- RS8: Conduct of mine emergency exercises (PDF, 343.2KB)
- RS9: Monitoring of sealed areas (PDF, 157.2KB)
- RS10: Mine surveying and drafting (PDF, 265.7KB)
- RS11: Training in coal mines (PDF, 491.0KB)
- RS 12: Place change mining operations in underground coal mines (PDF, 373.3KB)
- RS 13: Tyre, wheel and rim management (PDF, 1.3MB)
- RS14: Monitoring respirable dust in coal mines (PDF, 267.4KB)
- RS 15: Underground respirable dust control (PDF, 1.9MB)

Recognised standards are not mandatory, but when followed, they provide a way of meeting safety and health obligations. A person may adopt another way of managing a risk, but in the event of an incident, the person may be required to show that the method adopted was at least equivalent to the method in the recognised standard.

Workplace Consultation

Consultation is at the core of any effective workplace health and safety program. This means that management works with workers to create a safe workplace. The mining legislation aims to involve various parties/stakeholders to achieve the Act objectives through the involvement of safety representatives and industry safety and health representatives.

Site Safety and Health Representatives

Coal Mining Safety & Health Act 1999

Sections 93-107

Section 99 outlines the functions of site safety and health representatives as the following:

(1) A site safety and health representative for a coal mine has the following functions—
(a) to inspect the coal mine to assess whether the level of risk to coal mine workers is at an acceptable level;
(b) to review procedures in place at the coal mine to control the risk to coal mine workers so that it is at an acceptable level;
(c) to detect unsafe practices and conditions at the coal mine and to take action to ensure the risk to coal mine workers is at an acceptable level;
(d) to investigate complaints from coal mine workers at the mine regarding safety or health.
(2) The site senior executive and supervisors at the coal mine must give reasonable help to a site safety and health representative in carrying out the representative's functions.
Maximum penalty—40 penalty units.
(3) The site senior executive or the site senior executive's representative may accompany the site safety and health representative during an inspection.
(4) A site safety and health representative who makes an inspection of the coal mine must—
(a) make a written report on the inspection; and
(b) give a copy of the report to the site senior executive; and
(c) if the inspection indicates the existence or possible existence of danger, immediately—
(i) notify the site senior executive or the responsible supervisor; and
(ii) send a copy of the report to an inspector.
(5) If a site safety and health representative believes a safety and health management system is inadequate or ineffective, the representative must inform the site senior executive.
(6) If the site safety and health representative is not satisfied the site senior executive is taking the action necessary to make the safety and health management system adequate and effective, the representative must advise an inspector.
(7) The inspector must investigate the matter and report the results of the investigation in the mine record.

The following other sections in Part 7 are also relevant for the role, powers and responsibilities of the Site Safety and Health Representatives:

Part 7 Site Safety & Health Representatives

Division 1 Purposes of part

- 92 Purposes of pt. 7

Division 2 Site safety and health representatives

- 93 Election of site safety and health representatives
- 94 Further election if site safety and health representative not available
- 95 Person must be qualified to act as site safety and health representative
- 96 Ceasing to be a site safety and health representative
- 97 Removal from office by Minister
- 98 Election after removal from office
- 99 Functions of site safety and health representatives
- 100 Powers of site safety and health representative
- 101 Stopping of operations by site safety and health representatives
- 102 Effect of report
- 103 Site senior executive not to restart operations until risk at an acceptable level
- 104 Site safety and health representative not to unnecessarily impede production
- 105 Protection of site safety and health representatives performing functions
- 106 Site senior executive to tell site safety and health representatives about certain things
- 107 Site senior executive to display identity of site safety and health representatives

Industry Safety and Health Representatives

Coal Mining Safety & Health Act 1999 Sections 108-124

Section 118 outlines the functions of industry safety and health representatives as the following:

118 Functions of industry safety and health representatives

(1) An industry safety and health representative has the following functions—

(a) to inspect coal mines to assess whether the level of risk to the safety and health of coal mine workers is at an acceptable level;

(b) to review procedures in place at coal mines to control the risk to safety and health of coal mine workers so that it is at an acceptable level;

(c) to detect unsafe practices and conditions at coal mines and to take action to ensure the risk to the safety and health of coal mine workers is at an acceptable level;

(d) to participate in investigations into serious accidents and high potential incidents and other matters related to safety or health at coal mines;

(e) to investigate complaints from coal mine workers regarding safety or health at coal mines;

(f) to help in relation to initiatives to improve safety or health at coal mines.

(2) The following persons may accompany the industry safety and health representative during an inspection—

(a) the site senior executive or a person representing the site senior executive;

(b) a site safety and health representative or a person representing the site safety and health representative.

The following other sections are also relevant for the role, powers and responsibilities of the Industry Safety and Health Representatives:

Part 8 Industry safety and health representatives

Division 1 Purposes of part

- 108 Purposes of pt. 8

Division 2 Industry safety and health representatives

- 109 Appointment of industry safety and health representatives
- 110 Industry safety and health representative to work full-time
- 111 Funding of industry safety and health representative
- 112 Termination of appointment
- 113 Appointment after termination
- 114 Filling of temporary vacancy
- 115 Vacancy generally

- 116 Persons not to pretend to be industry safety and health representatives if not appointed
- 117 Industry safety and health representative restricted to safety and health purposes
- 118 Functions of industry safety and health representatives
- 119 Powers of industry safety and health representatives
- 120 Industry safety and health representative not to unnecessarily impede production
- 121 Inadequate or ineffective safety and health management systems
- 122 Identity cards
- 123 Failure to return identity card
- 124 Production or display of identity card

Inspectors

Coal Mining Safety & Health Act 1999 Sections 125-181

The main role of inspectors is to monitor and enforce compliance with the Act, and where required implement the enforcement framework.

The inspector has specific powers under the Act and these are outlined below.

Each inspector is issued with an identity card containing a signature and a recent photograph, which he or she must show you before exercising any power under the Act.

128 Functions of inspectors and inspection officers

Inspectors and inspection officers have the following functions—

(a) to enforce this Act;
(b) to monitor safety and health performance at coal mines;
(c) to inspect and audit coal mines to assess whether risk to persons is at an acceptable level;
(d) to help persons to achieve the purposes of this Act by providing advice and information on how the purposes are to be achieved;
(e) to check that safety and health management systems and procedures are in place to control risk to persons affected by coal mining operations;
(f) to provide the advice and help that may be required from time to time during emergencies at coal mines that may affect the safety or health of persons;
(g) if unsafe practices or conditions at coal mines are detected, to ensure timely corrective or remedial action is being taken and, if not, require it to be taken;
(h) to investigate serious accidents and high-potential incidents at coal mines;
(i) to investigate matters at coal mines that affect the successful management of risk to persons;
(j) to investigate complaints about matters relating to safety or health resulting from coal mining operations.

Further functions of inspectors

Inspectors have the following additional functions—

- to advise the chief inspector on safety and health at coal mines;
- to make recommendations to the chief executive about prosecutions under this Act.

The following other sections from Part 9 are also relevant for the role, powers and responsibilities of inspectors and authorised officers:

Part 9 Inspectors and other officers and directives
Division 1 Inspectors and inspection officers

- 125 Appointments
- 126 Qualifications for appointment as inspector
- 127 Qualifications for appointment as inspection officer
- 127A Appointment conditions and limit on powers
- 128 Functions of inspectors and inspection officers
- 129 Further functions of inspectors

Division 2 Authorised officers

- 129A Appointments
- 129B Qualifications for appointment as authorised officer
- 129C Appointment conditions and limit on functions and powers
- 129D Functions of authorised officers
- 129E Information about functions and powers

Division 3 Identity cards for inspectors, inspection officers and authorised officers

- 130 Identity cards
- 131 Failure to return identity card
- 132 Production or display of identity card

Division 4 Powers of inspectors, inspection officers and authorised officers
Subdivision 1 Preliminary

- 132A Definition for div 4

Subdivision 2 Power to enter places

- 133 Entry to places

Subdivision 3 Procedure for entry

- 134 Consent to entry
- 135 Application for warrant
- 136 Issue of warrant
- 137 Special warrants
- 138 Warrants—procedure before entry

Subdivision 4 General powers

- 139 General powers after entering coal mine or other places
- 140 Failure to help officer
- 141 Failure to answer questions
- 142 Site senior executive must help officer

Subdivision 5 Power to seize evidence

- 143 Seizing evidence at coal mine or other place
- 144 Securing things after seizure

- 145 Tampering with things subject to seizure
- 146 Powers to support seizure
- 147 Receipts to be given on seizure
- 148 Forfeiture
- 149 Return of things that have been seized
- 150 Access to things that have been seized

Subdivision 6 Power to stop and secure plant and equipment

- 151 Officer may stop and secure plant and equipment

Subdivision 7 Power to obtain information

- 152 Power to require name and address
- 153 Failure to give name or address
- 154 Power to require production of documents
- 155 Failure to produce document
- 156 Failure to certify copy of document
- 157 Power to require attendance of persons before an officer to answer questions
- 158 Failure to comply with requirement about attendance
- 159 Person must answer question about serious accident or high potential incident

Subdivision 8 Additional powers of chief inspector

- 160 Additional powers of chief inspector

Division 5 Directives by inspectors, inspection officers and industry safety and health representatives Subdivision 1 Power to give and way of giving directives

- 161 Directive may be given
- 162 How directive is given
- 163 How directive is given for ss 166, 167 and 170

Subdivision 2 Matters for which directives may be given

- 164 Directive to ensure coal mine worker competent
- 165 Directive to carry out test
- 166 Directive to reduce risk
- 167 Directive to suspend operations for unacceptable level of risk
- 168 Directive to review safety and health management system and principal hazard management plans
- 169 Directive to suspend operations for ineffective safety and health management system
- 170 Directive to isolate site
- 171 Directive about separate part of the mine
- 172 Directive to provide independent engineering study

Subdivision 3 Recording of directives and other matters

- 173 Records must be kept
- 174 Directives

Subdivision 4 Review of directives

- 175 Application for review

- 176 Procedure for review
- 177 Review of directive
- 178 Stay of operation of directive
- 179 False or misleading statements
- 180 False or misleading documents
- 181 Obstructing inspectors, officers or industry safety and health representatives

3.3 Coal Mining Safety & Health Regulation 2017

The Coal Mining Safety & Health Regulation 2017 prohibit exposure to a risk or prescribes a way to prevent or minimize exposure to a risk. Where a regulation or a ministerial notice exists for a specific risk or hazard then the only way an obligation can be met is by following that prohibition or prescribed way.

The Coal Mining Safety & Health Regulation 2017 sets out the legal requirements to prevent or control certain hazards in the workplace which might cause injury or death in the workplace. It either

- prohibits exposure to a risk.
- prescribes ways of preventing or minimising exposure to a risk.
- deals with administrative matters.

If a regulation exists for specific risks at your workplace, in order to meet your obligations under the Act **you must do what the regulation says** to prevent or minimise the impact of the risk.

A copy of the regulations can be accessed on the internet at www.legislation.qld.gov.au

3.4 Functions and Roles for Consultation in Health and Safety

Absolute responsibility for occupational health and safety is the direct responsibility of the person who is in ultimate charge, such as the Site Senior Executive.

Just as authority is delegated from this top position down through the organisational structure to ensure that the objectives of the organisation are efficiently fulfilled (i.e., finance, personnel, purchasing, distribution, sales, production, etc) so occupational health and safety needs to be delegated and persons held accountable.

In order to carry out the task, the degree of authority delegated must equal the amount of responsibility given. The authority delegated to carry out health and safety responsibilities must operate the same way as other management functions. It begins at the top level with an approved set of written policy statements, procedures, rules and instructions that, once issued, must have some type of appraisal system to measure compliance and personal accountability.

Many organisations evaluate health and safety performance, e.g., accident prevention results, as one aspect of performance when considering possible promotion opportunities. Frequently financial loss due to accidents, injuries and damage may equal or exceed the organisation's profit for the same period. Therefore, it is advisable that these losses and results be included in all relevant reports, including annual reports to shareholders. Legislative requirements related to specific Obligations were discussed earlier.

4.0 Risk Management

Hazards surround us in every aspect of our lives. There are hazards in the air we breathe, the food we eat, and the places we live in, through to the most hazardous sport, occupation or location we can think of. Almost every aspect of life has a hazard attached to it.

To survive, we all carry out a constant process of hazard identification, risk assessment, risk control, and review. This process is collectively referred to as the risk management process.

This risk management process is an integral part of managing any business. It is a logical and systematic approach to minimising losses and maximising opportunities. The key to risk management is to identify the hazards, analyse the risks and evaluate whether the risk is acceptable or unacceptable. Control options then need to be developed, evaluated and implemented to treat the risk.

Communication and consultation should be conducted throughout the risk management process. The success or failure of risk management strategies rests on the effectiveness of this communication and consultation.

The effectiveness of risk control measures often comes down to the commitment of individuals to the risk management process. Therefore, it is essential that these people have ownership of the risk management process and can see the benefits to themselves and the organisation of effectively managing risk.

Before we move on, we should consider some key terms that are identified in the Australian Standard for Risk Management (Standards Australia, 1999, Risk Management).

4.1 Key Definitions

- **Risk** is the chance of something happening that will have an impact upon objects. It is measured in terms of consequences and likelihood.
- **Hazard** is a source of potential harm or a situation with a potential to cause loss.
- **Consequence** is the outcome of an event or situation expressed qualitatively or quantitatively, being a loss, injury, disadvantage, or gain.
- **Likelihood** is used as a qualitative description of probability and frequency.
- **Frequency** is a measure of likelihood expressed as the number of occurrences of an event in a given time.
- **Probability** is the likelihood of a specific outcome, measured by the ratio of specific outcomes to the total number of possible outcomes. Probability is expressed as a number between 0 and 1, with 0 indicating an impossible outcome and 1 indicating an outcome is certain.
- **Risk Acceptance** is an informed decision to accept the likelihood and the consequences of a particular risk.
- **Risk Analysis** is a systematic use of available information to determine how often specified events may occur and the magnitude of their likely consequences.
- **Risk Avoidance** is an informed decision not to become involved in a risk situation.
- **Risk Control** is that part of risk management which involves the provision of policies, standards, and procedures to eliminate, avoid or minimise adverse risks facing an enterprise.
- **Risk Identification** is the process of determining what can happen, why and how.
- **Risk Management** is the systematic application of management policies, procedures, and practices to the tasks of identifying, analysing, assessing, treating, and monitoring risk.

Responsibilities for the management of workplace risk is a function of all personnel at the mine site through the obligations of the Coal Mining Safety & Health Act 1999.

Authority is also delegated from the Site Senior Executive (SSE) to All Department Heads to ensure identified risk within their department is eliminated or reduced down to what is prescribed as an acceptable level of risk.

Statutory Officials, Supervisors and Coordinators will assist the Department Heads in achieving an acceptable level of risk at the mine.

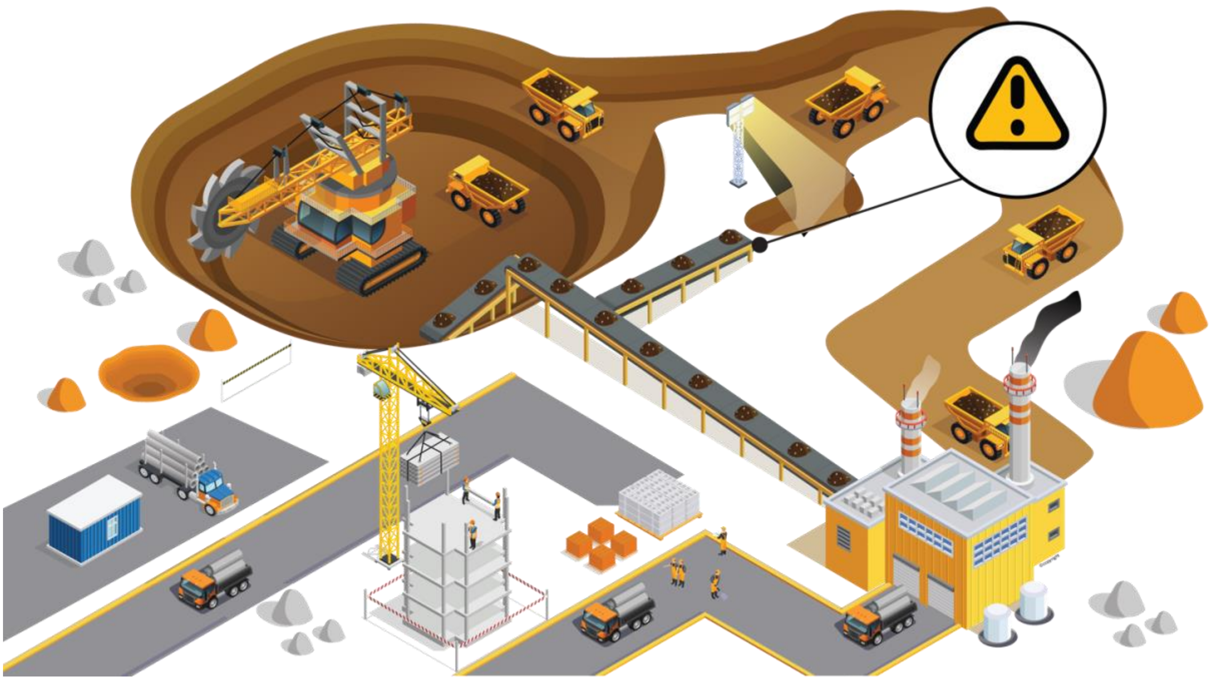
The Safety & Training Superintendent will monitor consistency of application of the risk management process throughout the mine and will advise the SSE on process effectiveness.

Contractor Supervisors will ensure that Contractors manage risk to the same acceptable level as that for Coal Mine employees.

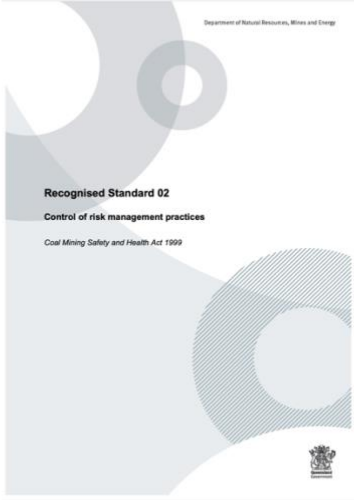
Supervisors responsible for the management of the workplace are to ensure that all stakeholders, in particular the affected workers, are fully involved in the process of risk management through formal employee consultation.

From a risk management perspective, the Coal Mining Safety and Health Act 1999 refers to the definition of 'acceptable risk', how this is achieved and what must occur if the risk is unacceptable. It states that the level of risk is unacceptable only after the probability and consequences have been regarded, and where the question is asked whether the risk is "as low as reasonably achievable". This implies that each coal mine must set their own criteria on what is an acceptable level of risk, and have all personnel use that criterion in their daily activities.

The management of risk is recognised as a statutory and integral part of good workplace management practice. It is a process consisting of six (6) steps which, when undertaken in sequence, enable continual improvement in important decision-making. Risk management is also the heart of any Occupational Health and Safety Management System (OHSMS), and everyone has an obligation to ensure the health and safety at the mine is maintained in line with statutory requirements.



4.2 Risk Management and Legislation:
In Queensland Coal and Metalliferous Mining Operations, workplace health and safety is legislated through the **Coal Mining Safety & Health Act 1999 and Regulation 2017 or the Mining & Quarrying Safety and Health Act 1999 or Regulation 2017.** Section 30 of the Coal Mining Safety & Health Act 1999 specifies a risk management approach as a way in which exposure to risks can be managed. A Recognised Standard 02 has been released by the Department for the Control of Risk Management Practices.



Part 2 The Control and management of Risk and other basic concepts

Division 1 Control and management of risk

30 How is an acceptable level of risk achieved
(1) To achieve an acceptable level of risk, this Act requires that management and operating systems must be put in place for each coal mine.
(2) This Act provides that the systems must incorporate risk management elements and practices appropriate for each coal mine to—
(a) identify, analyse, and assess risk; and
(b) avoid or remove unacceptable risk; and
(c) monitor levels of risk and the adverse consequences of retained residual risk; and
(d) investigate and analyse the causes of serious accidents and high potential incidents with a view to preventing their recurrence; and
(e) review the effectiveness of risk control measures, and take appropriate corrective and preventive action; and
(f) mitigate the potential adverse effects arising from residual risk.
(3) Also, the way an acceptable level of risk of injury or illness may be achieved may be prescribed under a regulation.

However, the Act and associated Regulations specify ways in which particular health and safety issues must be managed. These requirements must be followed regardless of the application of a risk management approach.
If there is no regulation, ministerial notice, code of practice about the hazard, then the organisation may choose any appropriate way to manage exposure to the risk. However, the organisation can fulfil its workplace health and safety obligations only if it takes reasonable precautions and exercises proper diligence. This may be achieved through the risk management process.

Risk Management is the systematic application of management policies, procedures and practices to the tasks of identifying, analysing, assessing, treating and monitoring. The previous Risk Management Standard AS/NZS 4360:2004 has now been superseded by AS/NZS ISO 31000:2009, Risk Management - Principles and guidelines. In the past, there have been incidents where it has been shown that little was done in managing risks and as a result, people have died and damage has been extreme.

4.3 Safety Management Systems and Risk Management

In order to meet their obligations under the respective jurisdiction, workplaces will are often required to demonstrate how they intend to manage the risks of the hazards they encounter in their workplaces. Often organisations develop Safety and health Management Systems. For example, the Qld Coal Mining Legislation defines such a system as:

62 Safety and health management system
(1) A safety and health management system for a coal mine is a system that incorporates risk management elements and practices that ensure the safety and health of persons who may be affected by coal mining operations.

Source: Queensland Coal Mining Safety and Health Act, 1999

A Safety Management System (SMS) is defined in the Australian Standard for SMS as the:

"Overall management system which includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing achieving and reviewing and maintaining the OHS policy, and so managing the risks associated with the business of the organisation".

Source: AS/NZS 4804 Occupational Health and Safety Management Systems

Examples of elements that should constitute an SMS under the Coal Mining Legislation for example include:

a) A comprehensive Risk and Hazard Identification and Assessment Program, complying to a recognised standard that will accurately identify all hazards which may impact on the health and safety of any person at the workplace.
b) Hazard and Risk Control Measures, including but not limited to Standard Operating Procedures and Work Instructions to control the identified risks
c) Principal Hazard Management Plans
d) Programs to implement the Hazard and Risk Control Measures.
e) Programs for the provision of First Aid, including first aid supplies and adequate coverage by current First Aid certificate holders.
f) Programs for the management of accidents, incidents and hazards.
g) Programs for the reporting and investigation of accidents, incidents and hazards.
h) Programs for the handling of emergencies.
i) Programs for the conduct of Emergency Exercises
j) Programs for the communication and dissemination of relevant health and safety information, data and material.
k) Programs and schemes for the recording, reporting and storage of relevant health and safety information, data and material.
l) Programs to identify training needs, and implement and maintain training programs and training records.
m) Programs for the audit, review and continuous improvement of the Safety Management System including correct and preventative measures.

Safety Management Systems must address all aspects of the mine and must contain at least a comprehensive Risk and Hazard Identification and Assessment Program, complying to a recognised standard that will accurately identify all hazards which may impact on the health and safety of any person at the mine, Hazard and Risk Control Measures, including but not limited to Standard Operating Procedures and Work Instructions to control the risks so identified.

Elements of the Safety Management System

- All Coal Mines must develop Principal Hazard Management Plans as detailed in the Recognised Standard for Mine Safety Management Systems dealing with, as a minimum:
- Vehicle interaction.
- Explosives.
- High wall /Low wall failure.
- Principal Hazards are anything that can cause multiple fatalities.

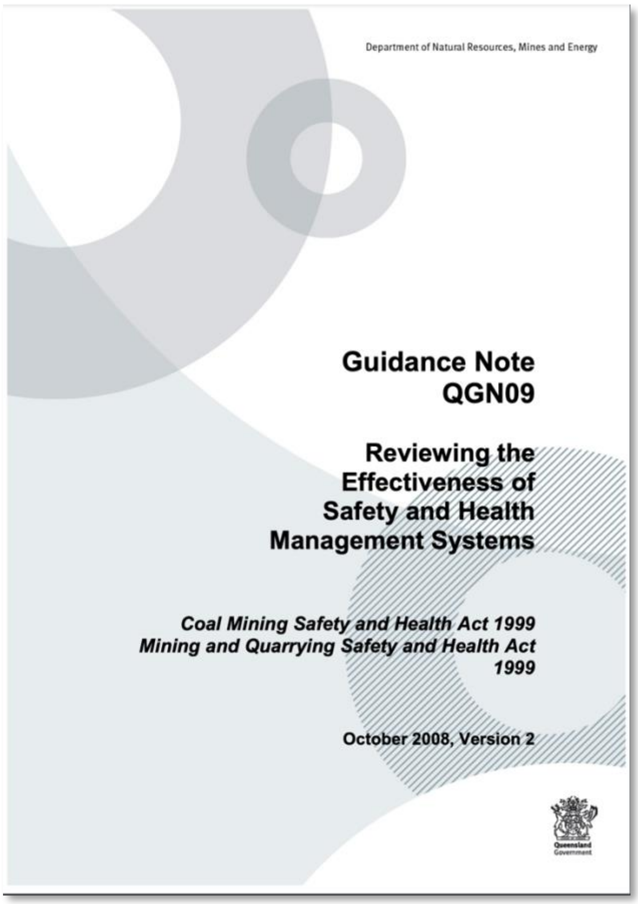
Known Risk Areas

- Working around explosives.
- Working with process pumps.
- Manual handling.
- Working near noise.
- Using ladders.
- Using welding and gas-cutting equipment.
- Working in a dusty environment.
- Basic slinging and lifting.
- Working in a wet environment.
- Working in confined spaces.
- Working at height.

Risk Areas

- Working on aerial work platforms.
- Working with compressed air.
- Working with hydraulics.
- Vehicles and mobile equipment.
- Working with chemicals and hazardous substances.
- Poor housekeeping practices.
- Working with electricity.
- Stationary equipment and machinery.
- Working around conveyors.
- Working with lubricants.

The Department has released a Guidance Note QGN 09 outlining the process to 'Reviewing the Effectiveness of Safety & Health Management Systems'.

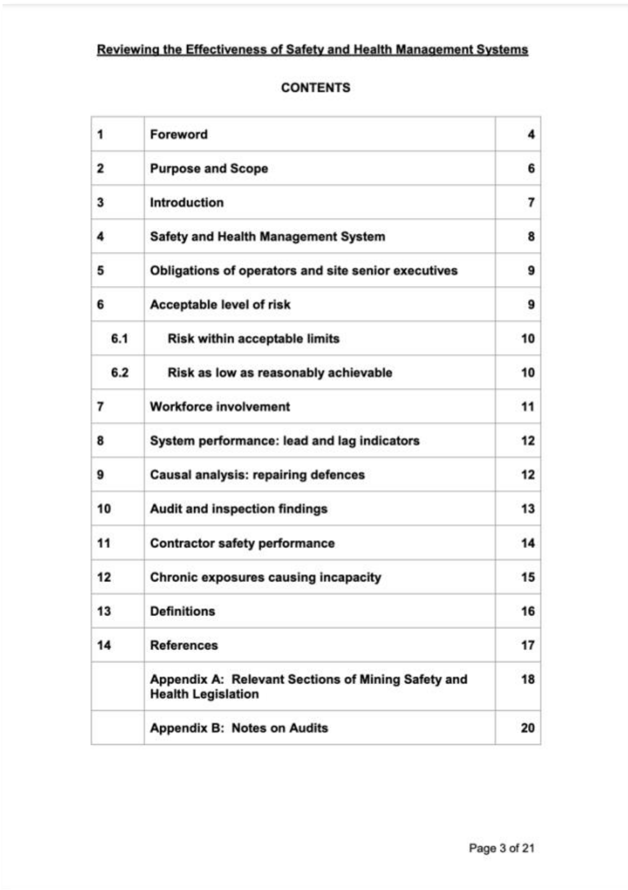

Department of Natural Resources, Mines and Energy

Guidance Note
QGN09

Reviewing the Effectiveness of Safety and Health Management Systems

Coal Mining Safety and Health Act 1999
Mining and Quarrying Safety and Health Act 1999

October 2008, Version 2


Reviewing the Effectiveness of Safety and Health Management Systems

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The Department also regularly releases Safety Bulletins and Safety Alerts about issues, incidents, situations in the industry as a way of assisting the industry with its OH&S obligations. These documents often outline the event, findings, and recommendations.

Department of Employment, Economic Development and Innovation

Safety bulletin

Mines

Mines Inspectorate

Safety bulletin no. 104
17 January 2011

Resuming operations after severe weather

The current severe weather conditions have resulted in a number of high potential incidents when operations have restarted. Queensland mining safety and health legislation requires that potential hazards be identified and suitable controls established to deal with the hazards.

Early last year I asked you to review the change management procedures in place at your mine. Restarting mining operations after the amount of recent wet weather is a change management issue, e.g. the nature of a waste dump is likely to have changed.

At least three trucks and one bull dozer have been affected by slumping at the edge of a tip.

The effect of large volumes of rain on a tip requires a change management process involving appropriately qualified people. For an Open Cut Examiner to make effective inspections, he may need advice from geologists and / or civil or geotechnical engineers.

Each truck involved in a reported slump was a new generation, high capacity unit. Understandably these trucks are preferred when available and when, for operational reasons, only part of a mine's fleet can be used. However, in assessing the preferred truck also consider whether lower capacity trucks would be preferable in some circumstances.

Other areas where change has been identified at some mines include:

- Reduction in the width of roadways
- Damage to road surfaces
- Slippery road conditions
- Strata failure of high and low walls.

When hazards are identified, it is important that the controls are specific, suitable and communicated well. At one mine, after a truck approached an edge which had slumped, the

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Department of Employment, Economic Development and Innovation

Safety Alert

Mines

Office of the Commissioner for Mine Safety & Health

No. 1
28 March 2011

Earthmover tyre and rim safety

Over the past few months there have been several tyre-related incidents and accidents involving earthmovers, including a fatality last December at the Foxleigh mine that involved an on-highway tyre mounted to a coal haulage roadtrain.

Tyres, rims and wheel assemblies are safety-critical items that must be maintained and used correctly if people's lives are not to be placed at risk.

The purpose of this alert is to refresh your understanding of the causes of these accidents so as to help you guard against the risk.

***Note**: Many of the points made here apply also to light vehicles, personnel carriers and buses, and other non-earthmoving applications such as forklifts and cranes.*

Be sure to:

- **maintain** correct inflation pressure, payload and vehicle speed
- **maintain** an optimal working environment for tyres
- **employ** trained and competent mine service personnel, in line with established safe work procedures, who use fit-for-purpose equipment
- **test** rims and wheels for metal fatigue, as per relevant Standards and manufacturers' guidelines.
- **capture and analyse** tyre and rim operational data to ensure a sound understanding of the health of the mine's tyre and rim assets.
- **prepare and follow** emergency procedures for dealing with tyre-related accidents.

Your general obligations

Everyone involved with earthmover tyres — from design and manufacture to use and maintenance — must adhere to safety standards. This is required by mining legislation and supported by the recently revised Australian Standards on earthmover tyres:

- AS4457:1 2007 Earthmoving Machinery – Off the road wheels, rims and tyres – Maintenance and repair Part 1: Wheel assemblies and rim assemblies.
- AS4457:2 2008 Earthmoving Machinery – Off the road wheels, rims and tyres – Maintenance and repair Part 2: Tyres.

Critical aspects of tyre management

Selection — The key to safe tyre performance is the correct selection of tyres. In consultation with the tyre manufacturer, it is vital to choose tyres that suit the operating conditions at the mine.
The safe operation envelope of the tyre in terms of payload and vehicle speed must be established through weight and cycle time studies to allow calculation of the 'tonne kilometre per hour' (TKPH) of the

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4.4 Process of Risk Management

The Australian/New Zealand Standard for Risk Management, AS/NZS ISO 31000:2009, Risk Management—Principles and Guidelines, was developed to provide a generic framework for all organisations.

Risk Management can be used as a process to address risk in an organisation in a systematic way so that the organisation may be better informed about the potential impact that their decisions may have on operations. Within this competency, our focus will be on the risk that mining activities can have on the health and safety of individuals.

The process covers:

- Hazard identification
- Risk assessment, which separates low, moderate, and high risks
- Eliminating or controlling risks, which is referred to as risk treatment, and
- Monitoring and reviewing the whole process and recommendations to ensure remedial actions are completed.

The process concentrates initially on the highest risks to people, i.e., those risks that are more likely to cause serious injury or death. It also focuses on equipment damage and other risks that are likely to cause harm or interrupt production.

The process consists of:

1. *Establishing the context* within which the work and the risks lie.
2. *Identifying the hazard/s* which involves asking and answering the 2 questions, "What can happen?" and "How/Why might it happen?" It is important that all steps within a task or project are defined and examined to determine associated risks. This can be achieved through a number of processes, e.g., task analysis.
3. *Analysing the risks*, which culminates in producing a "level of risk". This is achieved by determining the likelihood of incidents occurring and the consequences if the incidents do occur.
4. *Evaluating the risks* includes prioritising risks and determining whether particular risks are acceptable or unacceptable. As it is impossible to eliminate risks completely without eliminating tasks, we need to "live" with those that are acceptable as long as some controls are in place.
5. *Treating the risks.* There are a number of strategies that can be employed to treat risks, e.g. Risk avoidance, risk reduction, risk transference and risk acceptance and retention. We will look at ways to reduce or control risks, which can result in injury and/or damage, by taking appropriate actions.

Step 1: Preparation - Define the Context / Scope of the Risk Assessment

1. Define the topic/context.
2. Select a facilitator.
3. Management's approval for risk assessment.
4. The client clarifies their needs.
5. Suitable teams selected.
6. Resources, tools, venue and risk ranking methodology organised.
7. Conduct a risk assessment.
8. Risk Assessment delivered to appropriate personnel.

Scoping Document

Topic: Bucket change on digger	**Objective**: Assess risks related to changing a bucket on a digger
Facilitator: Justin Jones	**Method:** The HAZAN method
Approval: SSE	**Outcome:** New controls
Venue: Training room 2	**Time allotted**: Two shifts
Team: Brendan Brown 20 years exp Ray White 4 years	**Delivered to:** Training coordinator

A Facilitator must:

- Define the goals.
- Define the group's authority.
- Nominate a leader.
- Determine the group size.
- Set the rules.
- Nominate a person to record.

A Facilitator is also.

- An initiator – setting up the activity/work for others to take on.
- A model – demonstrating through their own actions what is to be done, and what is possible.
- A coach – offering encouragement, support and direction where needed as the skills and tasks of the team member are developed and refined.
- A mentor a partner.

Facilitation must:

- Keep exercise flowing, don't get bogged down in detail and discussion even if it is interesting.
- Don't accept assertions at face value – ask for an explanation or supporting evidence (e.g., how, when, why, who.)
- It is not the facilitator's role to do the risk assessment himself, his role is to encourage participation from all team members.
- If an issue is too difficult for the team to deal with, or information needed is not available, accept this, record the problem and move on.
- Prepare before the risk assessment.
- Research into the subject.

Skills

- Be prepared.
- Keep on track.
- Keep the progress going.
- Prompt answers.
- Be honest.
- Don't take full control.
- Acknowledge.
- Show interest.
- Seek feedback.

Communication Skills

- Ask questions.
- Show empathy.
- Participate.
- Problem solve.
- Solve conflict.
- Listen.
- Give feedback.
- Share ideas.

Step 2 – Identifying the Hazards

Identifying hazards means looking at our workplace and the tasks that we complete, and identifying those things that have the potential to cause harm. Hazards are not always obvious.

Remember that when conducting inspections or entering the workplace any safety rules of procedures must be complied with.

There are a number of ways actually to identify the hazards in a workplace. These include:

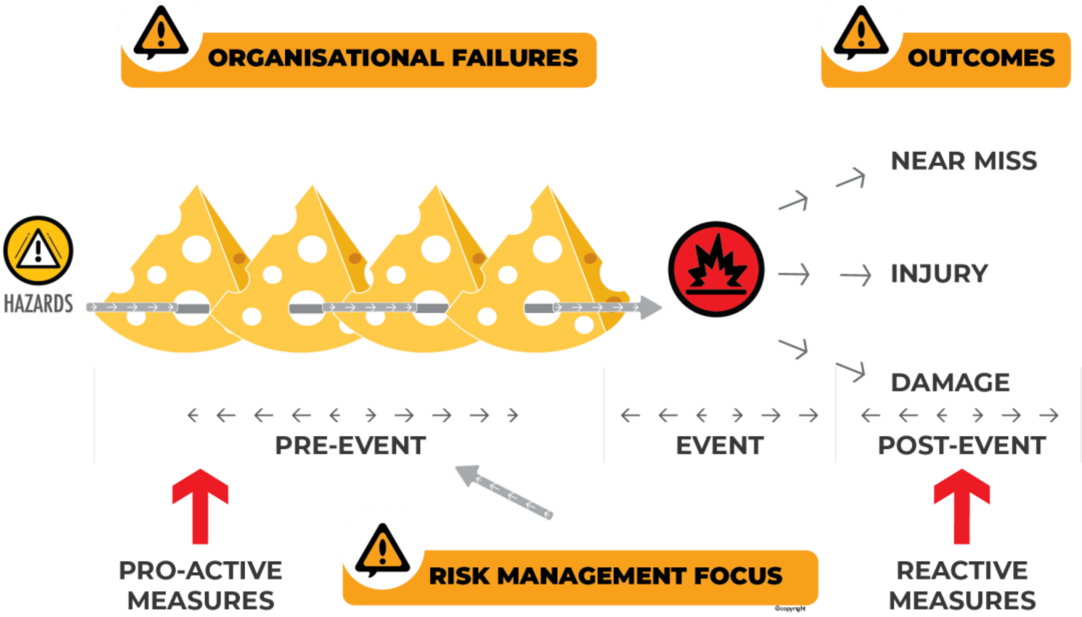
- **Inspection and Observation** -walking through an area or location and observing tasks as they are conducted.
- **Consultation** – consulting with workers, WH&S representatives, WH&S Committees.
- **Job Safety Analysis** - considering how tasks are conducted, what could go wrong and considering how equipment or tools could fail;
- **Audits** - independent evaluation (e.g., safety audit, analysis of noise or dust exposure);
- **Workplace monitoring** – testing of plant, equipment and work environment for health hazards, including noise and airborne contaminants. Monitoring equipment includes a noise meter, light meter, dragger pump and gas monitor.
- **Past Incidents** - reviewing previous reports of accidents and near misses;
- **Safety Data Sheets (SDS)** - A Safety Data Sheet (formerly known as a Material Safety Data Sheet or MSDS) is a document that contains information on the potential health effects of exposure and how to work safely with the hazardous substances.
- **External Sources** - reviewing the information available from industry groups, health and safety publications, manufacturers or suppliers of equipment, chemicals, etc.

The definition of risk and hazard is reasonably consistent within various Australian jurisdictions. For example, the Coal Mining Health & Safety Act QLD 1999 defines hazard and risk as follows:

> ***18 Meaning of risk***
> *(1)* ***Risk means the risk of injury or illness to a person arising out*** *of a hazard.*
> *(2) Risk is measured in terms of consequences and likelihood.*
>
> ***19 Meaning of hazard***
> *A* ***hazard is a thing or a situation with potential to cause injury*** *or illness to a person.*
>
> ***20 Meaning of principal hazard***
> *A* ***principal hazard at a coal mine is a hazard at the coal mine*** *with the potential to cause multiple fatalities.*

We carry out assessments of workplaces to find hazards and to enable us to appreciate the risks that are present and take corrective action **before** incidents occur. This can be done using a number of techniques such as inspections, audits, task or situation analysis, brainstorming in work groups, fault tree analysis, HAZOP studies, or a number of other recognised techniques i.e. Take 5 worker reviews.

The figure below shows an incident's pre-event, event and post-event stages. The barriers in the pre-event stage represent elements of the risk management systems such as formal risk assessments, task analysis, JSA and training. They may also be mechanical such as guards on machines.



If there are gaps or holes in the system (organisational failures), hazards can 'track' through them, with the associated risks being recognised, resulting in injury, damage or, if lucky, a near miss. After the incident has occurred, an incident investigation takes place. This is referred to as incident management.

Risk Management is focused on the pre-event stage, although information gained from thorough incident investigations is important when assessing risks. With the diligent application of hazard identification and risk assessment, the gaps in the system can be eliminated.

Often, risk management is carried out when a project is near completion or is completed. This poor management practice exposes people and equipment to unforeseen risks. However, a carefully planned risk management strategy will enable us to define previously undetected risks.

Risk management should be practised from the concept or big picture stage and continued through the process to everyday practices such as work procedures. It should be included in the following:

- *New projects*
- *Modifications*
- *Existing operations*
- *Following incident investigations*
- *During job or task analysis*

Hazard identification is an important part of the Risk Management process that can be easily overlooked when wanting to 'fix' a problem. Many techniques and considerations should be made before a risk value can be placed on a hazard so that the true extent of the issue can be recognised.

Hazards are best identified by various techniques, in various contexts, and by various people continuously. These may include:

- Consultation with workplace/site workers
- Conducting Take 5 reports
- Incident and hazard reports
- Inspections
- Performing Safety Interactions with the workers by the Supervisor
- Audits
- Accident Reports
- Workers' Compensation claims
- Supplier/Manufacturer/Importer information
- Specialist consultation

These techniques can apply to risk management activities such as:

- Hazard reporting
- Incident reporting
- Auditing
- Job Safety Analysis
- Scoping Risk Assessments for new equipment, processes or merely to review existing activities.
- Purchasing Controls
- Contractor Management

Once the hazards are recognised and are determined to require rectification, a company needs to commence a documentation process. This may be quite simple, where the identification occurs as part of a planned inspection or a job safety analysis. Where a singular hazard is identified during the course of daily work activities, documentation needs to occur on a hazard report form or a similar document. From here, the risk management process may be continued through with risk analysis, evaluation, control and review.

Remember the model presented earlier of the Risk Management Approach? The term "Communicate and Consult" was highlighted on the left-hand side of the model. It is highly recommended that from this point forward, in any risk management activity, you always communicate and consult with others to ensure that you have not 'missed' anything. It is essentially a '2 heads are better than 1' philosophy!

The initial part of risk management considers informal hazard identification and risk assessment. This is used every day on all tasks to ensure we understand everyday hazards and risks. It is simply a quick way of determining if a task is safe by asking a series of questions prior to commencing any task.

Stress – Causes and Effects

Stress is a normal, involuntary response to any demand made upon the body. Stress is a very complex phenomenon.

As a result, it is often very difficult to determine the causes of stress-related complaints and illnesses. Generally, there are numerous contributing factors, some of which are related to personal experience and personality, some related to social environment (home, family, money, etc.), and some related to work.

"Stress" has become a widely used and yet poorly understood term.

As a result, a number of misconceptions about stress exist. Two of the most prominent misconceptions are that:

- ***All stress is bad;***

Stress is a part of life (which is true), and there is nothing that you can do about it (which is not true)

- **Stress is caused solely and completely by environmental factors.**

Stress is very much a personal condition, and individuals vary in their ability to cope with different forms and levels of stress.

Health Hazards

Manual handling - Body stress, lifting, holding, restraining and grasping.

Strain or sprain injury claims account for over a third of all injuries for which a claim is lodged. Of these, the back is the major body location, accounting for over one-tenth of all claims registered. The next most common injury is a disease of the musculoskeletal system. Although a small part of the claim population, psychiatric or psychological injuries are the most expensive claims.

Type	**Description**
Soft Tissue Injury	Injury to muscles, tendons, or ligaments.
Strain	Overstretching of a muscle.
Sprain	Wrenching or twisting of a joint with partial rupture of joint structures (e.g., meniscus, membrane, or bursa) or other attachments (e.g. ligaments).
Dislocation	Displacement of a joint (may be with tearing of the surrounding soft tissues).
Fractures	
Partial	A fracture in which the break across the bone is incomplete.
Complete	A fracture in which the break across the bone is complete, so that the bone is broken into separate pieces.
Compound (open)	A fracture in which the broken ends of the bone protrude through the skin.
Closed	A fracture in which the bone does not break through the skin.
Contusion	Another name for a bruise. A collection of blood in a confined area, usually resulting from trauma that has ruptured blood vessels, causing blood to escape.
Disc Herniation	This refers to the situation where the jelly-like centre of the intervertebral disc protrudes outside of the fibrous outer ring.

Substances

Contact with solids, liquids, dust, gases, fumes, vapours & mists.

Ergonomics

Fatigue, design causing stress, causing errors.

Biological, Microbial substances

Bacterial, fungal, viral, parasitic.

Animal / Insects

Vicious or venomous creatures.

Human Error

It is widely recognised that human error is a causal factor in most mining accidents and incidents.

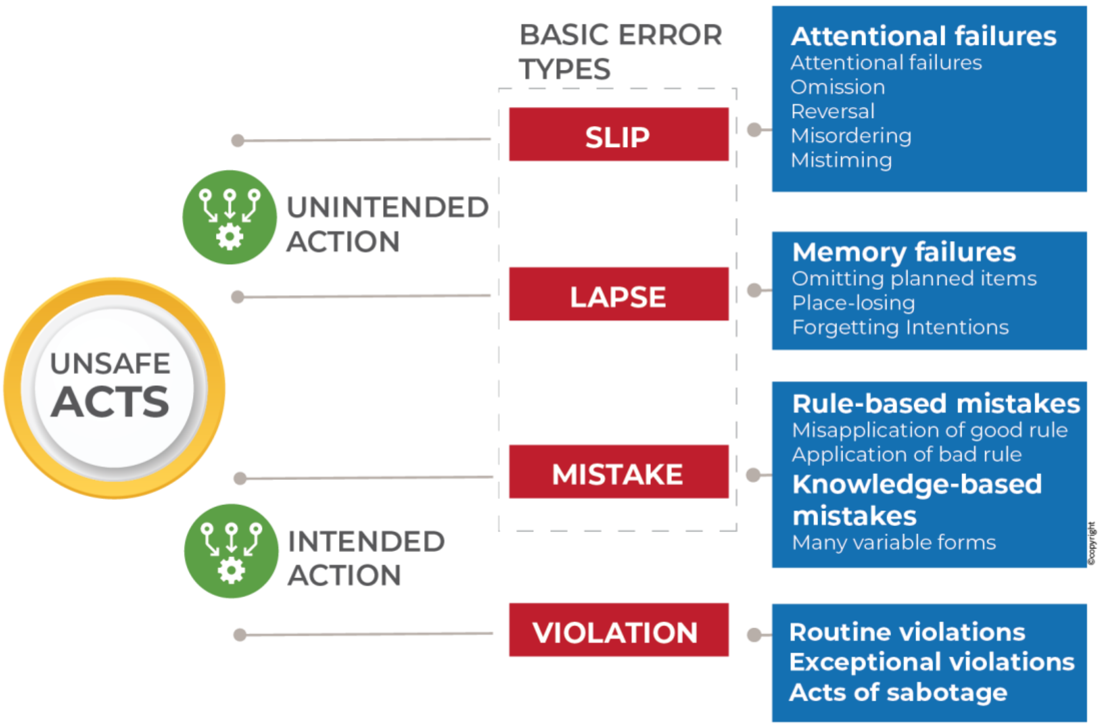
A review of the fatal accident reports and mining disaster inquiry reports indicates that human error has been identified as a causal factor in about 80% of cases.

Regardless of the actual number, the fact is that human error is a key factor in a significant proportion of mining mishaps.

Think of the last incident that you investigated that did not involve some type of human error.

The common divisions that may be observed here are:

- **Slip** – an unintentional deviation due perhaps to inattention, over-attention, or bodily fatigue.
- **Violation** – either positive (made in good faith) or negative (made for self-preservation) and can involve misapplication of rules.
- **Lack of Ability** – related to knowledge-based performance, where a lack of knowledge or skill contributed to the occurrence.
- Human error can be categorised as those events where a major contributing cause has been identified as an error of judgement or failure to perform a physical task.
- Where an investigation identified that an incorrect action or a lack of action directly contributed to an accident or incident, the human error model may be consulted to explore further why this occurred, with a view to taking corrective actions resulting from the findings.
- It is not simply a fault-blaming model because the human being is a biological machine, and the work may have been organised beyond the reasonable scope or ability of the worker.



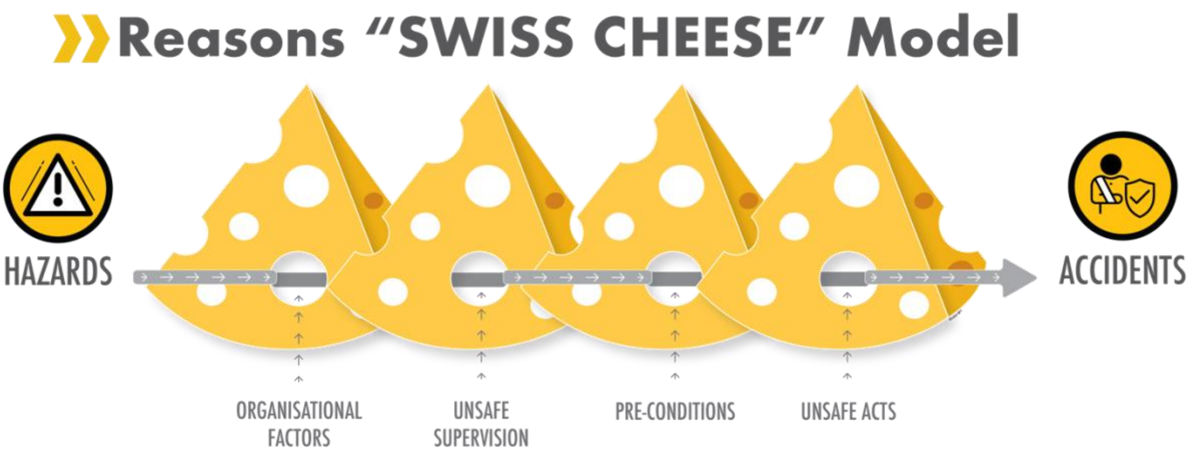
The Reason Model *(Professor James Reason)*

Reason believes that accidents in high technology industries are rarely caused exclusively by mistakes or failures by the "front-line operators".

Reason classifies system failures according to how quickly the failure becomes evident.

These are termed active or latent failures. A front-line operator typically commits an active failure. The failure's consequences are usually made known soon after the error is committed, such as a dozer operator backing over a light vehicle.

Latent failures are systemic flaws, the consequences of which may not surface until long after being introduced into the system. These dormant conditions usually result from decisions, actions or inactions of those who are far removed from the front line, such as managers or regulatory authorities.



In itself, a latent failure may not result in an accident; however, when combined with other active or latent failures, a "window of accident opportunity" may be opened.

Five Types of Hazard Defences

1. **Awareness Defences**: A knowledge of the hazards that can exist and how they are most effectively managed. E.g., Knowledge of wet ramps in open cuts.

2. **Detection Defences:** These warn of a potential energy release or loss of a control measure. E.g., Utilising roadway inspections in open cuts.

3. **Control Defences**: These limit the extent of damage immediately following the energy release either to people or equipment, allowing the system to recover. E.g., Equipment to stop in wet conditions in open cuts.

4. **Containment Defences**: These limit the extent of damage caused once the awareness, detection and control defences have failed. E.g., Barricade ramps in open cuts.

5. **Escape Defences:** To enable victims of the event to be evacuated to a place of safety and the accident site made safe. E.g., Crib rooms in open cuts.

Accidents

From approximately the beginning of mechanization in the 1950s and 60s, this culture began to change towards one of engineered safety management where an accident occurred, and corrective engineering solutions were applied to inhibit the re-occurrence of a similar event.

This culture led to such improvements as flameproof equipment, improved electrical protection, methane monitoring, and R.O.P.S. cabs.

Learning from Accident / Incident Investigation

Clapham Junction

12/12/1988

A crowded commuter train runs head-on into the rear of a stationary train outside Clapham Junction station. The impact of the collision caused the first train to veer off and strike an oncoming train. Thirty-five people died, and nearly 500 more were injured, 69 of them seriously.

Cause 1 –	There was a lack of clarity about job responsibilities and accountabilities.
Cause 2 –	Organisational restructuring failed to consider the resources needed to make the new structures work effectively.
Cause 3 –	There was a failure of management leadership and communication.
Cause 4 –	Training was inadequate.
Cause 5 –	Established safe systems of work were not followed.
Cause 6 –	There were failures to audit.
Cause 7 –	The warning signals from previous accidents were ignored.

Piper Alpha

6/7/1988

The oil rig Piper Alpha, located 100 miles off the coast of Scotland, experienced an escape of flammable gas. The gas ignited, causing an explosion, and 167 people died.

Cause 1 – There was no adequate risk assessment

Cause 2 – The permit-to-work system was inadequate

Cause 3 – The permit-to-work system was not followed

Cause 4 – There was no formal training in the permit-to-work system

Cause 5 – Auditing of the permit-to-work system was inadequate

Cause 6 – Senior managers assumed that ‘no news is good news

Cause 7 – There was a failure to act on known deficiencies

Cause 8 – The warning signals from earlier incidents were ignored…

Moura Mine Disasters

Sept 20, 1975 *Kianga Mine* – 13 killed from an explosion initiated by
spontaneous combustion. July 16, 1986. *Moura No. 4* – 12 killed from explosion
(frictional ignition or flame safety lamp.
August 7, 1994. *Moura No. 2* – 11 killed from explosion(s) initiated by spontaneous combustion.

Westray Coal Mine Disaster – Nova Scotia Canada

Pictou County, Nova Scotia

Saturday, May 9, 1992, 5.18 am **a methane gas** and subsequent coal dust explosion killed 26 miners. It was Canada's worst mining disaster since 1958.

Pike River Mine Disaster NZ

Began on 19 November 2010 in the Pike River Mine, 46 kilometres (29 mi) northeast of Greymouth, in the West Coast Region of New Zealand's South Island. A first explosion occurred in the mine at approximately 3:44 pm (NZDT, UTC+13). At the time of the explosion 31 miners and contractors were present in the mine. Two miners managed to walk from the mine; they were treated for moderate injuries and released from hospital the next day. The remaining 16 miners and 13 contractors were believed to be at least 1,500 metres (4,900 ft) from the mine's entrance.

Following a second explosion on 24 November at 2:37 pm, the 29 remaining men were believed by police to be dead. Police Superintendent Gary Knowles, officer in command of the rescue operation (Operation Pike) said he believed that "based on that explosion, no one survived. A third explosion occurred at 3:39 pm on 26 November 2010, and a fourth explosion occurred just before 2 pm on 28 November 2010.

The Pike River Mine incident ranks as New Zealand's worst mining disaster since 43 men died at Ralph's Mine in Huntly in 1914. It also resulted in the country's worst loss of life caused by a single disaster since the 1979 crash of Air New Zealand Flight 901, although this was surpassed four months later by the 2011 Christchurch earthquake.

Mine Disasters

What are the lessons to be learnt from these tragedies?

Accidents and incidents will occur, sometimes, regardless of how well you think you are managing your workplace.

The key and moral responsibility to preventing their recurrence is to find everything that contributed to them and then control or eliminate all those contributing factors.

An investigation is undertaken to find all of the contributing factors and hopefully prevent a recurrence.

A thorough investigation may uncover hazards or problems that can be eliminated or avoided in the future.

Prompt follow-up action is required to gather all the facts and prevent a recurrence.

4.5.2 Step 2 – Assess the Risk

Risk assessment is the process of assessing the level of risk associated with each identified hazard. Risk is the likelihood that death, injury or illness might result from exposure to the hazard. The objective of risk assessment is to provide a structured and systematic method for determining the level of risk. From this point, risks can be prioritised and evaluated to determine whether they are acceptable or not.

The level of risk is determined by the magnitude of the consequences and the likelihood. If the consequences of the incident are high and the likelihood of the incident occurring is high, then the risk is high. Risk analysis involves determining the consequences of the incident and the likelihood of the incident occurring and combining these two factors systematically to determine the level of risk.

Once we have determined the hazards and identified the associated risks, we need to analyse those risks to determine their level, i.e., whether they are low, medium or high risks.

Risk comprises 2 elements: **Consequence** and **Likelihood**.

The consequence is the resultant harm of the out-of-control energy if it does occur.

The likelihood is the probability of the harm occurring and the frequency with which it will occur.

You may find examples of where this could be addressed in current legislation, as in the example below.

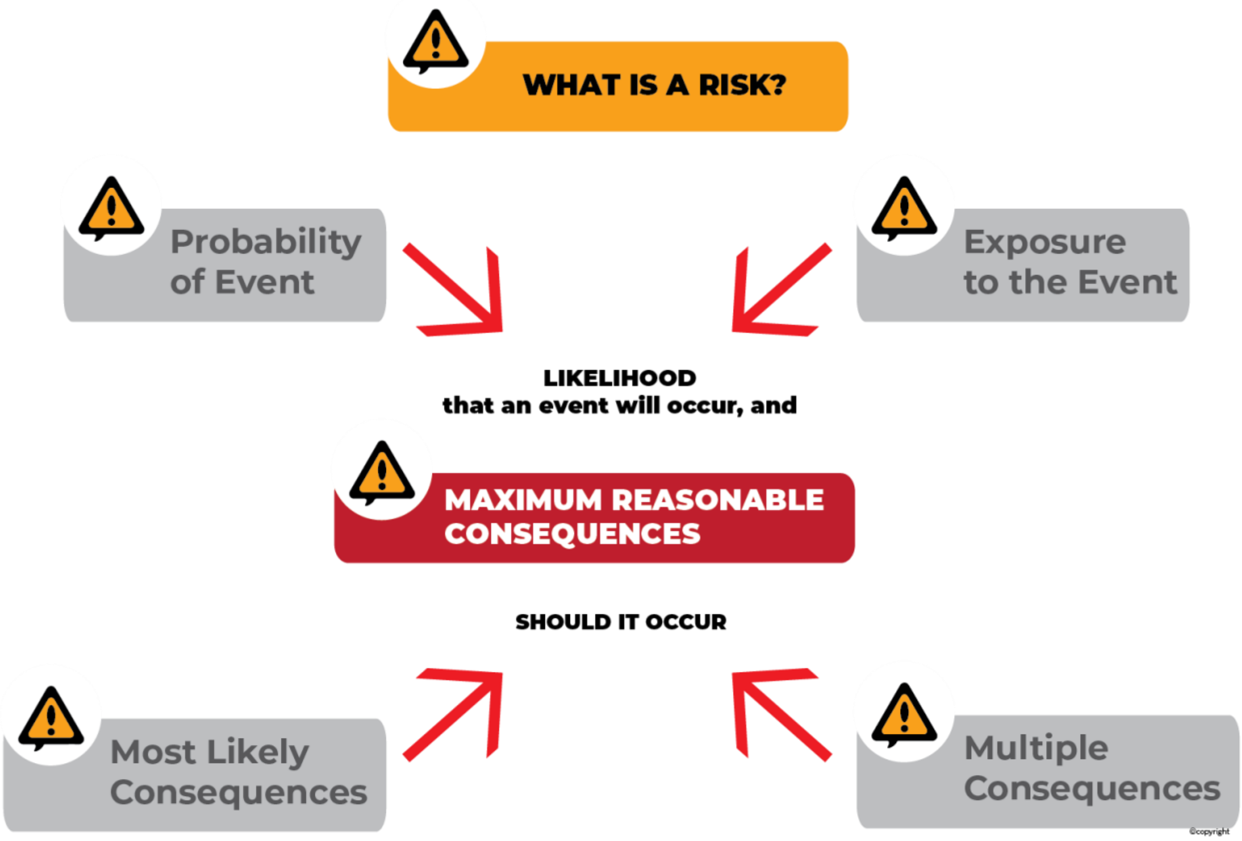
These terms are also found in ISO31000 Risk Management. We can, therefore, conclude that the Australian Standard 'recommends' and mining legislation 'requires' us to decide on the magnitude of the risk (how big) by factoring in both the chance of it occurring (likelihood or probability) and the likely level of harm sustained from exposure (severity or consequences).

If we combine these two elements, it will give us an idea of the magnitude of the risk, after which we have reasonable information with which to define the type of management approach we will use to control it. Let's explore both consequence and likelihood in more detail with a sample "Risk Assessment Tool'.

The Team Who will be involved with the risk assessment- all or some?

Step 3: Analyse risk

Before we analyse and then determine the level of risk let us first look at what constitutes a risk.



Qualitative Analysis – involving subjective assessment in word form or descriptive scales.

This is used where the risk does not justify the time and resources needed to complete numerical analysis or where numerical data is not appropriate.

This is most commonly used on mine sites when assessing daily risks.

Quantitative Analysis – uses numerical values, normally involving the use of data gathering and workplace monitoring.

This is used where measurable information can be collected.

The way in which consequences and likelihood are expressed and combined to provide a level of risk will vary according to the type of risk and the context in which the level of risk is to be used.

Step 4: Evaluate Risk

How to use a Risk Assessment Tool

Step 1

The first step in the process of finding the level of risk is to determine the consequences associated with the event occurring.

Step 2

Determine the likelihood of the consequences if the event occurs.

Step 3

Once we have determined the consequence and likelihood, we then calculate the risk on a risk matrix.

Where the two columns cross on this matrix is the calculated risk that will show whether the risk is high, moderate or low as per the smaller box on the bottom of the matrix.

There are many risk assessment tools in use in the industry.

RISK ANALYSIS MATRIX - LEVEL OF RISK

	CONSEQUENCES				
LIKELIHOOD	Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
A Almost Certain	HIGH (11)	HIGH (16)	EXTREME (20)	EXTREME (23)	EXTREME (25)
B Likely	MODERATE (6)	HIGH (12)	HIGH (17)	EXTREME (21)	EXTREME (24)
C Possible	LOW (3)	MODERATE (8)	HIGH (13)	EXTREME (18)	EXTREME (22)
D Unlikely	LOW (2)	LOW (5)	MODERATE (9)	HIGH (14)	EXTREME (19)
E Rare	LOW (1)	LOW (4)	MODERATE (7)	HIGH (10)	HIGH (15)

LEGEND:

E:	Extreme Risk;	Immediate Action Required
H:	High Risk;	Senior Management Attention Needed
M:	Moderate Risk;	Management Responsibility Must Be Specified
L:	Low Risk;	Management By Routine Procedures

MEASURES OF CONSEQUENCES

LEVEL	CATEGORY	DESCRIPTION	DAMAGE $	PROCESS
1	Insignificant	No Treatment	≤$5K	≤1 HOUR
2	Minor	First Aid Treatment	$5K - $50K	1 HOUR - 1 SHIFT
3	Moderate	Medical Treatment	$50K - $100K	1 SHIFT - 1 DAY
4	Major	Extensive Injuries	$100K - $250K	1 DAY - 1 WEEK
5	Catastrophic	Multiple Fatalities	≥$250K	≥1 WEEK

MEASURES OF LIKELIHOOD

LEVEL	CATEGORY	DESCRIPTION
A	Almost Certain	Is Expected To Occur In Most Circumstances
B	Likely	Will Probably Occur In Most Circumstances
C	Possible	Might Occur At Some Time
D	Unlikely	Could Occur At Some Time
E	Rare	May Occur Only In Exceptional Circumstances

When a risk value is made, you need to have consideration for the following:

- *How often the situation occurs*
- *How many people are involved/affected/exposed*
- *Skills and experience of those persons involved/affected/exposed*
- *Any special characteristics for those persons involved/affected/exposed*
- *Duration of the hazard*
- *The position of the hazard relative to other workers*
- *Distractions*
- *Quantities/concentrations/volumes of materials involved*
- *Environmental conditions*
- *Condition of equipment*
- *Effectiveness of existing controls*
- *Heights/weights/ forces and energies*

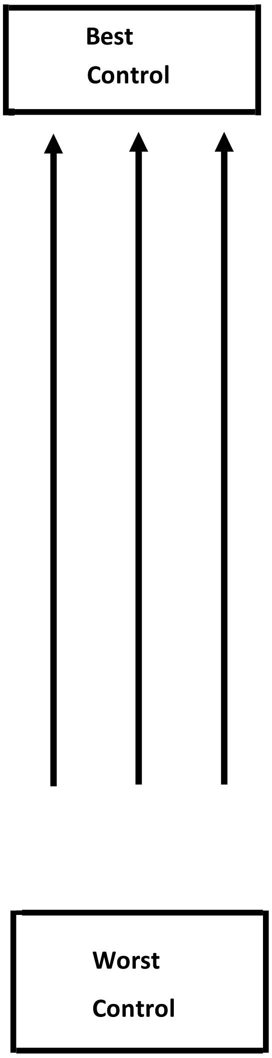
Therefore, after considering these items, a risk value may be arrived at. Remember that you are less likely to miss vital information if you 'communicate and consult' along the way. For a 'risk analysis' and consequent 'risk evaluation' to be truly representative of the workplace, it must be carried out using a team approach. Your efforts, on your own may grossly underestimate or even overestimate the risk.

Step 5: Treat Risk

Decide on Control Measures

If a risk is determined to be unacceptable then the risk needs to be treated according to the prioritised lists of risks based on the level of risk assessed.

Treatment options can be identified by working through the control hierarchy. Treatment options at the top of the hierarchy are most effective in reducing the risk.



1. Remove the hazard completely
- e.g. remove risk of electrocution by using compressed air tools.

2. Substitute the hazard for one with less risk
- e.g. use water based glue rather than solvent based glue

3. Isolate the hazard
- e.g. replacing a machine with better guarding
- e.g. extraction fans to remove hazardous fumes
- e.g. Install screens or barriers around hazardous areas

4. Use an engineered control
- e.g. use a machine to lift heavy objects
- e.g. use scaffolding rather than ladders to reduce risks of falls.

5. Administrative controls
- e.g. train persons in lifting techniques or hazardous substances
- e.g. place warning signs
- e.g. rotating workers performing work in hazardous area

6. Personal Protective Equipment (PPE)
- e.g. hearing protection, eye protection, respiratory protection

Note PPE should be the last barrier to protect people when all else fails.

In most cases a number of control measures will need to be implemented to manage the risk. These measures may consist of short-term and long-term strategies. For example, in the short-term personal protective equipment and awareness training may be used to reduce the risk. Longer-term strategies might include redesign of equipment or processes, or purchase of new, less hazardous equipment or materials.

When looking at treatment options, we use the "Hierarchy of Control" method to determine the most effective means of control. This model is illustrated in figure below.

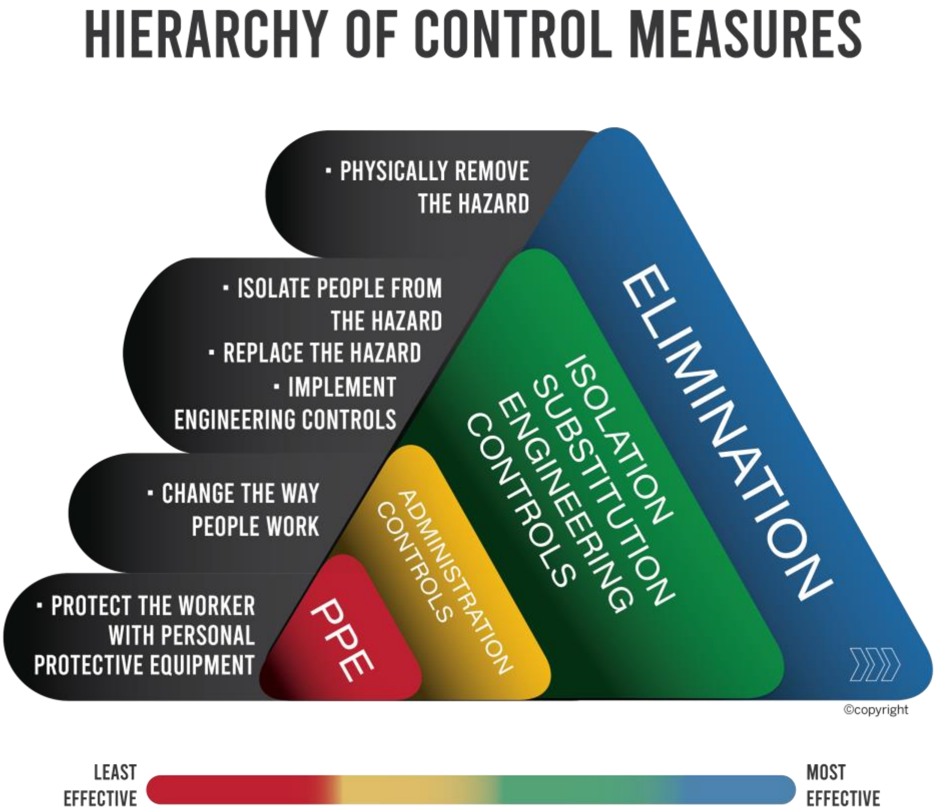


Figure 11: Hierarchy of control

Hierarchy of Control

A series of questions is asked, starting from the most effective treatment of a risk, which is elimination, and working down the triangle to the least effective, which is personal protective equipment. These questions are:

Elimination - Is it possible to re-design the project or task to eliminate the risk?

Substitution - Is it possible to substitute materials, equipment or process with less hazardous ones?

Engineering/Isolation/Separation - Is it possible to provide physical, engineered barriers to isolate the hazard from people?

Administration/Training - Are there policies, standards and standard working procedures in place to minimise the risk?

Personal Protective Equipment (PPE) - Should PPE be used as additional protection?

Critical Control Management

The risk management process should also consider critical control management (CCM) as a way of providing additional governance over prioritised risks.

To further understand concepts relating to critical controls, it is important to understand key definitions as outlined by the ***ICMM Health and Safety Critical Control Management Good Practice Guide,*** *a readily available free document.*

Critical Controls: A control that is critical to preventing the event or mitigating the consequences of the event. The absence or failure of a critical control would significantly increase the risk despite the existence of the other controls.
In addition, a control that prevents more than one unwanted event or mitigates more than one consequence is normally classified as critical.

Critical Control Management (CCM): A process of managing the risk of material unwanted events that involves a systemic approach to ensure critical controls are in place and effective.

Material Unwanted Event:
An unwanted event where the potential or real consequence exceeds a threshold defined by the company as warranting the highest level of attention (e.g., a high-level health or safety impact).

Object:
In relation to a control, is a material thing that can be seen and touched. It is a thing used to control or divert hazardous energy and/or materials.

Each mine should determine a criterion to define the threshold a risk must exceed before critical controls are required to be identified. Generally, these risks should be identified, and the criteria applied at the Layer 1 – Mine Baseline / Broad Brush risk assessment.

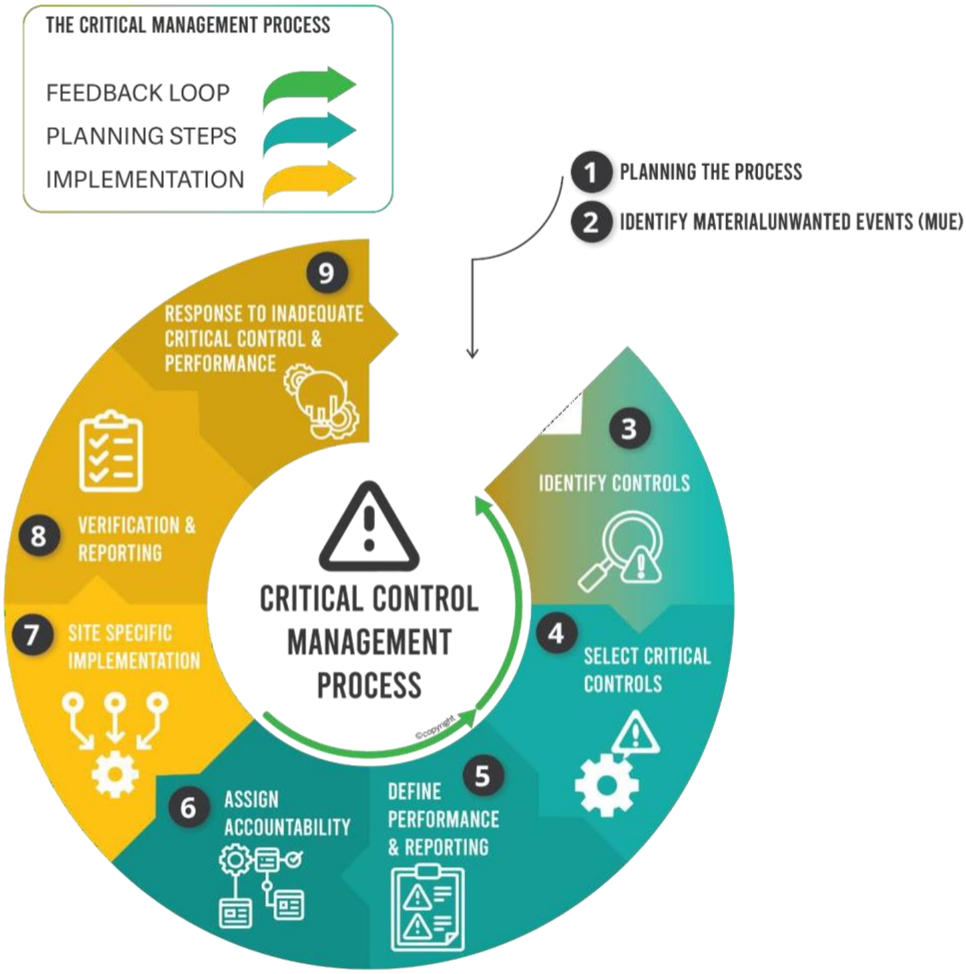
A decision tree is recognised as an appropriate way to identify critical controls.

In addition, a process for identifying the critical controls and methods for monitoring critical control implementation and effectiveness should be established by the SSE.

Critical controls must be supported by performance requirements that detail:

- The objective of the critical control, which defines what it is meant to do
- How the critical control is going to act to achieve the objective
- What needs to be verified and checked to confirm the critical control is working
- The performance threshold that triggers immediate action to shut down or change operation or improve control performance.

Critical control management (CCM) consists of nine steps, six of which are required to plan the CCM program before implementing them in the last three steps. The *ICMM Health and Safety Critical Control Management Good Practice Guide* discusses the steps in more detail.



CRITICAL CONTROL MANAGEMENT STEPS AND TARGET OUTCOMES

	STEP	TARGET OUTCOME
PLANNING STEPS	1	A plan that describes the scope of the project, including what to be done by whom and the timescales.
	2	Identify MUEs that need to be managed.
	3	Identify controls for MUEs, both existing controls and possible new controls. Prepare a bowtie diagram.
	4	Identify the critical controls for the MUE.
	5	Define the critical controls objectives, performance requirements and how performance is verified in practice.
	6	A list of the owners for each MUE, critical control and verification activity. A verification and reporting plan is required to verify and report on the health of each control.
IMPLEMENTATION	7	Defined MUE verification and reporting plans, and an implementation strategy based on site - specific requirements.
	8	Implement verification activities and report on the process. Define and report the status of each critical control.
	9	Critical control and MUE owners are aware of critical controls performance. If critical controls are under performing or following an incident, investigate and take action to improve performance or remove critical status from controls.

Problem Solving

As risk assessments are a consultative team-based task there will be times when there are problems or conflicting views throughout the risk management process.

A supervisor may need to take a facilitator's role to help problem-solve to determine what is reasonably practicable.

This may include needing to understand the true nature of the problem before leading the team through analysing different options using objective criteria, company policies, and industry information to resolve any problems.

Consider the following;

- ✓ Understand the problem from both sides
- ✓ Are the organisational risk matrix and descriptors being used correctly
- ✓ Refer to legislation requirements for specific hazards
- ✓ Review safety alerts or bulletins that may outline more specific controls
- ✓ Look at past injury statistics
- ✓ Having a detailed risk matrix that has clear descriptors may be also useful to work through problems.
- ✓ Using quantifiable data
- ✓ Using a risk facilitator to objectively guide the team through the process may also be of use. Ensure the facilitator has relevant site authorization to assist in this process.

Step 6: Implement Control Measures

Once a decision has been made on which control measures are the most effective, steps need to be taken to implement these control measures. Activities that might need to be conducted to ensure effective implementation include:

- ***Developing work procedures***
  Work procedures relating to the new control measures may need to be developed. Alternatively, current work procedures may need to be reviewed to ensure that they cover the process with the new control measure in place.
- ***Communicate with workers about implementation***
  Workers and other people affected by the changes should be informed of the changes and the reasons for the changes.
- ***Provide training and instruction to workers***
  Training and instruction needs relating to the changes should be identified, and training conducted.
- ***Supervise and enforce control measures***
  Once the training has been completed, it is important to check that the new control measures are being implemented as required and enforce where required.
- ***Record the process***
  Records of implementation of the risk management process must be kept.
- ***Set out the maintenance***
  Consideration should be given to work procedures relating not only to operation, but also to the maintenance requirements of the control measures to be introduced.
- ***Consultation***
  Consultation between workers, supervisors and managers will allow feedback on the implementation of the measures and any new problems which may have been introduced.

When selecting a risk treatment / control the following should be considered.

Identify treatment options - Remember the aim is to try to eliminate or reduce the likelihood and consequences that make up the risk.

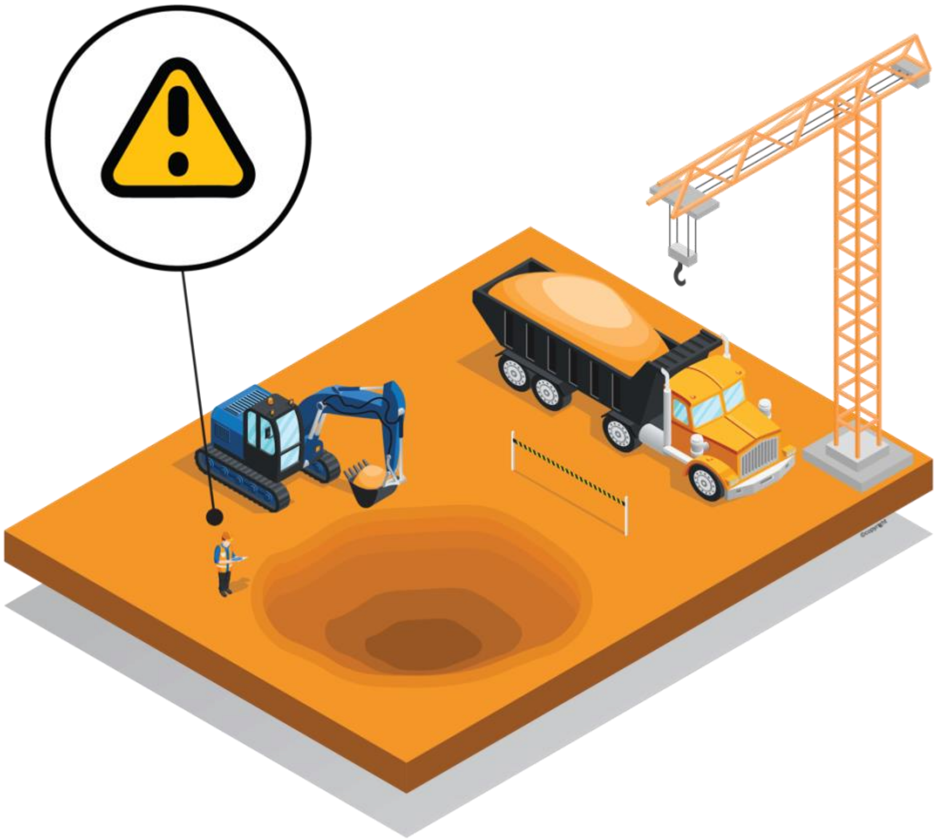
Evaluate treatment options - Consider the feasibility of the treatment in terms of ‘cost’ and ‘benefits’ before recommending the ‘fix’. Select the strategy for the implementation of the fix based on the “hierarchy of control” model. The size of the plan and who is involved in the decision-making process depends on the level of risk and the cost of implementation of the fix.

Prepare treatment plans - Plans should be aimed at the elimination or control of the risk based on the chosen options and strategy.

Implement plan - Once the plan is implemented, there should be a reduction in the likelihood and consequences of the event occurring. Remember that it is not always possible to reduce the likelihood, but we can put controls in place to reduce the consequences. In making judgments about the effectiveness of the controls relative to the nature of each identified hazard and its consequences, other questions to ask are:

- What types of controls are provided?
- Are they of adequate technical standards and quality?
- Are there enough of them?
- Does the combination of controls follow a precedence order to match the nature of the hazard?
- Are the controls maintained in working order at all times?
- What contingencies are provided to support and are a back up to the controls?

Remember - controls such as elimination, substitution, design and isolation are stronger and more effective than human oriented controls like education, procedures and administration.



Post implementation – Monitor and Review

The final step in the risk management process is the continual monitoring and review of risks. Areas that should be considered are:

- Have control measures been implemented as planned?
- Are the control measures being used and used correctly?
- Have the implemented control measures been effective in reducing the risk?
- Have the control measures introduced any new problems - new hazards or risks; operational, production or maintenance problems?

A regular review process should be put in place to ensure the process is still valid, and things have not changed.

Monitoring the risks, the effectiveness of the controls and the management system is an essential but often neglected component of risk management. The effectiveness of the control measures and other 'brewing' risks need to be monitored to ensure changing circumstances do not alter your priorities. Few risks ever remain the same.

By conducting an ongoing review, your management plans will remain relevant. Work factors may affect the consequences or likelihood of your risks, as may the cost or suitability of various control options. Therefore, it is necessary to repeatedly implement the risk management cycle.

The evaluation and review process can occur informally/incidentally, or it can be conducted in a formalised way with the implementation of audits and inspections. Both have their place in risk management, and both require the use of observation and feedback. Observation skills and giving constructive and timely feedback are critical to the success of this process.

The use of these activities and skills will be regulated or restricted by:

- Company expectations
- Workplace culture expectations
- Resource expectations
- Procedural expectations
- Behavioural expectations.

For example, if auditing has been used for some time in the organisation, further audits focussing on risk management are unlikely to be viewed upon with suspicion or indifference. They may be 'embraced' by the company's personnel, and personnel at all levels may be interested in hearing about the results.
Observation techniques may take a variety of formats:

- Indirect sampling, for example, visual observation with no worker communication
- Direct sampling, for example, short interviews are conducted with selected personnel
- Individually conducted
- Team-based observations

- Scheduled
- Unscheduled
- Continuous, for example, where an observation is required at the commencement of the implementation of a new work procedure
- Localised (i.e. by section or generalised).

Feedback is necessary in any system where work requires assessment and possible correction. Early feedback is important with any new process, both for the worker and for management who will then know whether or not the instructions and procedure are accurately received and carried out. Feedback can take many forms:

- Positive, highlighting the aspects done well
- Negative, only highlighting those performed incorrectly
- Immediate
- Delayed, where it is given some time after the event (often not proving to be timely and effective)
- Formal, for example in a report
- Informal, for example in a casual conversation
- Closed, where only a limited number of people are involved
- Carry connotations of discipline issues.

Disenchanted site workers may not be willing to assist with future review processes if they think that their assistance and opinions will not be taken seriously and appropriately actioned. Feedback to them is therefore crucial. Any of these types of feedback may have a bearing on the future success of risk management initiatives, since they are likely to ignite human behavioural responses. The responses may mirror the company's requirement or may totally ignore it.

Consider this:
The wrong (ineffective) feedback which is also poorly timed can help to stall months of effort that has gone into developing risk management initiatives.

Therefore, a combination of the optimal observation technique for your organisation coupled with the provision of the most suitable feedback is likely to increase your chance of maintaining and /or changing human behaviour to the required performance.

Example of an industry Safety Interaction used by Supervisors.

SAFETY INTERACTION

What does a Safety Interaction do?
Safety Interactions are a tool for leaders to encourage and develop safe behaviours.

What is a Safety interaction?
- A safety interaction is a face to face discussion between peers doing work or their leader about safe behaviours.
- A safety interaction is an opportunity to check and coach people in identifying hazards.
- A safety interaction should result in a commitment to improve less safe behaviours and reinforce positive safety behaviours.

SAFETY INTERACTION

PLAN / PREPARE
- What Activities?
- What Preparation? (E.g. Review standard procedure)
- Who with?
- Have some messages expectations and safer habits that you want to reinforce.

OBSERVE
- Use all senses
- Look above, below, behind, and at the work activity as well as the work process.
- Look for safer as well less safe behaviours.

DISCUSS
- Introduce yourself
- Comment on safer behaviours
- Discuss (using mostly open-ended questions)
- Consequences of less safe behaviours
- Safer ways to do the work
- Gain commitment to work safer
- Discuss other safety issue
- Thank the person

REVIEW / DEBRIEF
- Self reflect or debrief with co-auditor
- Coach you teams' leaders and receive feedback
- Review what went well and what could be improved next time

RECORD
- Actions agreed and key safer and less safe behaviours noted and analysed

FOLLOW UP
- Recognise employees' behaviour improvements on the job
- Ensure work groups use data for improvement
- Ensure key actions are carried out

1.THE RISK ASSSESSMENT REVIEW	
1.1 Is there a description of the operation or equipment being assessed	YES/NO
1.2 Is there a description of the mine and physical environment where the activity is to take place	YES/NO
1.3 Does it state the presence of significant hazards in relation to the task that have already been identified in mining operations that have previously operated or are continuing to operate	YES/NO
1.4 Is there a list of the people involved in the risk identification step	YES/NO
1.5 Has the technique adopted to identify hazards been identified	YES/NO
1.6 Is there an adequately detailed outline of the approach used to identify the risks?	YES/NO
1.7 Is there an outline of the method used for assessing the likelihood and consequences of the risks?	YES/NO
1.8 Are there lists of identified risks, ranked by: a) Likelihood of assessed risk occurring, and a) Consequence magnitude	YES/NO
1.9 Has risk assessment been signed by all personnel taking part in the process	YES/NO
1.10 Is there a list of the main actions to be taken to reduce risks and to manage risks?	YES/NO
1.11 Is there a timetable for review?	YES/NO
2. THE PROCESS USED	
2.1 The range of expertise of the team involved in the risk assessment	YES/NO
2.2 The appropriateness of the degree of detail of the risk assessment	YES/NO
2.3 The identification of the key risk scenarios to be addressed	YES/NO
2.4 The method for assessing likelihood and consequences	YES/NO

4.5 Benefits of Risk Management

The benefits of applying risk management are:

- Improved performance in key areas of Health, Safety and Environmental Damage, Asset Loss/Damage, Production disruption and Legal Liability.
- A more structured basis for planning and decision-making.
- Improved ability for identifying opportunities and grasping the benefits that flow from those opportunities.
- Identification of the key risks associated with particular activities.
- A means of demonstrating duty of care and effective Corporate Governance.
- Greater openness and transparency of decision-making.
- Improved visibility of the ongoing management process.
- Improved delivery of product or service.
- Enhanced emergency and contingency planning.
- Reduction in insurance premiums for the organisation.
- Better documentation of risks and acceptable strategies for dealing with those risks.
- Enhanced "corporate memory".
- Traveller safety.

5.0 Risk Assessment Tools

Risk assessment tools enable us to make a more informed decision on the inherent risks we face in the work environment.

It can be argued that no single tool is the 'ultimate' answer to accurately assessing the level of risk in any situation.

Rather, it is up to each workplace to decide on which tool to use and then present the findings to management so that controls may be put in place.

A summary of the risk assessment tools is provided below with an overview of the common team-based risk assessments provided.

Risk Management Tool	People	Facilitator	Purpose
SLAM – Behavioural Management System	Individuals	Every person at the mine site	To provide individuals with a simple tool to assess and manage everyday hazards encountered during shift
Observation Form	Individuals	Any person inducted at the mine site	To systematically enable the identification of hazards that require risk treatment before starting a task
Audits	Group or individual	Experience in auditing	Monthly auditing, 6 monthly audits form part of risk management approach.
JSA	Individual or Group involvement	Individuals, Supervisors with minimum Apply Risk Management Process or MNC C6	To provide a structured means to reduce a task to a stepped approach and then identifying potential hazards and recommending suitable controls to manage risk to an acceptable level
Workplace Risk Assessment and Control (WRAC) .	Group involvement	Mine Site or External Facilitator with minimum MNC G1002A Implement and Apply the Risk Management Process	Provides a method of identifying hazards and existing controls and quantifying the risk using the risk control matrix before recommending suitable additional controls for the development of Standard Operating Procedures
Incident Cause Analysis Method (ICAM) or Fault tree analysis	Group involvement	Mine Site or External Facilitator with ICAM training or experience in Fault Tree analysis	A systematic approach to analyse, understand and display the logical structure of events that lead to a specific unwanted incident
Hazard Operability Study (HazOp)	Group involvement	Mine Site or External Facilitator with appropriate experience.	The study of a design, equipment or process to identify abnormal circumstances or problems that could occur and may result in serious consequences or operational issues. Recommended tool for complex equipment, modifications and major contract processes before they occur.

Job Safety Analysis (JSA) / Workplace Risk Assessment & Control (WRAC)

Two valuable and important management tools to prevent accidents and to improve health conditions are the technique known as Job Safety Analysis JSA or (JSEA/JHA/WMS) and a WRAC (Workplace Risk Assessment and Control). They aim to prevent accidents and losses by identifying and controlling potential loss-producing situations. Job Safety Analysis studies a job in order to develop the safest, most efficient work method. A JSA will review job methods, reveal hazards and redesign the job process to eliminate those hazards.

The WRAC lends itself to the analysis of a problem where many variables exist, but each may be analysed separately whilst still contributing to the solution. Examples may include the analysis of newly purchased equipment, changes to the mine's ventilation or the construction of a new roadway. A WRAC does not study the tasks within a job but the elements that comprise the integration of people and machinery, materials and the environment. When your organisation has a requirement to plan a job using a risk management approach, a Job Safety Analysis is a useful tool to employ. A summary of this is presented below.

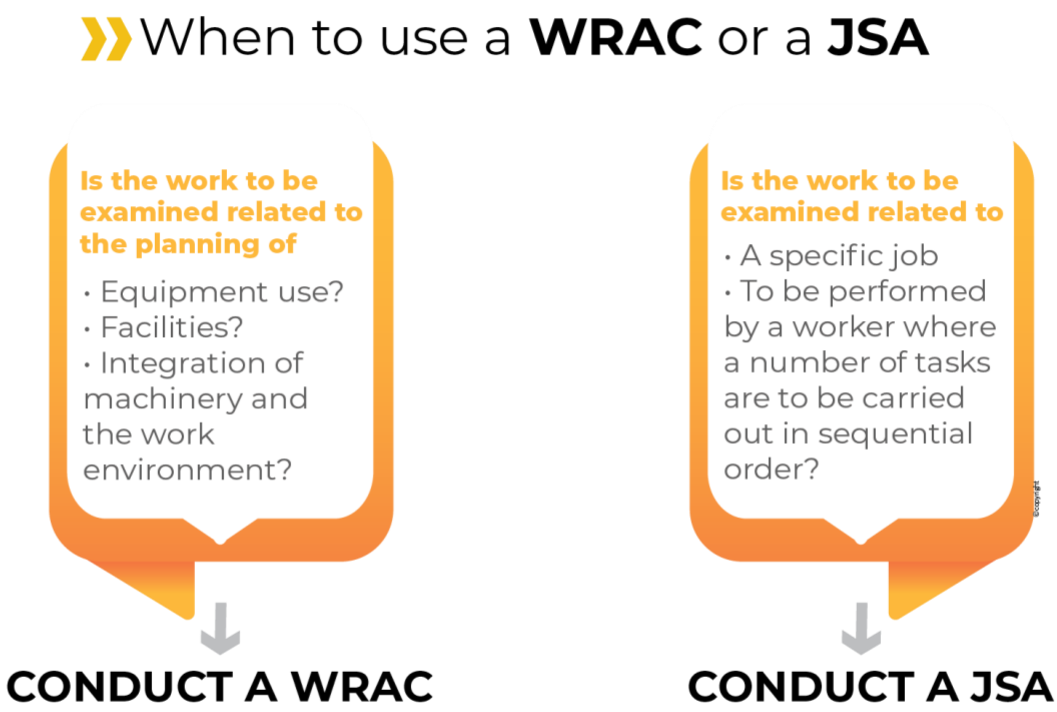


Figure: When to use a WRAC or a Job Safety Analysis

A relatively common method of presentation of the identified hazards, determined risk levels and the required controls within the mining industry is the WRAC (Workplace Risk Assessment and Control), discussed at length in the Department of Mineral Resources (NSW) publication *Risk Management Handbook for the Mining Industry MDG1010*. The method utilizes the risk management approach in presenting an overview of the problem using a risk management approach (and hence format). A 'snapshot' of a sample template is presented here below. The WRAC lends itself to analysing a problem where many variables exist, but each may be analysed separately whilst still contributing to the solution. Examples may include the analysis of newly purchased equipment, changes to the mine's ventilation or the construction of a new roadway.

WORKPLACE RISK ASSESSMENT AND CONTROL – WRAC

The below identifies common contents of a WRAC and a possible layout for different elements.

1. Title showing risk assessment and facilitator details
2. Purpose
3. Objective
4. Scope
5. Background information
6. Methodology
7. Risk assessment team and reviews
8. Determination of consequence/probability/risk ranking
9. Hazard identification, risk analysis, controls identification and review
10. List of all hazards ranked according to assessed risk
11. Control implementation plan
12. Training and communication
13. Non consensus matters
14. Approval (Management sign off)

Hazard identification, risk analysis, and controls identification:

TASK STEP What are the Steps in the Activity?	HAZARD What could hurt me or others?	Current Controls	Current Risk			Recommended Additional Controls	Residual Risk			Acceptable Level of Risk (Yes /No)
			C	L	R		C	L	R	

Risk Control Implementation Planning:

Item	*Action required to implement control*	*Responsibility*	*Due Date*
1.			
2.			

Training:

Training requirement	*Who needs the training*	*Responsibility*	*Due Date*
1.			
2.			

Job safety analysis (JSA)

A JSA is based on the following:

- Any job or task can be separated into a series of relatively simple steps.
- Potential hazards or risks associated with each step are identified and evaluated.
- Solutions can be developed to control and eliminate these potential hazards.

Effective job training is an easy way to prevent accidents/injury, particularly in the critical jobs or tasks where there are obvious risks or where workers have been hurt. Carefully thought-out training by a trained instructor can guide worker skill development in the safest way to do each job.

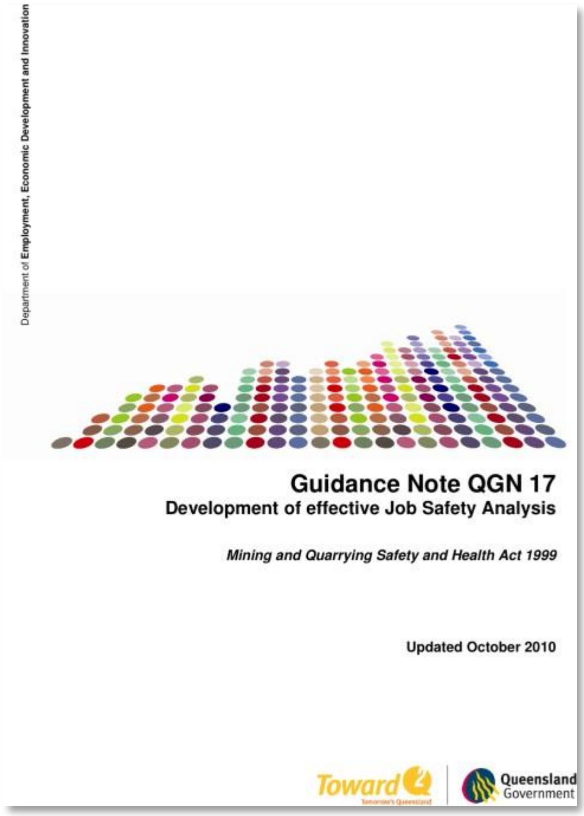
Job/tasks analysis aims to take positive steps to reduce accidents through identifying and acting on potential accident causes before accidents and injuries occur. Safe work procedures prepared from job safety analysis information become basic guides for worker skill training.

Some of the advantages of a Job Safety Analysis are:

- Development of safe work procedures for skill training.
- Safe work procedures can be used to induct new site workers to safe, efficient work procedures.
- Maintains a higher level of safety awareness, which usually results in fewer accidents.
- Use as safety standards to develop refresher training programs and retrain reassigned site workers.
- Assists supervisors maintain a high level of safety awareness during day-to-day workforce contact.
- Assists supervisors and employees to make observations to ensure safe work procedures are being followed.
- Provides uniform safety instructions and procedures for each critical job.
- Review and elimination of outmoded procedures or equipment.
- Involves the people who carry out the tasks in the development of safe work procedures.

The technique for the development of Job Safety Analysis could be summarised into the following steps:

1. Select the job or task to be analysed.
2. Separate the job into its basic steps.
3. Identify all the hazards/potential losses associated with each step.
4. Evaluate your options for hazard/loss control action.
5. Establish controls for each hazard or other potential loss area.
6. Prepare a safe work procedure.



Step 1 – Task Selection

Identify critical jobs, prepare an inventory and set priorities for analysis.

- Inform people who are involved with the process what you are doing and why.
- Encourage site workers to contribute safety improvement ideas.
- Where possible use the people who normally carry out the task.

Step 2 – Separation into Steps

Separate the selected tasks into 5-15 basic steps and record each step on a JOB. Each "Step" or activity listed should briefly describe what is being done but not how to do the operation.

- Usually use 3-4 words for each job step.
- Show the activity or verb/action work first and complete the description by naming the item that is acted upon.
- Ensure no important steps are missed, but there are no more than are actually needed to accurately describe the work. Any job can be separated into steps regardless of its complexity.

Step 3 – Hazard Identification

Examine each step to identify any hazards or other potential accident loss sources. We include hazards associated with:

- Machine
- Tools
- Supplies
- Worker actions or lack of action
- Job Procedures
- Overall Work Environment

Use the broad questioning approach of "What would happen if?" in relation to each job step to identify potential hazards to the worker or fellow site workers.

The terms/concepts listed can be applied, where relevant, to each basic step to make hazard identification easier to job/task analysis recording.

Step 4 – Evaluate Hazard Controls

Develop suitable control solutions designed to eliminate, or if this is not feasible, to adequately control these hazards.

For every known hazard associated with a job step, there must be a solution that offsets that hazard. The control hierarchy should be consulted here. This should be considered using option types in sequence from eliminating the hazard, substitution, engineering controls, administrative controls (procedures, etc) and finally, PPE.

Step 5 – Establish Controls

At this stage, a neat, permanent record of the job analysis must be completed. There must be a clearly defined procedure for eliminating hazards or loss potential that is exposed by analysis. The completed job analysis will clearly indicate what must now be done to eliminate or otherwise control all the identified hazards or risks. Control measures must be put into action without delay so that preparation of standard job procedures can then proceed.

Step 6 – Safe Work Procedures

A safe work procedure is prepared from:

- Steps outlined on the job analysis sheet.
- Hazards identified and not eliminated.
- Recommended personal protective equipment (include a list of equipment or other safety devices required).
- Any special safety devices are recommended.

A format for a safe work procedure will be discussed shortly. Note that there is no need to include that part of a job analysis that indicated hazards that have been subsequently eliminated by the remedial action in Step 5.

A Job Safety Analysis (JSA) is a very important investigation technique and proactive safety management tool. It is usually prepared by the people performing the task and is prepared by:

– Determining the critical job to be analysed.
– Breaking the job down into a logical sequence of steps.
– Determining the potential for incidents.
– Making an efficiency check on each job step.
– Developing recommended controls.
– Writing the analysis.

This information is then compiled into a task list, after which a JSA can be started. Considerations when identifying tasks that are added to the critical list include:

- high-risk jobs associated with accident history
- jobs where site workers are exposed to excessive amounts of energy or hazardous materials
- new jobs, or those requiring the use of new or modified equipment or machinery
- jobs with the potential to cause heavy losses if a stoppage or an accident occurs.

Some examples of organizational JSA's (JSEA/JHA/SWMS) are reproduced herein or on the next few pages *(note that we do not verify the correctness or accuracy of any of these, though. They are shown as illustrative purposes as how the industry is currently producing these documents).*

Job Safety Analysis Video

A video, 'Developing an effective Job Safety Analysis' distributed at the 2010 mining conference, was developed to support Queensland Guidance Note QGN 17 'Development of effective Job Safety Analysis'.

The Department has provided the video as:
https://www.youtube.com/watch?v=U5p1GdnzEHg&list=PLl2B0uqgoj86WGHKvWV8gZLD-6Eh0mooA

Other tools –

Fault tree analysis

Fault tree analysis (FTA) is a failure analysis in which an undesired state of a system is analysed using Boolean logic to combine a series of lower-level events. This analysis method is mainly used in the field of safety engineering to quantitatively determine the probability of a safety hazard.

History
Fault Tree Analysis (FTA) was originally developed in 1962 at Bell Laboratories by H.A. Watson, under a U.S. Air Force Ballistics Systems Division contract to evaluate the Minuteman I Intercontinental Ballistic Missile (ICBM) Launch Control System. Following the first published use of FTA in the 1962 Minuteman I Launch Control Safety Study, Boeing and AVCO expanded use of FTA to the entire Minuteman II system in 1963-1964. FTA received extensive coverage at a 1965 System Safety Symposium in Seattle sponsored by Boeing and the University of Washington. Boeing began using FTA for civil aircraft design around 1966. In 1970, the U.S. Federal Aviation Administration (FAA) published a change to 14 CFR 25.1309 airworthiness regulations for transport aircraft in the Federal Register at 35 FR 5665 (1970-04-08). This change adopted failure probability criteria for aircraft systems and equipment and led to widespread use of FTA in civil aviation.

Within the nuclear power industry, the U.S. Nuclear Regulatory Commission began using probabilistic risk assessment (PRA) methods including FTA in 1975, and significantly expanded PRA research following the 1979 incident at Three Mile Island. This eventually led to the 1981 publication of the NRC Fault Tree Handbook NUREG–0492, and mandatory use of PRA under the NRC's regulatory authority.

Fault Tree Analysis (FTA) attempts to model and analyse failure processes of engineering and biological systems. FTA is basically composed of logic diagrams that display the state of the system and is constructed using graphical design techniques. Originally, engineers were responsible for the development of Fault Tree Analysis, as a deep knowledge of the system under analysis is required.

Often, FTA is defined as another part, or technique, of reliability engineering. Although both model the same major aspect, they have arisen from two different perspectives. Reliability engineering was, for the most part, developed by mathematicians, while FTA, as stated above, was developed by engineers.

Fault Tree Analysis usually involves events from hardware wear out, material failure or malfunctions or combinations of deterministic contributions to the event stemming from assigning a hardware/system failure rate to branches or cut sets. Typically, failure rates are carefully derived from substantiated historical data such as mean time between failure of the components, unit, subsystem or function. Predictor data may be assigned. Assigning a software failure rate is elusive and not possible. Since software is a vital contributor and inclusive of the system operation it is assumed, the software will function normally as intended. There is no such thing as a software fault tree unless considered in the system context. Software is an instruction set to the hardware or overall system for correct operation. Since basic software events do not fail in the physical sense, attempting to predict manifestation of software faults or coding errors with any reliability or accuracy is impossible, unless assumptions are made. Predicting and assigning human error rates is not the primary intent of a fault tree analysis, but may be attempted to gain some knowledge of what happens with improper human input or intervention at the wrong time.

FTA can be used as a valuable design tool, can identify potential accidents, and can eliminate costly design changes. It can also be used as a diagnostic tool, predicting the most likely system failure in a system breakdown. FTA is used in safety engineering and in all major fields of engineering.

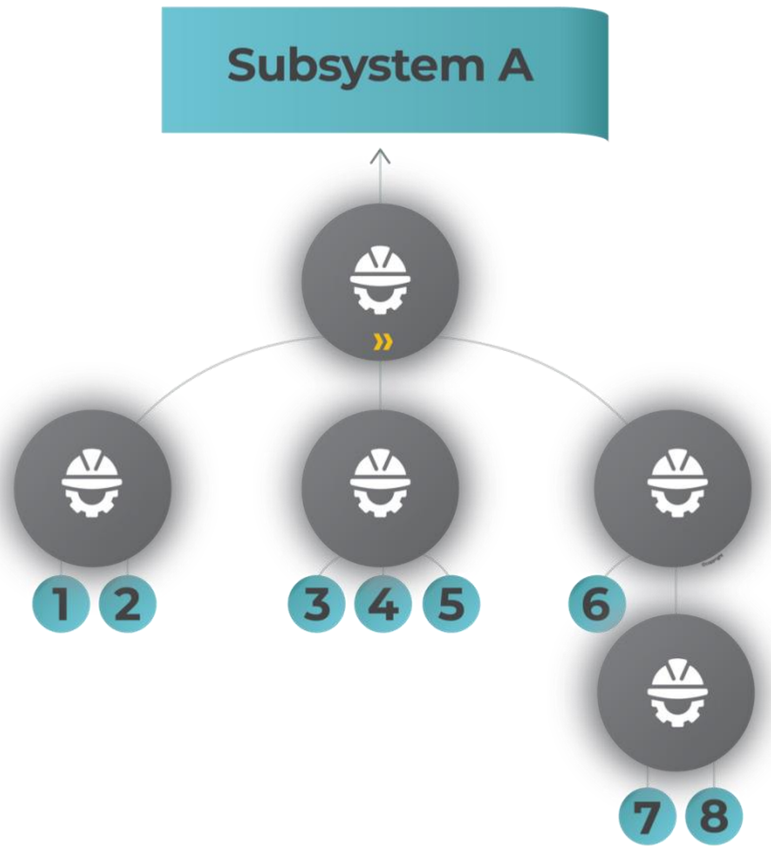
Methodology

FTA methodology is described in several industry and government standards, including NRC NUREG–0492 for the nuclear power industry, an aerospace-oriented revision to NUREG–0492 for use by NASA, SAE ARP4761 for civil aerospace, MIL–HDBK–338 for military systems for military systems. IEC standard IEC 61025 is intended for cross-industry use and has been adopted as European Norme EN 61025.

Since no system is perfect, dealing with a subsystem fault is a necessity, and any working system eventually will have a fault in some place. However, the probability for a complete or partial success is greater than the probability of a complete failure or partial failure. Assembling an FTA is thus not as tedious as assembling a success tree which can turn out to be very time consuming.

Because assembling an FTA can be a costly and cumbersome experience, the perfect method is to consider subsystems. In this way dealing with smaller systems can assure less error work probability, less system analysis. Afterward, the subsystems integrate to form the well analysed big system.

An undesired effect is taken as the root ('top event') of a tree of logic. There should be only one Top Event and all concerns must tree down from it. Then, each situation that could cause that effect is added to the tree as a series of logic expressions. When fault trees are labelled with actual numbers about failure probabilities (which are often in practice unavailable because of the expense of testing), computer programs can calculate failure probabilities from fault trees.



A fault tree diagram

The Tree is usually written out using conventional logic gate symbols. The route through a tree between an event and an initiator in the tree is called a Cut Set. The shortest credible way through the tree from fault to initiating event is called a Minimal Cut Set.

Some industries use both Fault Trees and Event Trees (see Probabilistic Risk Assessment). An Event Tree starts from an undesired initiator (loss of critical supply, component failure etc.) and follows possible further system events through to a series of final consequences. As each new event is considered, a new node on the tree is added with a split of probabilities of taking either branch. The probabilities of a range of 'top events' arising from the initial event can then be seen.

Classic programs include the Electric Power Research Institute's (EPRI) CAFTA software, which is used by many of the US nuclear power plants and by a majority of US and international aerospace manufacturers, and the Idaho National Laboratory's SAPHIRE, which is used by the U.S. Government to evaluate the safety and reliability of nuclear reactors, the Space Shuttle, and the International Space Station. Outside the US, the software Risk Spectrum is a popular tool for Fault Tree and Event Tree analysis and is licensed for use at almost half of the world's nuclear power plants for Probabilistic Safety Assessment.

Analysis

Many different approaches can be used to model an FTA, but the most common and popular way can be summarized in a few steps. Remember that a fault tree is used to analyse a single fault event and that one and only one event can be analysed during a single fault tree. Even though the "fault" may vary dramatically, a FTA follows the same procedure for an event, be it a delay of 0.25 msec for the generation of electrical power, or the random, unintended launch of an ICBM.

FTA involves five steps:

1. Define the undesired event to study.
    - Definition of the undesired event can be very hard to catch, although some of the events are very easy and obvious to observe. An engineer with a wide knowledge of the design of the system or a system analyst with an engineering background is the best person who can help define and number the undesired events. Undesired events are used then to make the FTA, one event for one FTA; no two events will be used to make one FTA.

2. Obtain an understanding of the system.
    - Once the undesired event is selected, all causes with probabilities of affecting the undesired event of 0 or more are studied and analysed. Getting exact numbers for the probabilities leading to the event is usually impossible for the reason that it may be very costly and time-consuming to do so. Computer software is used to study probabilities; this may lead to less costly system analysis.
    - System analysts can help with understanding the overall system. System designers have full knowledge of the system and this knowledge is very important for not missing any cause affecting the undesired event. For the selected event all causes are then numbered and sequenced in the order of occurrence and then are used for the next step which is drawing or constructing the fault tree.

3. Construct the fault tree
    - After selecting the undesired event and having analysed the system so that we know all the causing effects (and if possible, their probabilities) we can now construct the fault tree. Fault tree is based on AND and OR gates which define the major characteristics of the fault tree.

4. Evaluate the fault tree
    - After the fault tree has been assembled for a specific undesired event, it is evaluated and analysed for any possible improvement or in other words study the risk management and find ways for system improvement. This step is as an introduction for the final step which will be to control the hazards identified. In short, in this step we identify all possible hazards affecting in a direct or indirect way the system.

5. Control the hazards identified
    - This step is very specific and differs largely from one system to another, but the main point will always be that after identifying the hazards all possible methods are pursued to decrease the probability of occurrence.

Comparison with other analytical methods

FTA is a deductive, top-down method aimed at analysing the effects of initiating faults and events on a complex system. This contrasts with failure mode and effects analysis (FMEA), which is an inductive, bottom-up analysis method aimed at analysing the effects of single component or function failures on equipment or sub-systems. FTA is very good at showing how resistant a system is to single or multiple initiating faults. It is not good at finding all possible initiating faults. FMEA is good at exhaustively cataloguing initiating faults, and identifying their local effects. It is not good at examining multiple failures or their effects at a system level. FTA considers external events, FMEA does not.[14] In civil aerospace the usual practice is to perform both FTA and FMEA, with a failure mode effects summary (FMES) as the interface between FMEA and FTA.

Alternatives to FTA include dependence diagram (DD), also known as reliability block diagram (RBD) and Markov analysis. A dependence diagram is equivalent to a success tree analysis (STA), the logical inverse of an FTA, and depicts the system using paths instead of gates. DD and STA produce probability of success (i.e., avoiding a top event) rather than probability of a top event.

Failure mode, effects, and criticality analysis

Failure mode, effects, and criticality analysis (FMECA) is an extension of failure mode and effects analysis (FMEA). FMEA is a bottom-up, inductive analytical method which may be performed at either the functional or piece-part level. FMECA extends FMEA by including a *criticality analysis*, which is used to chart the probability of failure modes against the severity of their consequences. The result highlights failure modes with relatively high probability and severity of consequences, allowing remedial effort to be directed where it will produce the greatest value. FMECA tends to be preferred over FMEA in space and North Atlantic Treaty Organization (NATO) military applications, while various forms of FMEA predominate in other industries.

History

FMECA was originally developed in the 1940's by the U.S military, which published MIL–P–1629 in 1949. By the early 1960's, contractors for the U.S. National Aeronautics and Space Administration (NASA) were using variations of FMECA under a variety of names. In 1966 NASA released its FMECA procedure for use on the Apollo program. FMECA was subsequently used on other NASA programs including Viking, Voyager, Magellan, and Galileo. Possibly because MIL–P–1629 was replaced by MIL–STD–1629 (SHIPS) in 1974, development of FMECA is sometimes incorrectly attributed to NASA. At the same time as the space program developments, use of FMEA and FMECA was already spreading to civil aviation. In 1967 the Society for Automotive Engineers released the first civil publication to address FMECA. The civil aviation industry now tends to use a combination of FMEA and Fault Tree Analysis in accordance with SAE ARP4761 instead of FMECA, though some helicopter manufacturers continue to use FMECA for civil rotorcraft.

Ford Motor Company began using FMEA in the 1970's after problems experienced with its Pinto model, and by the 1980's FMEA was gaining broad use in the automotive industry. In Europe, the International Electrotechnical Commission published IEC 812 (now IEC 60812) in 1985, addressing both FMEA and FMECA for general use. The British Standards Institute published BS 5760–5 in

1991 for the same purpose.

In 1980, MIL–STD–1629A replaced both MIL–STD–1629 and the 1977 aeronautical FMECA standard MIL–STD– 2070. MIL–STD–1629A was cancelled without replacement in 1998, but nonetheless remains in wide use for military and space applications today.[11]

Methodology

Slight differences are found between the various FMECA standards. By RAC CRTA–FMECA, the FMECA analysis procedure typically consists of the following logical steps:

- Define the system
- Define ground rules and assumptions in order to help drive the design
- Construct system block diagrams
- Identify failure modes (piece part level or functional)
- Analyse failure effects/causes
- Feed results back into design process
- Classify the failure effects by severity
- Perform criticality calculations
- Rank failure mode criticality
- Determine critical items
- Feed results back into design process
- Identify the means of failure detection, isolation and compensation
- Perform maintainability analysis
- Document the analysis, summarize uncorrectable design areas, identify special controls necessary to reduce failure risk
- Make recommendations
- Follow up on corrective action implementation/effectiveness

FMECA may be performed at the functional or piece part level. Functional FMECA considers the effects of failure at the functional block level, such as a power supply or an amplifier. Piece part FMECA considers the effects of individual component failures, such as resistors, transistors, microcircuits, or valves. A piece part FMECA requires far more effort, but is sometimes preferred because it relies more on quantitative data and less an engineering judgment than a functional FMECA.

The criticality analysis may be quantitative or qualitative, depending on the availability of supporting part failure data.

System definition

In this step, the major system to be analysed is defined and partitioned into an indentured hierarchy such as systems, subsystems or equipment, units or subassemblies, and piece parts. Functional descriptions are created for the systems and allocated to the subsystems, covering all operational modes and mission phases.

Ground rules and assumptions

Before detailed analysis takes place, ground rules and assumptions are usually defined and agreed to. This might include, for example:

- Standardized mission profile with specific fixed duration mission phases
- Sources for failure rate and failure mode data
- Fault detection coverage that system built-in test will realize
- Whether the analysis will be functional or piece part
- Criteria to be considered (mission abort, safety, maintenance, etc.)
- System for uniquely identifying parts or functions
- Severity category definitions

Block diagrams

Next, the systems and subsystems are depicted in functional block diagrams. Reliability block diagrams or fault trees are usually constructed at the same time. These diagrams are used to trace information flow at different levels of system hierarchy, identify critical paths and interfaces, and identify the higher-level effects of lower level failures.

Failure mode identification

For each piece part or each function covered by the analysis, a complete list of failure modes is developed. For functional FMECA, typical failure modes include:

- Untimely operation
- Failure to operate when required
- Loss of output
- Intermittent output
- Erroneous output (given the current condition)
- Invalid output (for any condition)

For piece part FMECA, failure mode data may be obtained from databases such as RAC FMD–91 or RAC FMD–

97. These databases provide not only the failure modes but also the failure mode ratios. For example:

Device Failure Modes and Failure Mode Ratios (FMD–91)		
Device Type	**Failure Mode**	**Ratio (α)**
Relay	Fails to trip	.55
	Spurious trip	.26
	Short	.19
Resistor, Composition	Parameter change	.66
	Open	.31
	Short	.93

Each function or piece part is then listed in matrix form with one row for each failure mode. Because FMECA usually involves very large data sets, a unique identifier must be assigned to each item (function or piece part), and to each failure mode of each item.

Failure effects analysis

Failure effects are determined and entered for each row of the FMECA matrix, considering the criteria identified in the ground rules. Effects are separately described for the local, next higher, and end (system) levels. System level effects may include:

- System failure
- Degraded operation
- System status failure
- No immediate effect

The failure effect categories used at various hierarchical levels are tailored by the analyst using engineering judgment.

Severity classification

Severity classification is assigned for each failure mode of each unique item and entered on the FMECA matrix, based upon system level consequences. A small set of classifications, usually having 3 to 10 severity levels, is used. For example, when prepared using MIL–STD–1629A, failure or mishap severity classification normally follows MIL–STD–882.

Mishap Severity Categories (MIL–STD–882)		
Category	**Description**	**Criteria**
I	Catastrophic	Could result in death, permanent total disability, loss exceeding $1M, or irreversible severe environmental damage that violates law or regulation.
II	Critical	Could result in permanent partial disability, injuries or occupational illness that may result in hospitalization of at least three personnel, loss exceeding $200K but less than $1M, or reversible environmental damage causing a violation of law or regulation.
III	Marginal	Could result in injury or occupational illness resulting in one or more lost work days(s), loss exceeding $10K but less than $200K, or mitigatable environmental damage without violation of law or regulation where restoration activities can be accomplished.
IV	Negligible	Could result in injury or illness not resulting in a lost work day, loss exceeding $2K but less than $10K, or minimal environmental damage not violating law or regulation.

Current FMECA severity categories for U.S. Federal Aviation Administration (FAA), NASA and European Space Agency space applications are derived from MIL–STD–882.

Failure detection methods

For each component and failure mode, the ability of the system to detect and report the failure in question is analysed. One of the following will be entered on each row of the FMECA matrix:

- *Normal*: the system correctly indicates a safe condition to the crew
- *Abnormal*: the system correctly indicates a malfunction requiring crew action
- *Incorrect*: the system erroneously indicates a safe condition in the event of a malfunction or alerts the crew to a malfunction that does not exist (false alarm)

Criticality ranking

Failure mode criticality assessment may be qualitative or quantitative. For qualitative assessment, a mishap probability code or number is assigned and entered on the matrix. For example, MIL–STD–882 uses five probability levels:

Failure Probability Levels (MIL–STD–882)			
Description	**Level**	**Individual Item**	**Fleet**
Frequent	A	Likely to occur in the life of the item	Continuously experienced
Probable	B	Will occur several times in the life of an item	Will occur frequently
Occasional	C	Likely to occur sometime in the life of an item	Will occur several times
Remote	D	Unlikely but possible to occur in the life of an item	Unlikely, but can reasonably be expected to occur
Improbable	E	So unlikely, it can be assumed occurrence may not be experienced	Unlikely to occur, but possible

The failure mode may then be charted on a criticality matrix using severity code as one axis and probability level code as the other. For quantitative assessment, *modal criticality number* C_m is calculated for each failure mode of each item, and *item criticality number* C_r is calculated for each item. The criticality numbers are computed using the following values:

- Basic failure rate λp
- Failure mode ratio α
- Conditional probability β
- Mission phase duration t

The criticality numbers are computed as $C_m = \lambda p \alpha \beta t$ and

$$C_r = \sum_{n=1}^{N} (C_m)_n$$

The basic failure rate λp is usually fed into the FMECA from a failure rate prediction based on MIL–HDBK–217, PRISM, RIAC 217Plus, or a similar model. The failure mode ratio may be taken from a database source such as RAC FMD–97. For functional-level FMECA, engineering judgment may be required to assign a failure mode ratio. The conditional probability number β represents the conditional probability that the failure effect will result in the identified severity classification, given that the failure mode occurs. It represents the analyst's best judgment as to the likelihood that the loss will occur. For graphical analysis, a criticality matrix may be charted using either C_m or C_r on one axis and severity code on the other.

Critical item/failure mode list

Once the criticality assessment is completed for each failure mode of each item, the FMECA matrix may be sorted by severity and qualitative probability level or quantitative criticality number. This enables the analysis to identify critical items and critical failure modes for which design mitigation is desired.

Recommendations

After performing FMECA, recommendations are made to design to reduce the consequences of critical failures. This may include selecting components with higher reliability, reducing the stress level at which a critical item operates, or adding redundancy or monitoring to the system.

Maintainability analysis

FMECA usually feeds into both Maintainability Analysis and Logistics Support Analysis, which both require data from the FMECA.

FMECA report

A FMECA report consists of system description, ground rules and assumptions, conclusions and recommendations, corrective actions to be tracked, and the attached FMECA matrix which may be in spreadsheet, worksheet, or database form.

Risk priority calculation

RAC CRTA–FMECA and MIL–HDBK–338 both identify Risk Priority Number (RPN) calculation is an alternate method to criticality analysis. The RPN is a result of a multiplication of detectability (D) x severity (S) x occurrence (O). Each on a scale from 1 to 10. The highest RPN is 10x10x10 = 1000. This means that this failure is not detectable by inspection, very severe and the occurrence is almost sure. If the occurrence is very sparse, this would be 1 and the RPN would decrease to 100. So, criticality analysis enables to focus on the highest risks.

Advantages and disadvantages

Strengths of FMECA include its comprehensiveness, the systematic establishment of relationships between failure causes and effects, and its ability to point out individual failure modes for corrective action in design. Weaknesses include the extensive labour required, the large number of trivial cases considered, and inability to deal with multiple-failure scenarios or unplanned cross-system effects such as sneak circuits.

According to an FAA research report for commercial space transportation,

Failure Modes, effects, and Criticality Analysis is an excellent hazard analysis and risk assessment tool, but it suffers from other limitations. This alternative does not consider combined failures or typically include software and human interaction considerations. It also usually provides an optimistic estimate of reliability. Therefore, FMECA should be used in conjunction with other analytical tools when developing reliability estimates.[18]

Hazard and operability study

A **hazard and operability study** (HAZOP) is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent risks to personnel or equipment, or prevent efficient operation. The HAZOP technique was initially developed to analyse chemical process systems, but has later been extended to other types of systems and also to complex operations and to software systems. A HAZOP is a qualitative technique based on guide-words and is carried out by a multi- disciplinary team (HAZOP team) during a set of meetings.

Method Outline

The method applies to processes (existing or planned) for which design information is available. This commonly includes a process flow diagram, which is examined in small sections, such as individual equipment items or pipes between them. For each of these, a design *Intention* is specified. For example, in a chemical plant, a pipe may have the intention to transport 2.3 kg/s of 96% sulfuric acid at 20°C and a pressure of 2 bar from a pump to a heat exchanger. The intention of the heat exchanger may be to heat 2.3 kg/s of 96% sulfuric acid from 20°C to 80 °C. The Hazop team then determines what are the possible significant *Deviations* from each intention, feasible *Causes* and likely *Consequences*. It can then be decided whether existing, designed safeguards are sufficient, or whether additional actions are necessary to reduce risk to an acceptable level.

When Hazop meetings were recorded by hand they were generally scheduled for three to four hours per day. For a medium-sized chemical plant where the total number of items to be considered is 1200 (items of equipment and pipes or other transfers between them) about 40 such meetings would be needed.

The development of recording on computers with live projected display of the worksheet has facilitated HAZOP sessions of six hours per day.

Parameters and guide words

The key feature is to select appropriate **parameters** which apply to the design intention. These are general words such as Flow, Temperature, Pressure, and Composition. In the above example, it can be seen that variations in these parameters could constitute Deviations from the design Intention. In order to identify Deviations, the Study Leader applies (systematically, in order) a set of **Guide Words** to each parameter for each section of the process. The current standard[2] Guide Words are as follows:

Guide Word	Meaning
NO OR NOT	Complete negation of the design intent
MORE	Quantitative increase
LESS	Quantitative decrease
AS WELL AS	Qualitative modification/increase
PART OF	Qualitative modification/decrease
REVERSE	Logical opposite of the design intent
OTHER THAN	Complete substitution
EARLY	Relative to the clock time
LATE	Relative to the clock time
BEFORE	Relating to order or sequence
AFTER	Relating to order or sequence

(Note that the last four guide words are applied to batch or sequential operations.) These are therefore combined e.g., NO FLOW, MORE TEMPERATURE, and if the combination is meaningful, it is a potential deviation. In this case LESS COMPOSITION would suggest less than 96% sulfuric acid, whereas OTHER THAN COMPOSITION would suggest something else such as oil.

The following table gives an overview of commonly used guide word-parameter pairs and common interpretations of them.

Parameter /Guide Word	**More**	**Less**	**None**	**Reverse**	**As well as**	**Part of**	**Other than**
Flow	high flow	low flow	no flow	reverse flow	Deviating concentration	contamination	Deviatin material
Pressure	high pressure	low pressure	vacuum		delta-p		explosion
Temperature	high temperature	low temperature					
Level	high level	low level	no level		different level		
Time	too long / too late	too short/ too soon	sequence step skipped	backwards	Missing actions	extra actions	wrong time
Agitation	fast mixing	slow mixing	no mixing				
Reaction	Fast reaction /runaway	slow reaction	no reaction				Unwanted reaction
Start-up/ Shut-down	too fast	too slow			Actions missed		wrong recipe
Draining/ Venting	too long	too short	none		Deviating pressure	wrong timing	
Inertising	high pressure	low pressure	none			contamination	Wrong material
Utility failure (Instrument air, power)			failure				
DCS failure			failure				
Maintenance			none				
Vibrations	too low	too high	none				Wrong frequency

Once the causes and effects of any potential hazards have been established, the system being studied can then be modified to improve its safety. The modified design must then be subject to another Hazop, to ensure that no new problems have been added.

Team

Hazop is normally carried out by a team of people with roles as follows (with alternative names from other sources):

Name	Alternative	Role
Study leader	Chairman	someone experienced in Hazop but not directly involved in the design, to ensure that the method is followed carefully
Recorder	Secretary or scribe	to ensure that problems are documented and recommendations passed on
Designer	(or representative of the team which has designed the process)	To explain any design details or provide further information
User	(or representative of those who will use it)	To consider it in use and question its operability, and the effect of deviations
Specialist	(or specialists)	someone with relevant technical knowledge
Maintainer	(if appropriate)	someone concerned with maintenance of the process.

In earlier publications it was suggested that the Study Leader could also be the Recorder, but separate roles are now generally recommended. A minimum team size of 5 is recommended. In a large process there will be many Hazop meetings, and the team may change as specialists are brought in for different areas, and possibly different members of the design team, but the Study Leader and Recorder will usually be fixed. As many as 20 individuals may be involved but is recommended that no more than 8 are involved at any one time. Software is now available from several suppliers to aid the Study Leader and the Recorder.

History

The technique originated in the Heavy Organic Chemicals Division of ICI, which was then a major British and international chemical company. The history has been described by Trevor Kletz who was the company's safety advisor from 1968 to 1982, from which the following is abstracted.

In 1963 a team of 3 people met for 3 days a week for 4 months to study the design of a new Phenol plant. They started with a technique called *critical examination* which asked for alternatives, but changed this to look for **deviations**. The method was further refined within the company, under the name *operability studies*, and became the third stage of its hazard analysis procedure (the first two being done at the conceptual and specification stages) when the first detailed design was produced.

In 1974 a one-week safety course including this procedure was offered by the Institution of Chemical Engineers (IChemE) at Teesside Polytechnic. Coming shortly after the Flixborough disaster, the course was fully booked, as were ones in the next few years. In the same year the first paper in the open literature was also published. In 1977 the Chemical Industries Association published a guide. Up to this time the term **Hazop** had not been used in formal publications. The first to do this was Kletz in 1983, with what were essentially the course notes (revised and updated) from the IChemE courses. By this time, hazard and operability studies had become an expected part of chemical engineering degree courses in the UK.

Reliability-Centred Maintenance - RCM

Reliability-Centred Maintenance, often known as *RCM*, is a process to ensure that assets continue to do what their users require in their present operating context.[1]

It is generally used to achieve improvements in fields such as the establishment of safe minimum levels of maintenance, changes to operating procedures and strategies and the establishment of capital maintenance regimes and plans. Successful implementation of RCM will lead to increase in cost effectiveness, machine uptime, and a greater understanding of the level of risk that the organization is presently managing.

The late John Moubray, in his industry leading book RCM2 [2], characterized Reliability-centred Maintenance as a process to establish the safe minimum levels of maintenance. This description echoed statements in the Nowlan and Heap report from United Airlines.

It is defined by the technical standard SAE JA1011 [3], Evaluation Criteria for RCM Processes, which sets out the minimum criteria that any process should meet before it can be called RCM. This starts with the 7 questions below, worked through in the order that they are listed:

1. What is the item supposed to do and its associated performance standards?
2. In what ways can it fail to provide the required functions?
3. What are the events that cause each failure?
4. What happens when each failure occurs?
5. In what way does each failure matter?
6. What systematic task can be performed proactively to prevent, or to diminish to a satisfactory degree, the consequences of the failure?
7. What must be done if a suitable preventive task cannot be found?

Reliability-centred maintenance is an engineering framework that enables the definition of a complete maintenance regime. It regards maintenance as the means to maintain the functions a user may require of machinery in a defined operating context.

As a discipline, it enables machinery stakeholders to monitor, assess, predict and generally understand the working of their physical assets.

This is embodied in the initial part of the RCM process, which is to identify the operating context of the machinery and write a Failure Mode Effects and Criticality Analysis (FMECA).

The second part of the analysis is to apply the "RCM logic", which helps determine the appropriate maintenance tasks for the identified failure modes in the FMECA. Once the logic is complete for all elements in the FMECA, the resulting list of maintenance is "packaged", so that the periodicities of the tasks are rationalised to be called up in work packages; it is important not to destroy the applicability of maintenance in this phase.

Lastly, RCM is kept live throughout the "in-service" life of machinery, where the effectiveness of the maintenance is kept under constant review and adjusted in light of the experience gained.

Reliability Centred Maintenance can be used to create a cost-effective maintenance strategy to address dominant causes of equipment failure. It is a systematic approach to defining a routine maintenance program composed of cost-effective tasks that preserve important functions.

The important functions (of a piece of equipment) to preserve with routine maintenance are identified, their dominant failure modes and causes determined and the consequences of failure ascertained. Levels of criticality are assigned to the consequences of failure. Some functions are not critical and are left to "run to failure" while other functions must be preserved at all cost. Maintenance tasks are selected that address the dominant failure causes. This process directly addresses maintenance preventable failures. Failures caused by unlikely events, non-predictable acts of nature, etc. will usually receive no action provided their risk (combination of severity and frequency) is trivial (or at least tolerable). When the risk of such failures is very high, RCM encourages (and sometimes mandates) the user to consider changing something which will reduce the risk to a tolerable level.

The result is a maintenance program that focuses scarce economic resources on those items that would cause the most disruption if they were to fail.

RCM emphasizes the use of Predictive maintenance (PdM) techniques in addition to traditional preventive measures.

Historical background

The term Reliability-Centred Maintenance (RCM) was first used in public papers authored by Tom Matteson, Stanley Nowlan, Howard Heap, and other senior executives and engineers at United Airlines (UAL) to describe a process used to determine the optimum maintenance requirements for aircraft. Having left United Airlines to pursue a consulting career a few months before the publication of the final Nowlan-Heap report, Matteson received no authorial credit for the work. However, his contributions were substantial and perhaps indispensable to the document as a whole. The US Department of Defence (DOD) sponsored the authoring of both a textbook (by UAL) and an evaluation report (by Rand Corporation) on Reliability-Centred Maintenance, both published in 1978. They brought RCM concepts to the attention of a wider audience. The text book described efforts by commercial airlines and the US Navy in the 1960s and 70s to improve the reliability of their new jet the Boeing 747.

The first generation of jet aircraft had a crash rate that would be considered highly alarming today, and both the Federal Aviation Administration (FAA) and the airlines' senior management felt strong pressure to improve matters. In the early 1960s, with FAA approval the airlines began to conduct a series of intensive engineering studies on in-service aircraft. The studies proved that the fundamental assumption of design engineers and maintenance planners—that every airplane and every major component in the airplane (such as its engines) had a specific "lifetime" of reliable service, after which it had to be replaced (or overhauled) in order to prevent failures—was wrong in nearly every specific example in a complex modern jet airliner.

This was one of many astounding discoveries that have revolutionized the managerial discipline of physical asset management and have been at the base of many developments since this seminal work was published. Among some of the paradigm shifts inspired by RCM were:

- an understanding that the vast majority of failures are not necessarily linked to the age of the asset (this is often modelled by the "memoryless" exponential probability distribution).
- changing from efforts to predict life expectancies to trying to manage the process of failure.
- an understanding of the difference between the requirements of an assets from a user

perspective, and the design reliability of the asset.
- an understanding of the importance of managing assets on condition (often referred to as condition monitoring, condition-based maintenance and predictive maintenance).
- an understanding of four basic routine maintenance tasks.
- linking levels of tolerable risk to maintenance strategy development.

Today RCM is defined in the standard SAE JA1011, Evaluation Criteria for Reliability-Centred Maintenance (RCM) Processes. This sets out the minimum criteria for what is, and for what is not, able to be defined as RCM.

The standard is a watershed event in the ongoing evolution of the discipline of physical asset management. Prior to the development of the standard many processes were labelled as RCM even though they were not true to the intentions and the principles in the original report that defined the term publicly.

Today companies can use this standard to ensure that the processes, services and software they purchase and implement conforms with what is defined as RCM, ensuring the best possibility of achieving the many benefits attributable to rigorous application of RCM.

Basic Features

The RCM process described in the DOD/UAL report recognized three principal risks from equipment failures:

Threats:

- to safety,
- to operations, and
- to the maintenance budget.

Modern RCM gives threats to the environment a separate classification, though most forms manage them in the same way as threats to safety.

RCM offers four principal options among the risk management strategies:

- on-condition maintenance tasks,
- scheduled restoration or discard maintenance tasks,
- failure-finding maintenance tasks, and
- one-time changes to the "system" (changes to hardware design, to operations, or to other things).

RCM also offers specific criteria to use when selecting a risk management strategy for a system that presents a specific risk when it fails. Some are technical in nature (can the proposed task detect the condition it needs to detect? does the equipment actually wear out, with use?). Others are goal-oriented (is it reasonably likely that the proposed task-and-task-frequency will reduce the risk to a tolerable level?). The criteria are often presented in the form of a decision-logic diagram, though this is not intrinsic to the nature of the process.

In use

After being created by the commercial aviation industry, RCM was adopted by the U.S. military (beginning in the mid-1970s) and by the U.S. commercial nuclear power industry (in the 1980s). It began to enter other commercial industries and fields in the early 1990s.

It is probably clear from the account of RCM's basic features that it is a highly complex analytic process.[*citation*] Starting in the late 1980s, a series of independent initiatives sprang up that were intended to reduce the process's complexity without reducing its benefits. A partial list of these initiatives would include:

- "RCM 2", Aladon
- "RCM Blitz" RCM Blitz
- "Streamlined" RCM,
- "PM Optimization," or PMO PM Optimisation,
- Naval Sea Systems Command "Classic RCM" and "Backfit RCM". Outlined in references below. Backfit RCM is used as a continuous process improvement process tool to evaluate existing maintenance tasks.

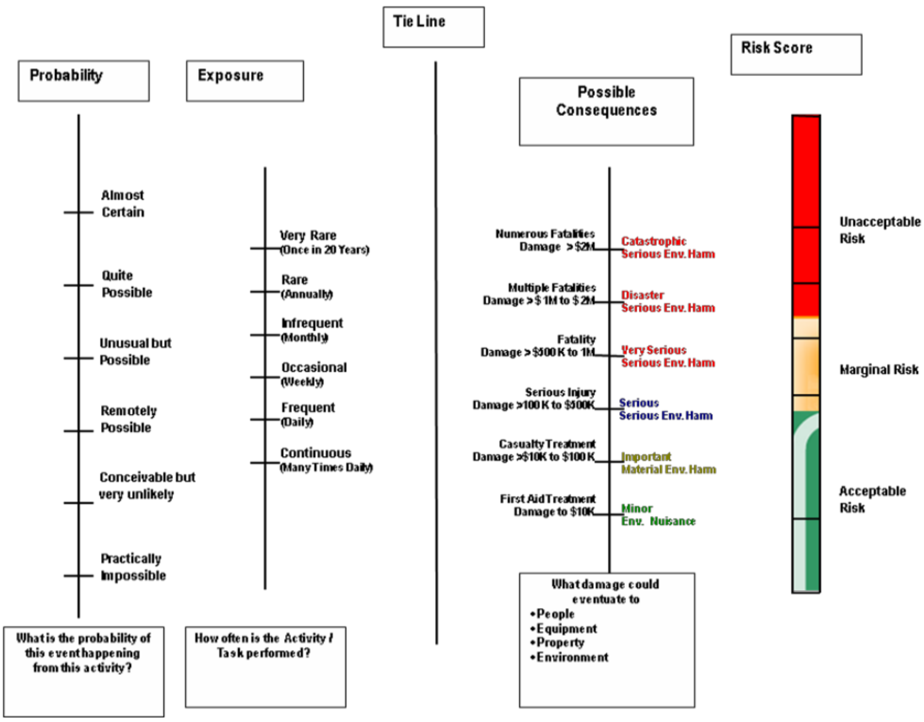
Since each initiative is sponsored by one or more consulting firms eager to help clients use it, there is still considerable disagreement about their relative merits (and dangers). Also, there is a tendency for consulting firms to promote a software package as an alternative methodology.

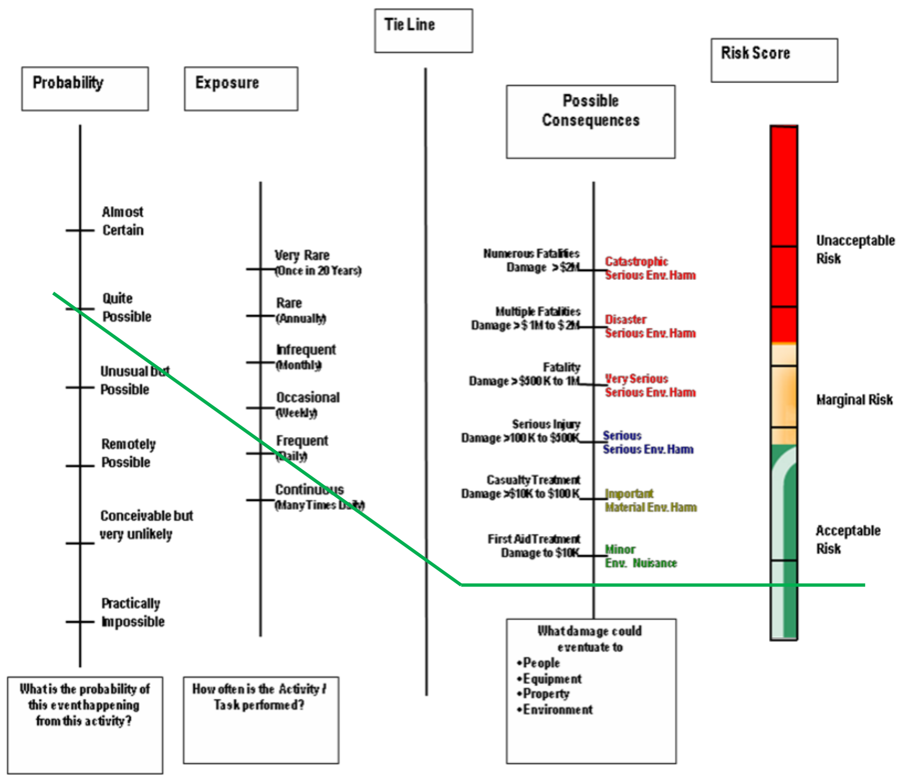
However, the RCM standard (SAE JA1011, available from http://www.sae.org) provides the minimum criteria that processes must comply with if they are to be called RCM. Although a voluntary standard, it provides a reference for companies looking to implement RCM to ensure they are getting a process, software package or service that is in line with the original report.

Nonetheless, everyone well-acquainted with RCM seems to agree that a thorough application of the RCM analytic process is still the most flexible and comprehensive tool available for identifying the actions that need to be taken to ensure that the risks of equipment failure are reduced to a tolerable level.

Tie Line - Probability x Exposure x Consequences = Level of Risk

A tie line brings exposure into the risk calculation and once each of the criteria have been established and agreed upon the facilitator can draw a line through the probability and exposure levels to the middle tie line and then change direction to the possible consequence and thus giving an overall risk score. The below image may give an easier summary of how to use the tie line.





6.0 Standard Operating Procedures (SOP's) / Standard Work Instructions (SWI's)

Over time, we learn that some ways work well and others not so well. From a safety perspective, those ways that do not work so well may have resulted in property damage, injury or death. Therefore, both from a safety and commercial point of view, it is in the best interests of the company to follow the ways that are known to work.

Those ways that work well are commonly known as operating procedures. Management initiates the development of these in order to continue running the business with best-known practice. Whether these procedures have been developed to give both the best commercial advantage and to offer the greatest degree of risk reduction to the site workers is the contentious issue that the safety professional and site workers debate with each other and with management.

Standard operating procedures (SOP) should at the very least reflect legislative requirements or an Australian Standard. Additionally, a common industry standard is likely to offer a higher degree of safety, since it comes from an industry body that has collective knowledge and expertise developed over time. For example, section 10 of the *Queensland Coal Mining Safety and Health Regulations, 2017* states that:

Developing standard operating procedures

10.(1) *The site senior executive must ensure the following steps are taken in developing standard operating procedures for managing and controlling hazards at the mine—*

(a) the site senior executive must consult with a cross-section of the mine's coal mine workers involved in carrying out a task under the proposed standard operating procedure to identify the hazards associated with the task and ways of controlling the hazards;

(b) the site senior executive must prepare a draft standard operating procedure and give a copy of it to the coal mine workers with whom the site senior executive consulted;

(c) if the coal mine workers agree with the draft standard operating procedure, the site senior executive must prepare it as the final standard operating procedure;

(d) if the coal mine workers do not agree with the draft standard operating procedure—

(i) for a disagreement that is not about a legal or technical matter—the site senior executive must decide the disagreed matter and prepare the final standard operating procedure; or

(ii) for a disagreement that is about a legal or technical matter—the site senior executive must—

(A) obtain further information or advice, including, for example, from a person having the necessary qualifications and experience to give the advice or from a recognised text on the matter; and

(B) after consulting with the workers about the information or advice, prepare a further draft standard operating procedure and give a copy of it to the workers; and

(C) if the workers disagree with the further draft—decide the disagreed

matter and prepare the final standard operating procedure;

(e) the site senior executive must include the final standard operating procedure in the mine's safety and health management system.

***(2)** The site senior executive must ensure—*

(a) the final standard operating procedure accords with—

(i) all matters agreed, under this section, between the site senior executive and coal mine workers; and

(ii) the site senior executive's decision, under this section, on any disagreed matters; and

(b) a record is kept of the disagreed matters.

***(3)** In developing the standard operating procedure, the site senior executive must—*

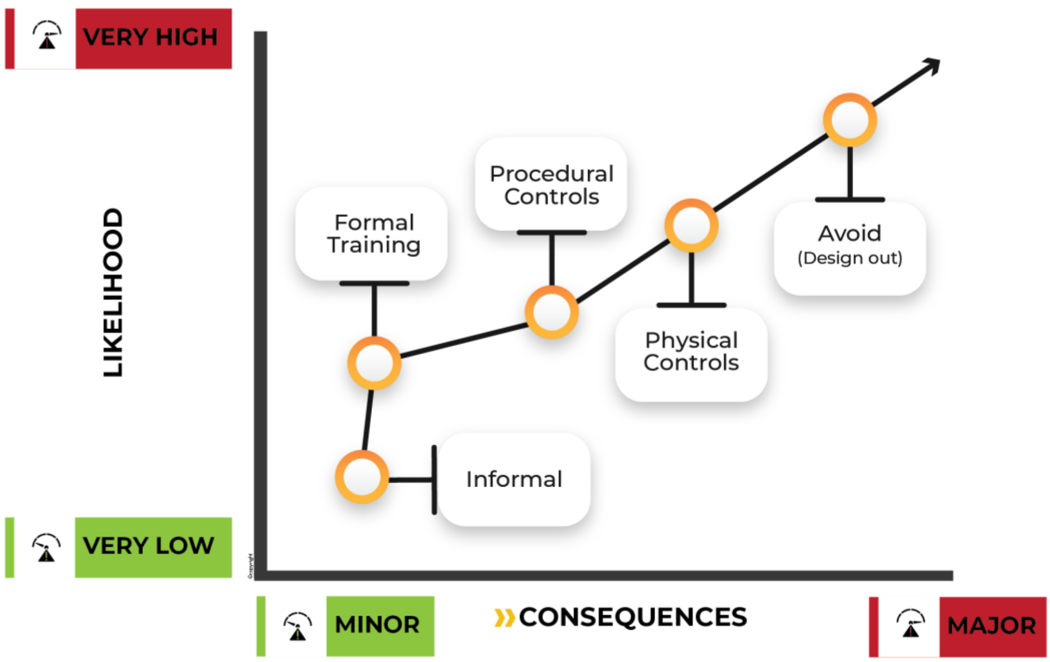
(a) use a risk assessment process recognised by the mining industry as an acceptable process for identifying and controlling hazards; and

(b) have regard to the methods of controlling the hazard stated in the database kept by the chief executive under section 280(1)(a)(i) of the Act.

***(4)** If, at the commencement of this section, the mine has a standard operating procedure for managing and controlling a particular hazard at the mine, the procedure is taken, until 1 March 2002, to have been developed under this section.*

It is evident here that a good degree of joint consultation needs to occur in the formulation of these standards at each mine site. After these legislative requirements have been addressed in the development of the standard, each individual company is able to tailor their SOP to the company's goals and policies.

So, when are SOPs needed? Consider the diagram below.



As can be seen from this Figure, procedures are likely to be needed where engineering controls are not feasible, and the work is of about a 'moderate' risk. They form an administrative control but are not the only answer to controlling the hazard. One must still consider all the other controls in the hierarchy. How are SOP written? Remember that SOP can originate from a Job Safety Analysis. They should have the following features:

- Title
- Purpose/Objective
- Step by step description of required actions
- Assessment of the risk in each case
- Potentially hazardous actions/circumstances
- The controls employed to reduce the risks
- Review date
- References to work teams, personnel or manuals

Finally, procedures are of no use if site workers do not comply with them. In order to make them clear and easily understood, the following features are desirable.

- Justification/Motivation– Why it is necessary. Explain why the workers should comply with the standard. Relate to the workers personal welfare, and to build pride in the worker.
- Concise
- Simple language (avoid jargon or abbreviations)
- Clear distinction between mandatory and advisory
- Use pictures and graphics, rather than straight text
- Make responsibilities clear
- Identify the training requirements
- Ensure it is auditable (you can measure whether it is being complied with)
- Always ensure that 'Hard Safety Barriers' or engineering controls are in place as well as the procedure (i.e., rack out cable as well as attaching safety tag), in order to lessen the total reliability on human decision-making.

Management should have a process in place that gives approval to a SOP and estimates and measures the success of its implementation. The success of the procedure may be evaluated with a 'Task Observation'. Essentially, it will measure compliance with the standard and the practicality of the new standard to the work process and company operations.

Points to consider when choosing risk treatment controls.

Identify treatment options - Remember the aim is to try to eliminate or reduce the likelihood and consequences that make up the risk.

Evaluate treatment options - Consider the feasibility of the treatment in terms of 'cost' and 'benefits' before recommending the 'fix'. Select the strategy for the implementation of the fix based on the "hierarchy of control" model. The size of the plan and who is involved in the decision-making process depend on the level of risk and the cost of implementation of the fix.

Prepare treatment plans - Plans should be aimed at the elimination or control of the risk based on the chosen options and strategy.

Implement plan - Once the plan is implemented, there should be a reduction in the likelihood and consequences of the event occurring. Remember that it is not always possible to reduce the likelihood, but we can put controls in place to reduce the consequences.

In making judgments about the effectiveness of the controls relative to the nature of each identified hazard and its consequences, other questions to ask are:

- What types of controls are provided?
- Are they of adequate technical standards and quality?
- Are there enough of them?
- Does the combination of controls follow a precedence order to match the nature of the hazard?
- Are the controls maintained in working order at all times?
- What contingencies are provided to support and are a backup to the controls?

Remember - controls such as elimination, substitution, design and isolation are stronger and more effective than human-oriented controls like education, procedures and administration.

All steps in the risk management process need to be documented to:

- demonstrate the process is conducted properly.
- provide a record of risks.
- provide the relevant decision makers with a risk management plan for approval and subsequent implementation.
- provide an accountability mechanism and tool.
- facilitate continuing monitoring and review.
- provide an audit trial.
- share and communicate information.

Individual areas of the organisation are required to prepare and maintain their own hazard register and risk profile. The extent of documentation and dissemination will of course depend on the level of risk and the scope to which it applies within each part of the organisation. As with recording, reporting and decision-making, guidelines are provided by the organisation for keeping a hazard register and recording risk profiles.

This step involves providing management with full and accurate information, including alternatives, so it can make intelligent, informed decisions concerning hazard control. Such hazard alternatives will include recommendations for training and education for better methods and procedures, equipment repair or replacement, environmental controls, and in rare cases where modification is not enough, recommendations for redesign. Information must be presented to management in a way that clearly states the actions required to improve conditions. The person who reports hazard information must do so in a manner that promotes, rather than hinders, action. After management's decision-makers receive hazard reports, they normally have three alternatives:

1. **They can choose to take no action.**
2. **They can redesign or modify the workplace and its components.**
3. **They can modify the work procedures.**

When management chooses to modify the system, it does so with the idea its operation is generally acceptable, but with the reported deficiencies corrected, performance will be improved. Examples of modification alternatives are:

a. *the acquisition of machine guards, personal protective equipment,*
b. *earth leakage circuit breakers to prevent electric shock,*
c. *a change in training or preventive practices,*
d. *isolating hazardous substances and processes,*
e. *replacing hazardous substances with less hazardous substances, and*
f. *purchasing new tools.*

Although redesign is not a popular alternative, it sometimes is necessary. When the redesign is selected, management must be aware of certain problems. Redesign usually involves substantial cash outlay and inconvenience. In this case it is vital that a hazard operability study is carried out on the new design to ensure risk is actually reduced.

One way to speed up decision-making regarding actions for hazard control is to present findings in such a manner that management can clearly understand the nature of the hazards, their location, their importance, the necessary corrective action, and the estimated cost.

7.0 Auditing

Work / Occupational health and safety auditing

In order to understand the safety requirements for occupational health and safety (OHS) auditing and your obligations for safety, you must consider and understand relevant legislation and statutory / industry requirements. It is not within the scope of this unit to deem a student as a competent auditor; however, a 'G2' qualified person should understand the basics of how to conduct a basic audit such as an inspection etc. and understand the processes of a good safety, audit including:

- What law applies
- Legal obligations, legislation, codes of practice & guides?
- What is an OHS audit, OHS management systems, why audit?

Compliance auditing
Meeting legislative requirements, ensuring compliance

Hazard Specific Audits
Auditing for specific hazards, checking control methods

Management system audit
Organisational structures, planning activities, responsibilities

Audit standards
Evaluation against ten defined elements

Accredited self-insurance auditors
Contacts for current accredited self-insurance auditors

About occupational health and safety auditing

Occupational health and safety (OHS) auditing is a term used to describe a wide range of assessments that can be undertaken for a variety of different purposes.

An OHS management system is a planned, documented and verifiable method of managing OHS hazards. What makes it a system is the deliberate linking and flow of processes that creates an intentional way of managing OHS matters.

Audits are conducted to determine the effectiveness of management systems and to identify the strengths and opportunities for improvements.

Compliance auditing

An audit can be specific and undertaken to determine if workplace practices are meeting legislative requirements. The Department of Industrial Relations (DIR) maintains an ongoing inspection and audit program through Mining and Workplace

Health and Safety Queensland Legislation where inspectors test compliance with the *Work Health and Safety Act 2011 Qld / Coal Mining Safety and Health Act 1999 Qld / Mining Quarrying Safety and Health Act 1999.*

Compliance auditing undertaken by inspectors is not a guarantee of a risk-free workplace as a detailed examination of every hazard is not possible during an inspectors' visit. The responsibility for ongoing effective health and safety management systems rests with workplace management.

The hazards addressed by inspectors during a compliance audit are determined by the workplace environment along with information obtained from specific inspectorate training, relevant injury data and industry input. The outcomes of compliance audits conducted by inspectors give results that indicate if compliance is being achieved or if further actions are required to meet legislative standards.

Employers can undertake similar audits by reviewing the workplace operations using a risk management model. This assessment should be undertaken by appropriately trained internal staff or by external providers. Persons performing these reviews should have experience in hazard identification, risk assessments and possess a strong knowledge of current legislative requirements.

Hazard specific audits

Hazard specific audits address particular issues such as confined space entry or working at heights and involve the inspection and testing of current workplace control methods. This type of audit has a narrow focus and looks at the effectiveness of policies and procedures in dealing with specific hazards.

These audits differ from compliance audits in that the standards set by the organisation to address a risk of injury may exceed legislative requirements. Many organisations use suitably qualified external providers to undertake these types of audits especially when hazardous tasks are being undertaken.

Mining and Workplace Health and Safety Queensland inspectors may review specific hazards in order to monitor legislative compliance at a workplace.

Management system audit

An occupational health and safety management systems audit has a wider scope, and although addressing hazards and risk controls, it also looks at organisational structures, planning activities, responsibilities, implemented procedures, review cycles and measurement and evaluation issues.

A basic occupational health and safety management system has some of the following characteristics:

- Existence of a health and safety policy that is communicated to staff
- Management commitment
- Allocation of responsibilities and accountability for health and safety matters
- Controls for suppliers, sub-contractors and purchasing
- Health and safety consultation
- Hazard identification, evaluation and control
- Provision of information and training of staff
- Incident recording, investigation, analysis and review
- Measuring and evaluating workplace health and safety performance.

Many organisations undertake these audits on an annual basis as the amount of resources and time required to conduct a management systems audit can be substantial. These audits can be undertaken by appropriately trained internal staff or by an external third party.

Audit Steps

1.	Planning	Set the scope.
2.	Investigation	Conduct the audit.
3.	Verification	Analysis of data collected.
4.	Reporting	Develop reports.
5.	Follow Up	Implement recommendations

Static and Procedural Audit

Static audit {Conveyors.}

- Inspect.
- Tick flick.

Compliance audit {Finds deficiencies.}

- Is there a procedure?
- Who is trained in the procedure?
- Are they using the procedure?

Audits

- Time-based
- Daily, Weekly, Monthly, Annually.

Event-based

New equipment or at the completion of each mining sequence following an accident/incident.

Team members.

- Safety department
- Safety representatives
- Supervisors
- Workers from relevant areas.

Risk Management System Audit

To audit the Risk Management System there are several important points to consider:

- Is there a Risk Management Policy in place?
- Is there a Risk Management Standard in place?

- Is there a system in place?
- Are there Risk Management documents/forms in place?
- Have workers been trained to use the system, documents and forms
- Are workers using the system, documents and forms
- Is the Risk Management system working?

All of the above points need to be carefully audited.

- Check that all blank Company documents and forms, including the signed Risk Management Policy are up to date with the correct:
  - Company Logo
  - SSE Name
  - Date
  - Version
  - Risk Calculation Chart
- They are readily accessible and easy to understand
- When auditing "completed" documents and forms check:
  - Title
  - Names of workers conducting Risk Assessment
  - Scope of work covered
  - Task broken down into logical steps
  - Hazards at each step are identified and managed
  - Risk scores are consistent with hazards and controls
  - Each hazard is assessed and controlled
  - Easy to read and understand
- As Above and " " (dito dito) are not used in RA documents as they are not recognised Hazards or Controls.
  - Matters not agreed to
  - Signed off by appropriate mine official
- When the Audit is complete the report should detail the evidence and details of:
  - Compliance,
  - Audited but unable to verify (called anecdotal evidence (everyone says so but no factual evidence to support either yes or no))
  - Non-Compliance
  - Improvements necessary/possible
  - Plan to rectify (who and when by)

8.0. SAFEGUARD

- A safety and health management system and audit criteria for the Queensland mining and quarrying industries

SafeGuard is a safety and health management system and audit tool for the Queensland mining and quarrying industries. SafeGuard will help assess your operation's safety and health management system, measure its performance and ensure continuous improvement.

Safeguard – link

Introduction—Why SafeGuard?

Mining and quarrying are, by their very nature, hazardous industries.

Many organisations have proven that the risks can be controlled to acceptable levels through effective safety and health management systems—supported by formal risk management processes that identify hazards, assess and rank risk, determine control measures and monitor effectiveness of the controls. However, it is possible to further reduce the incidence of injury, death and occupational disease in our mines, quarries and associated activities.

Those in control have a duty of care to provide safe systems of work and a safe and healthy workplace for all people on the site. Therefore, safety and health should be an integral part of management systems from the first day of planning the mine or quarry right through to every aspect of its operations. Safety and health should not be a bolt-on item or an afterthought.

Every aspect of an organisation's activities should consider the safety and health of employees. Machines and equipment should be designed, constructed and installed for safe operation. Work systems should be planned to minimise risk. In other words, helmets and safety glasses, while important, should not represent an organisation's only answer to safety and health.

Most importantly, making safety and health a part of everything you do prevents pain and suffering. It also has many financial benefits. A workplace free from injuries promotes higher productivity, lowers workers compensation insurance costs, reduces the threat of legal action or fines, improves employer– employee relationships, boosts morale and helps retain staff.

SafeGuard will help assess an organisation's safety and health management system, measure its performance and ensure continuous improvement.

The elements outlined for safety and health in this edition are modelled on the Australian and New Zealand standard AS/NZS 4801:2001 (see the table on page 3). This edition has also incorporated the revised requirements stated in ISO 14001:2004, which are also addressed in the 'how to' document AS/NZS ISO 19011, Guidelines for quality and/or environmental management systems auditing. Relevant elements from the second edition (which was modelled on the international standard AS/NZS ISO 9001:1994) have been incorporated into this edition.

SafeGuard has been developed by the Mines Inspectorate in consultation with industry, unions and occupational health and safety specialists.

SAFEGUARD - ***A safety and health management system and audit criteria for the Queensland mining and quarrying industries***

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Corresponding SafeGuard and AS/NZS 4801 elements

SafeGuard		AS/NZS 4801	
1	General requirements	**4.1**	General requirements
2	Safety and health policy Including communication and implementation of the safety and health policy	**4.2**	OHS policy
3	Planning for hazard and risk identification, assessment, and control	**4.3** **4.3.1**	Planning Planning identification of hazards, hazard/risk assessment and control of hazards/risks
4	Legal and other requirements	**4.3.2**	Legal and other requirements
5	Objectives, targets and management plans	**4.3.3** **4.3.4**	Objectives and targets OHS management plans
6	Resources, structure and responsibilities	**4.4** **4.4.1**	Implementation Structure and responsibility
7	Competency, training and awareness	**4.4.2**	Training and competency
8	Communication, consultation and reporting	**4.4.3**	Consultation, communication and reporting
9	Safety and health documentation	**4.4.4**	Documentation
10	Control of documents and data	**4.4.5**	Document and data control
11	Hazard and risk identification, assessment, and control	**4.4.6**	Hazard identification, hazard/risk assessment and control of hazards/risks
12	Emergency preparedness and response	**4.4.7**	Emergency preparedness and response
13	Monitoring and measurement	**4.5** **4.5.1**	Measurement and evaluation Monitoring and measurement
14	Incident investigation, corrective action, and preventive action	**4.5.2**	Incident investigation, corrective and preventive action
15	Safety and health records	**4.5.3**	Records and records management
16	Safety and health audits	**4.5.4**	OHMS audit
17	Management review	**4.6**	Management review

SafeGuard self-assessment chart

Element 1	Element 2	Element 3	Element 4	Element 5	Element 6	Element 7	Element 8	Element 9
General requirements	**Safety and health policy**	**Planning for hazard and risk identification, assessment and control**	**Legal and other requirements**	**Objectives, targets and management plans**	**Resources, structure and responsibilities**	**Competency, training and awareness**	**Communication, consultation and reporting**	**Safety and health documentation**
Senior management demonstrate visible leadership and proactive commitment to achieving S&H excellence.	S&H policy is implemented at all levels of the organisation and is demonstrated to be the basis of the site's S&HMS.	All S&H activities are defined, documented and adequately resourced for the effective implementation, operation, review and improvement of the S&HMS.	There is a well-established system for identifying and communicating S&H legislation, standards and codes.	Clear, measurable objectives, targets and plans based on the S&H policy are established, implemented and communicated.	A well-established system outlining resources, responsibilities, authorities and accountabilities is in place, clearly defined and effective.	Competency requirements are identified by training needs analysis.	Formal communication processes are in place to ensure S&H issues are communicated effectively.	S&H information (paper or electronic) describes the core elements of the S&HMS, their interaction and links to related documents.
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
The organisation operates on the premise that S&H is integral to all operational management systems.	The S&H policy is visibly displayed and is known to mine workers (company employees, contractors and other major stakeholders).	A hazard management system is in place ensuring that all operational hazards are identified, ranked and appropriately managed to an acceptable level of risk.	Regular compliance reviews examine the organisation's capability of meeting legal obligations and other recognised standards.	Objectives and targets include a system of positive KPIs.	An organisational chart is established, up to date and well communicated.	A training program achieves a high level of competency and awareness of S&H for all employees throughout the organisation.	There is a system for detecting and reporting accidents, incidents, near misses, hazards, substandard conditions, substandard practices and defects.	A S&HMS is in place and includes supporting documentation (such as SOPs, JSAs and work permits) to ensure its effectiveness.
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
A well-structured S&HMS is established, documented, maintained and continually improved.	There is commitment to the organisation's overall S&H objectives.	There are formal procedures for analysing S&H data including, where warranted, hazard/risk register(s) identifying hazards and documenting major hazards/risks in all work areas.		Management plans include usage criteria (e.g. monitor monthly, measure quarterly, review annually).	Roles and responsibilities are formally documented and communicated to all people in the management structure and/or work group.	People carrying out tasks and/or operating equipment where there is a requirement for specific competency are appropriately trained and authorised to do so.	Provision exists for immediate and longer term corrective action and follow-up, including the tracking of same.	Employees are aware of the S&H system, and the S&H manual (paper or electronic) is readily accessible. Relevant parts are understood by all.
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5		1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Where site operations are conducted by a major contractor or multiple contractors, there is a system to ensure a consistent approach to S&H.	There is commitment to the continual improvement of the S&HMS.	Trends are identified for accidents, incidents, substandard conditions and practices, hazards and disease.			Adequate budget plans are in place for resource commitments (e.g. financial, personnel and equipment commitments) of the S&H management plan.	There is a well-established system for recording competency, training and awareness for all workers, including trainees and contractors.	Employees are involved in, understand and use reporting systems.	There is a comprehensive system in place for reviewing, updating and communicating S&H documentation.
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5			1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
There is active employee involvement, effective consultation and communication.		A recognised system of risk assessment is used to rank risks and put in place appropriate controls.			There is active employee involvement, effective consultation and communication.	All people understand the process and equipment they are using.	There is a formal system for communicating all documents related to the S&HMS.	All employees are aware of and have a good working knowledge of relevant S&HMS documentation.
1 2 3 4 5		1 2 3 4 5			1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
There is demonstrated commitment to S&H at all levels of the organisation.		People performing hazard and risk identification, assessment and control are appropriately trained and competent.			Contractors are aware of areas of accountability and responsibility.	S&H training courses being undertaken are assessed for effectiveness and appropriateness.		S&H documentation (paper or electronic) describes the core elements of the S&HMS, their interaction and links to related documentation.
1 2 3 4 5		1 2 3 4 5			1 2 3 4 5	1 2 3 4 5		1 2 3 4 5

Key to self-assessment ratings

1. Little or no documentation within the S&HMS; little or no implementation of those items.
2. Some evidence of documentation within the S&HMS; implementation is inconsistent or on an ad hoc basis (with no or little supporting documentation).
3. Reasonable documentation within the S&HMS; reasonable but somewhat inconsistent implementation/application.
4. Documentation within the S&HMS; full implementation and consistent application across the operation
5. Documentation within the S&HMS; total integration into normal operations; regular review demonstrating continuous improvement and best practice.

Note: For instructions, refer to Part 2 of SafeGuard.

Abbreviations

S&H: Safety and health
S&HMS: Safety and health management system

SAFETY OBSERVATION

The sole purpose of the Safety Observation process is to prevent people from hurting themselves. A job observation and feedback process designed to promote the use of 'safe behaviours' through the use of positive reinforcement and coaching to identify 'at risk' or risky behaviours that contribute to incidents and gain commitment to change the behaviour or improve the work method to eliminate or reduce the risk.

Behaviour-The act that presents the risk

Condition- A physical hazard

At Risk- A condition or behaviour that has the potential to put a person or persons, plant, equipment or the environment at risk of injury or damage.

Preferred Behaviour- Behaviour that is 'safe' and consistent with rules and procedures and encourages awareness and positive behaviours in others

Job Observation- The observation and resultant discussion of the work observed by the observation team and the people doing the work

Observation result- An action implemented to prevent injury or damage before it occurs. Examples: Stopping a job due to immediate danger or risk of injury; retraining of safety expectations and standards with workers; training; revision of a Job Safety Analysis, work method statement or procedure; or disciplinary action.

Target of observation

To develop positive change in safety culture and behaviour through the reinforcement of safety expectations, and standards:

- Identify the hurdles that prevent safe behaviour including organisational, task and individual/team issues;
- Promote open, honest communications throughout

These targets are achieved by:

- Demonstrating leadership and commitment to safety
- Recognising, rewarding and encouraging safe or desired behaviours
- Increasing awareness of the potential consequences of at-risk or un-safe behaviour
- Clarifying safety standards and setting expectations
- Identifying and understanding why people take risks
- Understanding and removing the hurdles to safe behaviour
- Identifying safe and more efficient ways of doing work through communication and consultation

Key Guidelines for Conducting Job Safety Observations:

1. The purpose of Job Safety Observations (SO) is to:
    a. Identify "At Risk" behaviours of workers and unsafe workplace conditions that may affect the safety of themselves and other workers or cause damage to equipment or the environment.
    b. Provide workers with feedback about their work practices and where appropriate, to give practical advice and ideas on how to improve safety on the job.
    c. Provide encouragement and recognition to workers who demonstrate safe work practices.
2. A JSO may be conducted by one person (typically a department manager or supervisor), although it is recommended that a second person with workplace and / or job-related experience is involved.
3. The observers should demonstrate interest for the workers safety and welfare and also for environmentally and culturally appropriate behaviour.
4. Observers should focus on good practices as well as detecting At Risk behaviours and conditions:
    a. Where at Risk behaviours or conditions are identified, these are to be discussed with the worker(s).
    b. Appropriate control measures are to be developed in consultation with the worker(s) to manage the risk.
    c. Those control measures are to be implemented before the work task is continued.
5. Observations should be focussed and of short duration (approx. 15mins).
6. Observers shall provide feedback to the workers observed and note this on the form. If no unsafe conditions are detected, it is important to provide positive feedback of this to the worker(s).
7. Observation forms should be provided to the responsible Department Manager for review and follow up where necessary.
8. Completed JSO's can be used for review at toolbox meetings to highlight identified At Risk behaviours or conditions, although workers names are not to be mentioned.
9. The SO form should not be completed during the inspection. This takes away the observer's focus:
    a. The SO form should be completed as soon as possible following the observation. Make short prompt notes during the observation to assist with later completion of the form.
    b. JSO should not include the names of the worker(s) undertaking the work task, however this does not exclude any person from disciplinary action being taken against them where it is seen that they have wilfully or recklessly endangered themselves or other workers.
10. It is the responsibility of all department managers to decide the frequency and number of JSO's to be conducted within their department. Results of JSO's are to be tabled at the daily meetings.

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CHOOSE

OHSA

Industry Leaders

/ 20+ YEARS EXPERIENCE
/ 50,000+ STUDENTS
/ 1,500+ CLIENTS / 100+ COURSES
/ REAL INDUSTRY EXPERTS
/ MULTIPLE EXCELLENCE AWARDS
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