Course in Mining Supervisor

Unit:

RIIWHS301D
Conduct safety and health investigations (s2)

Student Study Guide

Revision Record

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Notes:

1.0 Introduction

Why should accidents / incidents be investigated?

The reasons for workplace incident investigations, according to Australian Standard AS 1885.1 *Measurement of occupational health and safety performance - Describing and reporting occupational injuries and disease (known as the National Standard for workplace injury and disease recording)* include the following:

- To provide information on the nature and extent of occupational injury and disease at the workplace.
- To provide a comprehensive set of data for the management of occupational health and safety at the workplace and enterprise level.
- To assist in the efficient allocation of resources.
- To identify appropriate preventive strategies.
- To provide data to monitor the effectiveness of preventive strategies.

In addition we conduct incident investigations to:

- Most importantly to find out the cause of occurrences;
- Rectify system inadequacies;
- Involve and educate personnel;
- Identify better/more efficient methods of work;
- Share information with other operations and within the industry;
- To fulfill any legal requirements;
- To determine the cost of an occurrence;
- To determine compliance with applicable safety regulations;
- To process workers' compensation claims.

Incidents that involve no injury or property damage should still be investigated to determine the hazards that should be corrected. The same principles apply to a quick inquiry of a minor incident and to the more formal investigation of a serious event.

Please note: The term incident is used in some situations and jurisdictions to cover both an "accident" and "incident". It is argued that the word "accident" implies that the event was related to fate or chance. When the root cause is determined, it is usually found that many events were predictable and could have been prevented if the right actions were taken -- making the event not one of fate or chance (thus, the word incident is used). For simplicity, we will use the term **<u>'occurrence'</u>** to mean all of the above events.

The information that follows is intended to be a general guide for supervisors or occupational health and safety committee members. When occurrences are investigated, the emphasis should be concentrated on finding the contributing factors and the root cause of the occurrence rather than the investigation procedure itself so you can prevent it from happening again. The purpose is to find facts that can lead to actions, not to find fault. Always look for deeper causes. Do not simply record the steps of the event.

2.0 Statutory Requirements

In the *Coal Mining Safety and Health Regulation 2001*, section 15 and 16, a coal mine's safety and health management system must provide for:

- A procedure for investigating accidents and incidents, involving the Open Cut Examiner (Open Cut mine) or the Explosion Risk Zone controller (underground mine)
- Making the investigation findings available to the coal mine's workers
- Implementing corrective actions
- Procedures for telling the Site Safety Representative about the incident

In the *Mining and Quarrying Safety and Health Regulation 2001*, section 15, a mine's safety and health management system must:

- Provide for documenting the techniques that must be used for investigating incidents
- Use techniques that are appropriate for:
  - the nature of the incident
  - the nature and level of the hazards involved
- Use techniques that are integrated with the risk management process
- Involve appropriate participation by persons involved in the incident

The Mine Site Senior Executive (SSE) must immediately notify an inspector of mines in the event of:

- a fatal accident;
- a serious accident, which is an accident that causes a person to be admitted to a hospital as an in-patient for treatment for the injury; or
- a high potential incident, which is an incident that had the potential to cause a significant adverse effect to the safety or health of a person. It is an incident which, given different circumstances, could have resulted in a fatality or serious accident.

The scene of such accidents and incidents must not be disturbed, other than to the extent necessary to remove the injured person, until the inspector has examined the site and given permission. In the case of a fatal accident the local police must also be informed as soon as possible.

It is essential that each accident and high potential incident be thoroughly investigated to determine the cause(s). This will allow corrective action to be identified and taken as soon as possible to prevent a recurrence of the event.

After the investigation, a report will need to be written. The reporting process often includes statutory requirements. The requirements itemised below may not pertain to your organisation, but is used here to highlight what is required in certain parts of the mining industry. For example, within the Queensland *Coal Mining Safety and Health Act, 1999* it is a requirement that an inspector and an industry safety and health representative are notified of a 'serious accident' which includes a death or a 'high potential incident' by the site senior executive (section 198).

The definition of a 'serious accident' and 'high potential incident' in this act is as follows:

16 Meaning of "serious accident"

A **"serious accident"** at a coal mine is an accident at a coal mine that causes—
(a) the death of a person; or
(b) a person to be admitted to a hospital as an in-patient for treatment for the injury.

17 Meaning of "high potential incident"

A **"high potential incident"** at a coal mine is an event, or a series of events, that causes or has the potential to cause a significant adverse effect on the safety or health of a person.

Within the Queensland *Mining and Quarrying Safety and Health Act, 1999* it is a requirement that an inspector and a district workers representative are notified of a 'serious accident' which includes a death or a 'high potential incident' by the site senior executive (section 195). The definition of a 'serious accident' and 'high potential incident' in this act is as follows:

17 Meaning of "serious accident"

A **"serious accident"** at a mine is an accident at a mine that causes—
(a) the death of a person; or
(b) a person to be admitted to a hospital as an in-patient for treatment for the injury.

18 Meaning of "high potential incident"

A **"high potential incident"** at a mine is an event, or a series of events, that causes or has the potential to cause a significant adverse effect on the safety or health of a person.

After the notification of a death, the inspector is required to investigate the accident to determine its nature and cause, and report the findings to the chief inspector (section 198 of *Coal Mining Safety and Health Act, 1999* and section 196 of the *Mining and Quarrying Safety and Health Act, 1999*). Additionally, the site of a serious accident or a high potential incident must not be interfered with without the permission of an inspector, except to save life or prevent further injury.

Additionally, for a serious accident or high potential incident, the site senior executive must:

- Carry out an investigation to decide the causes
- Prepare a report, including recommendations
- Forward the report to an inspector within 1 month of the occurrence (section 201 *Coal Mining Safety and Health Act, 1999* and section 198 of the *Mining and Quarrying Safety and Health Act, 1999*), in an approved form (Queensland *Coal Mining Safety and Health Regulation 2001*, section 16)

Part 11 Accidents and incidents : Division 1 Notification, information and inspections

S198 Notice of accidents, incidents, deaths or diseases

(1) Subject to subsections (2) and (3), as soon as practicable after becoming aware of a serious accident, high potential incident or a death at a coal mine, the site senior executive for the coal mine must notify an inspector and an industry safety and health representative about the accident, incident or death either orally or by notice.
Maximum penalty—40 penalty units.
(2) Subsection (3) applies to—
(a) a serious accident at a coal mine resulting in a person receiving—
(i) a bodily injury endangering, or likely to endanger, the person's life; or
(ii) an injury causing, or likely to cause, a permanent injury to the person's health; or
(b) a high potential incident at a coal mine of a type prescribed under a regulation; or
(c) a death at a coal mine, whether or not caused by an accident at the coal mine.
(3) The site senior executive must, as soon as possible after becoming aware of the accident, incident or death, by noticer orally notify an inspector and an industry safety and health representative about the accident, incident or death in terms that include the information (the ***primary information***) stated in subsection (3A).
Maximum penalty—40 penalty units.
(3A) For subsection (3), the primary information is all of the following
(a) the precise location where the accident, incident or death happened;
(b) when the accident, incident or death happened;
(c) the number of persons involved in the accident, incident or death;
(d) if the notification is about a death, whether or not caused by an accident—the name of the person who died;
(e) if the notification is about a serious accident or high potential incident—
(i) the name of any person who saw the accident or incident, or who was present when the accident or incident happened; and
(ii) the name of any person who was injured as a result of the accident or incident;
(f) if no one was present when the person mentioned in paragraph
(d) died or the person mentioned in paragraph
(e)(ii) was injured—the name of the person who found the deceased or injured person;
(g) a brief description of how the accident, incident or death happened.
Examples of types of descriptions that may be given under paragraph (g)—
'A light vehicle fell into the pit after the light vehicle collided with a truck on a ramp leading into the pit.'
'A worker fell from the top of a storage bin into the wash plant.'
(3B) If the site senior executive does not know the primary information at the time the notification is made under subsection (3), the site senior executive must—
(a) take all reasonable steps to find out the primary information as soon as possible; and
(b) as soon as possible after the primary information becomes known to the site senior executive, give the primary information to the inspector and representative.
Maximum penalty—40 penalty units.
(3C) It is not a defence in a proceeding under subsection (3) or (3B)that the giving of the primary information might tend to incriminate the site senior executive.
(3D) The primary information is not admissible in evidence against the site senior executive in any criminal proceeding.
(3E) Subsection (3D) does not prevent the primary information being admitted in evidence in criminal proceedings about the falsity or misleading nature of the primary information.
(4) If the site senior executive makes an oral report under subsection (1) or (3), the executive must confirm the report by notice within 48 hours.
Maximum penalty—40 penalty units.
(5) However, if the oral report relates to a death, the site senior executive must confirm the oral report by notice within 24hours.
Maximum penalty—80 penalty units.
(6) As soon as practicable after receiving a report of a disease prescribed under a regulation as a disease that must be reported under this section, the site senior executive must given inspector and an industry safety and health representative notice about the disease.
Maximum penalty—40 penalty units.

199 Place of accident must be inspected

As soon as practicable after receiving a report of a serious accident causing death at a coal mine, an inspector must inspect the place of the accident, investigate the accident to determine its nature and cause, and report the findings of the investigation to the chief inspector.

Division 2 Site of accident or incident

200 Site not to be interfered with without permission

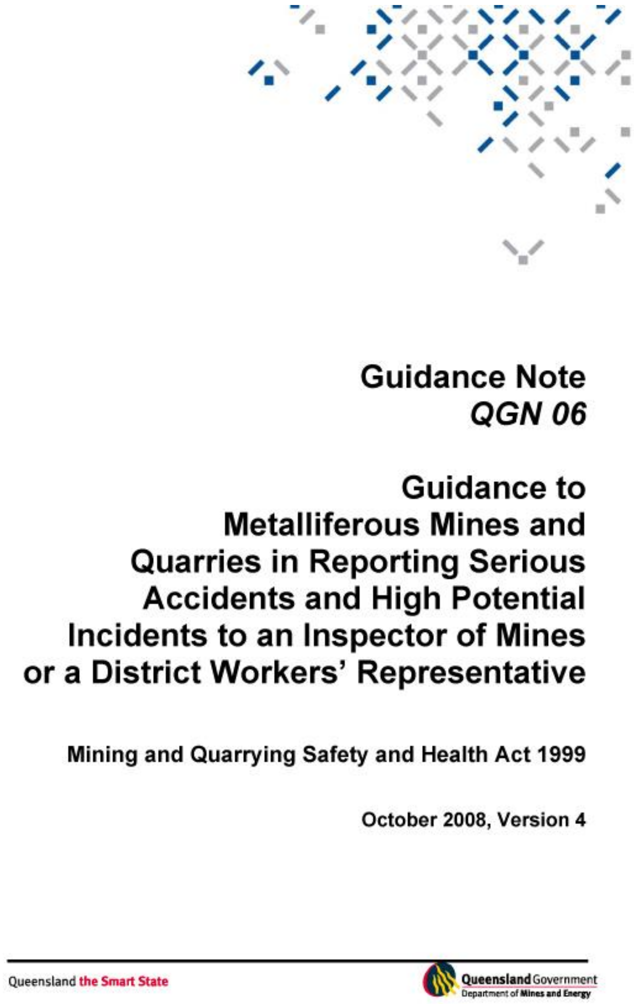
(1) A person must not interfere with a place at a coal mine that is the site of a serious accident or high potential incident of a type prescribed by regulation, without the permission of an inspector.
Maximum penalty—200 penalty units.
(2) Permission under subsection (1) must not be unreasonably withheld.
(3) For this division, action taken to save life or prevent further injury at a place is not interference with the place.

201 Action to be taken in relation to site of accident or incident

(1) If there is a serious accident or high potential incident, the site senior executive must—
(a) carry out an investigation to decide the causes of the accident or incident; and
(b) prepare a report about the accident or incident that includes recommendations to prevent the accident or incident happening again; and
(c) if the accident or incident is a type prescribed by regulation—forward the report to an inspector within 1month after the accident or incident.
Maximum penalty—100 penalty units.
(2) The site senior executive must ensure that the place of the accident or incident is not interfered with until—
(a) all relevant details about the accident or incident have been recorded and, if possible, photographed; and
(b) sufficient measurements have been taken to allow the development of an accurate plan of the site; and
(c) a list of witnesses to the accident or incident has been compiled.
Maximum penalty—100 penalty units.

After the investigation, a report will need to be written. The reporting process often includes statutory requirements.

The Queensland Department of Mines & Energy have produced a *Guidance to Coal Mines in Reporting Serious Accidents and High Potential Incidents to an Inspector of Mines or an Industry Safety & Health Representative* QGN 07 (QGN 06 is for Metalliferous mines) which assists the mine determine the necessary reporting requirements and it can be found at:
http://www.dme.qld.gov.au/zone_files/inspectorate_pdf/hpi_reporting_coal.pdf


Guidance Note
QGN 06

Guidance to Metalliferous Mines and Quarries in Reporting Serious Accidents and High Potential Incidents to an Inspector of Mines or a District Workers' Representative

Mining and Quarrying Safety and Health Act 1999

October 2008, Version 4

Queensland the Smart State

Queensland Government
Department of Mines and Energy

The Department releases regular reports of serious accidents and high potential incidents as shown here and can also be accessed on their website.

Department of Employment, Economic Development and Innovation

Serious accidents and high potential incidents

Mining and quarrying

Compilation of reports for February 2011

Fall of Person (3)

- A worker was washing his light vehicle when he slipped and fell 1.5m between the wash down ramps dislocating his shoulder.
- The driver of a Cat 740 articulated dump truck fell 2.5m from the cab access platform ladder over the handrail to the ground. He fractured his ribs, vertebrae and pelvis.

Fall of Equipment (22)

- A light vehicle was elevated on a Molnar four post vehicle hoist and then the front of the vehicle raised a further 400mm on a hydraulic jacking beam. The beam detached from the hoist ramp support rails and fell to the floor causing the front of the vehicle to drop onto the hoist ramps.
- The boom point sheaves tore off a BE1370 dragline boom and fell onto the stockpile while it was dumping. The ropes fell next to the cab.
- A one tonne stonedust bag fell from its supporting eyebolt above a hopper when a worker twisted the bag to reposition it. The worker's arm was caught between the bag and the mesh on top of the hopper.
- A Terex RH 120 excavator lost traction as it trammed up the loading ramp of a Bosich float and slid about 2m to the right.
- A 120m length of 1m diameter modular polyethylene ladderway fell 10m to the bottom of an escape raise as it was being lowered into position when the sheave assembly failed.
- A section of 250mm diameter poly pipe containing concentrate slurry fell onto a walkway when two pipe supports failed.
- An Hitachi EX3500 excavator was manoeuvring on a 6m bench when one track went over the side of the bench. The operator was able to lower the bucket and stabilise the excavator.
- An operator reversed the rear of his Cat 740 articulated dump truck up and onto a stockpile. When he raised the body it rolled onto its side.
- The operator exited the cab of a Cat 2900 loader and went under the raised and unsupported bucket to clean the lights.

Fall of Ground (4)

- A roof fall in an intersection of an underground coal mine followed an inrush of water through the roadways and already fractured roof strata.
- A 25m long section of rib slumped in an underground coal mine roadway.
- About 300kg of rock fell from the back of a drive where a cablebolting rig had been working.
- Four tonnes of rock fell from the back of an intersection.

Mechanical (15)

- While coupling a new rod on the drill string of a UDR 1000 surface drill rig the drilller's offsider used his right foot to align the rods. The jaw clamp closed on his foot injuring his toes.
- An Omega 16 tonne forklift was removing a stack of poly pipe from a semi trailer when the forklift over balanced lifting the rear steer wheels off the ground. The stack of pipes fell off the forks and the rear wheels fell back to the ground.
- A supervisor and two fitters were about to commence chassis repairs on a Cat 773 water truck when the position 5 tyre ruptured. The three workers were struck by dirt thrown up by the resultant air blast.
- A catastrophic tyre failure occurred on the trailer of a Cat 777 bottom dump truck while the operator was checking the pressures of the tyres on the other side of the truck.
- The inner wall of the position 6 tyre on a Cat 789 dump truck ruptured while the truck was parked up during a crib break. A piece of rubber from the tyre was thrown 15m from the failure point.
- The position 5 tyre on a Komatsu HD1500 dump truck started to smoke and caught alight while it was being monitored for a possible tread separation. An exclusion zone was established and the fire monitored from a safe distance.
- A worker was hammering a steel sleeve into a housing when a steel splinter flew from the hammer and lodged in his forearm.

Vehicle – Collision (20)

- A Cat D10 dozer reversed into a Cat 789 dump truck which was waiting on the dump tip head.
- Two fitters stood between two Cat 793 dump trucks while attempting to jump start on of them.
- A light vehicle travelled in the wrong direction along a one way haul road until it met a dump truck. Both vehicles took evasive action to avoid a collision.
- A tradesman boarded a Cat 793C dump truck to diagnose a fault and asked the operator to drive the truck as part of the diagnosis. The truck moved off from its park, turned right and drove over the tray of the tradesman's light vehicle.
- A water truck collided with a light vehicle while passing on a gravel road.

( ) The number in brackets next to each category heading is the total number of accidents and incidents reported for that category.

Queensland Government

3.0 Definitions

What is the difference between an accident, incident and occurrence?

Accident

The term "accident" can be defined as an unplanned event that interrupts the completion of an activity, and that may (or may not) include injury or property damage.

'Accident' is a term that is often considered out of date as it suggests inevitability, or an inability to prevent, or a lack of culpability on the part of those involved.

Incident

An incident usually refers to an unexpected event that did not cause injury or damage this time but had the potential for injury, ill-health or damage. "Near miss" or "dangerous occurrences" are also terms for an event that could have caused harm but did not.

While this term describes processes that give rise to injury or ill-health that arise suddenly and are of short duration it is not a useful term when the process of injury or ill-health occurs over time.

Occurrence

Occurrence is the process(es) which gives rise to damage, injury or ill-health.

When there is a loss of control of energy there is the potential for injury. This process is termed an **occurrence.** The time frame for an occurrence may be anything from a fraction of a second to many years. Where the time frame is extended we refer to the hazards as having a 'long latency'. Therefore 'occurrence' is the preferred term irrespective of the time period for the causation process.

4.0 Fines, Prosecutions & Criminal Offences

Example of a prosecution

13 February 2008

BMA Coal Operations will pay $300,000 toward coal mine safety research in Queensland, following an out of court settlement in the Industrial Magistrates Court in Brisbane on 30 January 2008.

The company also agreed to pay $236,000 to the Queensland Department of Mines and Energy for investigation and court costs.

The company had been charged with neglecting its duty of care obligations under *Queensland's Coal Mining Safety and Health Act 1999* over an incident at Goonyella Riverside mine west of Mackay on 28 July 2004. Maximum fines under the Act were $300,000.

The charges arose after two workers were injured by a large quantity of falling mud while trying to clear a build-up of mud from under the body of a large excavator.

One man suffered a fracture to the lower lumbar area of his spine and a fracture to his right ankle while the other suffered a split spleen that had to be removed.

Under the settlement terms the department will use the $300,000 solely for safety and health research, and for safety and health projects that will benefit the Queensland coal mining industry. The Department has total discretion in identifying the appropriate research projects.

The site senior executive of Goonyella Riverside mine XXXXXX will meet the Department's Safety and Health Division to explain improvements made in operating procedures at the mine and any additional improvements which were identified in the Mines Inspectorate's safety investigation report.

Queensland Department of Mines and Energy
Mining Exploration and Development Division
MinesInquiries@dme.qld.gov.au

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 which resulted in the death of a fellow worker 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

5.0 Conducting the Investigation

5.1 Objectives of the incident investigation

The definition of Root and Contributing Factors is:

Root Cause

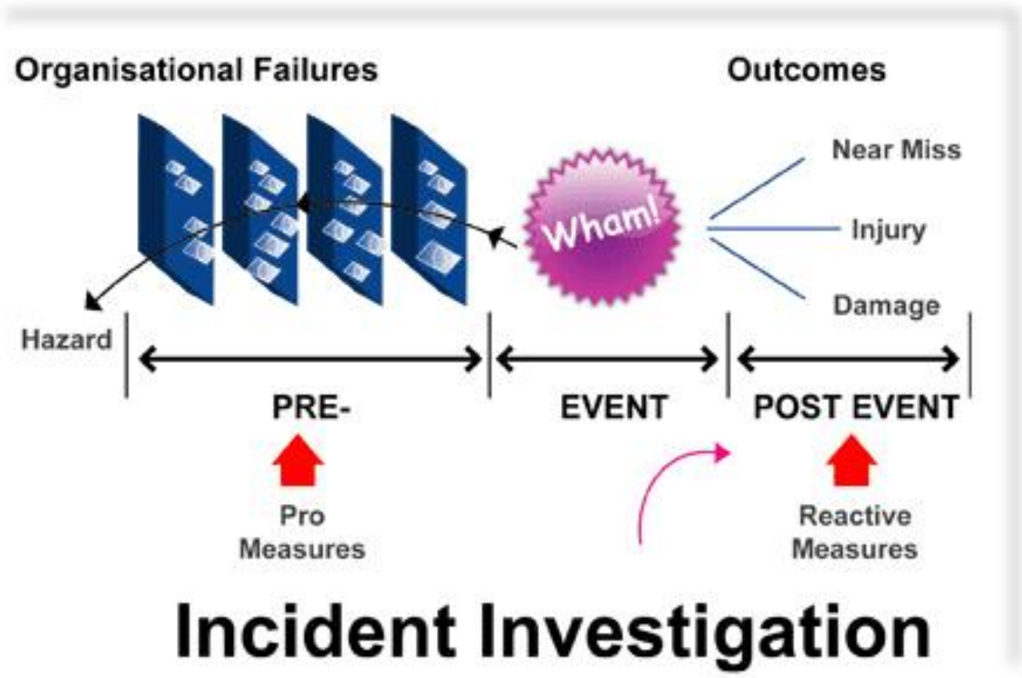
A Root Cause must be present (or absent) to enable a sequence of events to continue, leading to damage.

Contributing Factors

A Contributing Factor is one that increases the likelihood that the sequence of causes will alter the level of damage (better or worse) but not prevent the sequence continuing.

All work related incidents need to be managed through a formal process. The system should ensure that:

- The incident site is controlled for effective investigation and reporting;
- Suitable control measures are developed, implemented and monitored to prevent a recurrence;
- The site is returned to normal operational state as effectively as possible;
- And where an injury has occurred, the individual(s) are cared for and appropriate steps taken to assist their return to good health.



Incident Investigation is focused on post-event, or after the incident occurs (see figure above). The findings and recommendations are then used to prevent further incidents of the same type.

In order to understand the history of incident presentation, you need a good understanding of what it takes to reduce injuries. The accident pyramid model used many years ago as we will discuss will provide some useful information.

In 1969, a study of industrial accidents was undertaken by Frank E. Bird, Jr., who was then the Director of Engineering Services for the Insurance Company of North America. He was interested in the accident ratio of 1 major injury to 29 minor injuries to 300 no-injury accidents first discussed in the 1931 text

Industrial Accident Prevention by. H. W. Heinrich.

Since Heinrich estimated this relationship and stated further that the ratio related to the occurrence of a unit group of 330 accidents of the same kind and involving the same person, Bird wanted to determine what the actual reporting relationship of accidents was by the entire average population of workers. H.W. Heinrich's classic safety pyramid is now considered the foremost illustration of types of employee injuries.

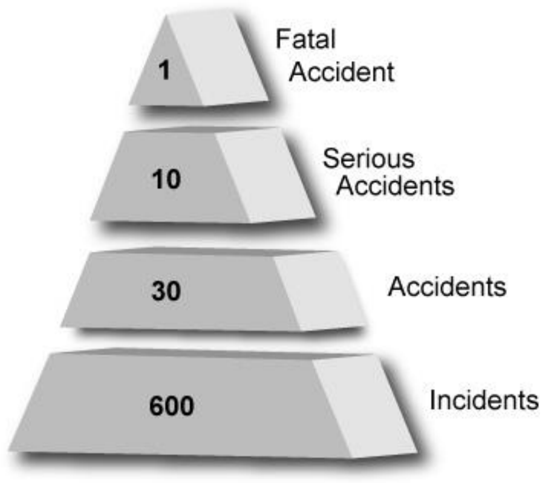
There Bird analyzed 1,753,498 accidents reported by 297 cooperating companies. These companies represented 21 different industrial groups, employing 1,750,000 employees who worked over 3 billion hours during the exposure period analyzed. The study revealed the following ratios in the accidents reported:

For every reported major injury (resulting in fatality, disability, lost time or medical treatment), there were 9.8 reported minor injuries (requiring only first aid). For the 95 companies that further analyzed major injuries in their reporting, the ratio was one lost time injury per 15 medical treatment injuries.

Forty-even percent of the companies indicated that they investigated all property damage accidents and eighty-four percent stated that they investigated major property damage accidents. The final analysis indicated that 30.2 property damage accidents were reported for each major injury.

Part of the study involved 4,000 hours of confidential interviews by trained supervisors on the occurrence of incidents that under slightly different circumstances could have resulted in injury or property damage. Analysis of these interviews indicated a ratio of approximately 600 incidents for every reported major injury.

In referring to the 1-10-30-600 ratio detailed in a pyramid it should be remembered that this represents accidents reported and incidents discussed with the interviewers and not the total number of accidents or incidents that actually occurred.



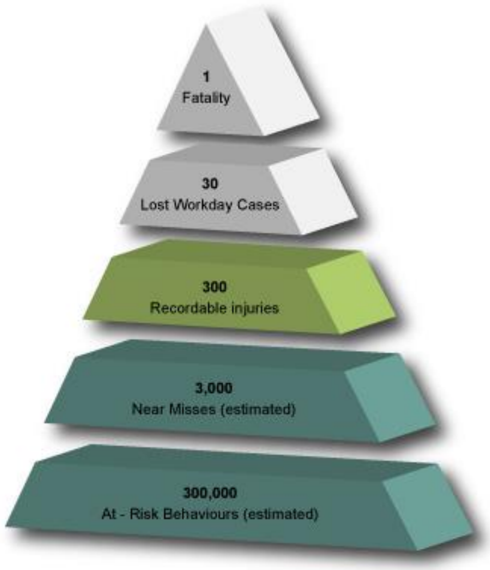
Bird continues, as we consider the ratio, we observe that 30 property damage accidents were reported for each serious or disabling injury. Property damage incidents cost billions of dollars annually and yet they are frequently misnamed and referred to as "near-accidents". Ironically, this line of thinking recognizes the fact that each property damage situation could probably have resulted in personal injury. This term is a holdover from earlier training and misconceptions that led supervisors to relate the term "accident" only to injury.

The 1-10-30-600 relationships in the ratio indicate clearly how foolish it is to direct our major effort only at the relatively few events resulting in serious or disabling injury when there are so many significant opportunities that provide a much larger basis for more effective control of total accident losses.

It is worth emphasizing at this point that the ratio study was of a certain large group of organizations at a given point in time. It does not necessarily follow that the ratio will be identical for any particular occupational group or organization. That is not its intent. The significant point is that major injuries are rare events and that many opportunities are afforded by the more frequent, less serious events to take actions to prevent the major losses from occurring. Safety leaders have also emphasized that these actions are most effective when directed at incidents and minor accidents with a high loss potential.

There is always a large variation between the most serious and no claim incident, as shown in both pyramids.

In 2003, ConocoPhillips Marine conducted a similar study demonstrating a large difference in the ratio of serious accidents and near misses. The study found that for every single fatality there are at least 300,000 at-risk behaviors, defined as activities that are not consistent with safety programs, training and components on machinery. These behaviors may include bypassing safety components on machinery or eliminating a safety step in the production process that slows down the operator. With effective machine safeguarding and training, at-risk behaviors and near misses can be diminished. This also reduces the chance of the fatality occurring, since there is a lower frequency of at-risk behaviors. The variation can be explained by distance or time – for example, the injury was missed by one second or by one inch. Machine safety can make a material. The difference in widening the variation, favorably impacting frequency and severity of claims and, therefore, workers' compensation premiums.



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The Compass: Management Practice Specialty News, Why You've Been Handed Responsibility for Safety, J.J. Keller and Associates, Winter 2000, pp. 1, 4.
Bird Frank E., Germain George L., Loss Control Management: Practical Loss Control Leadership, Revised Edition, Det Norske Veritas (U.S.A.), Inc, Figure 1-3, pp. 5, 1996

The safety triangle, commonly known as the safety pyramid or accident pyramid, has recently come under attack from safety professionals. It was originated in 1931 by H.W. Heinrich and detailed in his book, *Industrial Accident Prevention: A Scientific Approach*. Widely accepted for over 70 years, the safety triangle serves to illustrate Heinrich's theory of accident causation: unsafe acts lead to minor injuries and, over time, to major injury. The accident pyramid (Figure 1) proposes that for every 300 unsafe acts there are 29 minor injuries and one major injury.

Since unsafe acts are difficult to record accurately and Heinrich's theory seems logical, the safety pyramid remained unchallenged for decades. Its widespread acceptance sent safety managers and company presidents in pursuit of unsafe acts under the assumption that if they could control unsafe behavior then the major injury would not occur. In the end, despite targeting unsafe acts through behavioral systems and a variety of difficult-to-administer programs, the major injury still occurred, given enough man-hours.

Over the years, a number of safety managers modified the safety pyramid to create a more quantifiable construct based on Heinrich's theory.

Over time, a greater accumulation of accident data suggested that the pyramid is not an equilateral triangle at all; depending on a company's safety culture, it may take any one of a variety of shapes. For example, companies that attribute blame to employees for incidents tend to have fewer minor and more major injuries.

A March 2003 *Journal of Professional Safety* article, entitled “Severe Injury Potential,” by the highly esteemed safety consultant Fred Manuele indicates that safety professionals should indeed focus on preventing fatal accidents as well as the unsafe act. He says, “Many accidents that result in severe injury are unique and singularly occurring events in which a series of breakdowns occur in a cascading effect.”

While few safety professionals doubt that many factors contribute to the occurrence of an incident, the key elements or indicators of fatal accidents in one industry have been related to the following:

1. Not following lockout/tagout procedures, or not establishing lockout procedures for employees to follow.
2. Not having established, written, safe operating procedures in place for a given function, e.g., a laborer enters the top of a silo to break loose bridged-over material.
3. Not having adequate physical safeguards in place for a given process, such as unguarded bottom-feeding stockpiles.
4. Conducting unsafe practices for convenience, since the risk is perceived as insignificant.
5. Operating mobile equipment in an unsafe manner (perhaps previously allowed, or ignored, by supervisors).
6. Traffic accidents.

Each of the above indicators includes multiple underlying causes. These factors suggest that preventing the fatal accident does not depend primarily upon plant inspections in order to write up a mundane list of small items, such as frayed wires and machine guards. While frayed wires and machine guards in need of replacement can result in serious accidents, the fact remains: they seldom do. The focus of this type of inspection is typically not the prevention of the rare fatal incident, but rather, OSHA compliance. Easy-to-remedy and cheap-to-repair items are generated by safety supervisors who know the potentially severe, adverse political effects of identifying underlying management error, the need for possibly expensive training, failures with orientation, and similar costly issues.

The problem of ignoring the causes of fatal accidents is compounded when management becomes obsessed with the accident record — the dreaded lost-time accident count! Usually considered a freak incident, the rare fatal injury may be excluded from the accident count by one means or another. Many safety professionals are now focusing their efforts on preventing the fatal injury, i.e., focusing on Heinrich's incident pyramid from the top down rather than the bottom up.

Renowned safety consultant and professor Dan Petersen wrote in his second edition of *Safety Management:* “If we study any mass data, we can readily see that the types of accidents resulting in temporary total disabilities are different from the types of accidents resulting in permanent partial disabilities or in permanent total disabilities or fatalities. The causes are different.”

Focusing on the top down, however, can be expensive. Such an approach means conducting a thorough evaluation and step-by-step Job Safety Analysis (JSA) followed by the development of a written Safe (Standard) Operating Procedure (SOP) for every job in each plant. Because plants are seldom identical in equipment or production demands, a qualified safety professional should spend time with crew members evaluating and documenting their specific duties. Accordingly, employee training should be conducted on the basis of the JSA and SOP so that the requirements of each job are thoroughly understood.

Whenever an employee is observed not using a safety procedure, the oversight should be addressed immediately. As well, the supervisor should practice self-examination: Is the employee performing out of urgency to meet stringent production demands perceived as required by management. A more action-oriented pyramid could be developed as indicated below.

Identify a level of importance in preventing catastrophic injury

Identify a level of importance in preventing catastrophic injury	
Importance	Action
Most Important	Evaluate equipment and provide all available safety equipment and process equipment necessary to eliminate hazards
	Evaluate process and procedures, developing detailed Jon safety Analyses and Safe Operating Procedures
Least Important	Provide Training

Developing the JSA and SOP are not desk jobs. If JSAs and SOPs are poorly developed merely to satisfy an administrative requirement, more damage can be done to the safety effort than if they were omitted completely.

A practice that sorely damages a safety effort is blaming all injuries on the employee. Another of Heinrich's theories is “multiple causation,” i.e., all accidents occur as a result of many factors or multiple causes. Based on this theory is the “Root Cause Analysis” used in incident investigations whereby the obvious physical circumstance of the incident is investigated to determine its cause, and what led to that, and so forth, until no further upstream or lateral factors can be identified. To avoid litigation and the obvious political ramifications of following the cause upstream, many companies simply identify the cause of most incidents as employee error or failure to follow safety rules. This simple — and somewhat dishonest defense — is brutal to employees and their families and may generate long-term “attitude” problems among other employees.

5.2 Who should do the occurrence investigating?

Ideally, an investigation would be conducted by someone experienced in occurrence causation, experienced in investigative techniques, fully knowledgeable of the work processes, procedures, persons, and industrial relations environment of a particular situation.

Some jurisdictions provide guidance such as requiring that it must be conducted jointly, with both management and labour represented, or that the investigators must be knowledgeable about the work processes involved.

In most cases, the supervisor should help investigate the event. Other members of the team can include:

- employees with knowledge of the work
- safety officer
- health and safety committee
- union representative, if applicable
- employees with experience in investigations
- "outside" expert
- representative from local government

5.2.1 Should the immediate supervisor be on the team?

The advantage is that this person is likely to know most about the work and persons involved and the current conditions. Furthermore, the supervisor can usually take immediate remedial action. The counter argument is that there may be an attempt to gloss over the supervisors shortcomings in the occurrence. This situation should not arise if the occurrence is investigated by a team of people, and if the worker representative(s) and the members review all occurrence investigation reports thoroughly.

5.2.2 The Supervisor's Role in the Occurrence Investigation

Your involvement in occurrence investigation may include the requirement to assist in the investigation as part of a team, assembling statutory and non-statutory reports and perhaps presenting the report to the site senior executive or equivalent senior management representative.

As a Supervisor, it is essential that you are involved in investigations into incidents that occur within your area of responsibility, as supervisors:

- Have a personal interest in the outcome
- Know the people and work conditions the best
- Know how and where to find information needed
- Are able to implement and monitor corrective actions

As a Supervisor, there are a number of actions that you will be required to take, to effectively manage incidents including:

- Take control of the incident scene;
- Ensure the health and/or wellbeing of the casualty (only move seriously injured people if needed to prevent further injury);
- Ensure the Site emergency response plan has been initiated, where appropriate;
- Ensure the incident site is safe, to prevent further escaltion or recurrence of the incident;
- Ensure the incident site is preserved (not disturbed) for the investigation. The site may require securing, such as bunting off the area;
- Notify the Site Manager;
- Submit any preliminary Incident Notification Forms within the company prescribed time frames;
- Organise recording of incident scene details, such as photographs, site sketch and/or video footage;
- Complete/participate in the incident investigation.

It is also important that employees under your control are aware of their role in incident management including:

- If possible, take immediate temporary action to control any remaining hazard at the incident site, ensuring personal safety is not compromised and the incident site is safe;
- Ascertain the extent of any injuries and provide appropriate first aid (or call for first aid assistance). Where possible, remain with the injured person until assistance arrives;
- Raise the alarm and initiate the site emergency response plan, where applicable;
- Report the incident immediately to the Supervisor.

5.3 Understanding causes of incidents.

All incidents are investigated. The depth of the investigation is dependent on the potential risk of the incident (regardless of the actual level of loss or injury). Near-hits are just as important as actual injuries or losses, as they still have the potential to cause harm if they recur.

To prevent the recurrence of incidents and injuries it is necessary to:

- Identify the contributing factors and root causes of the incident
- Determine the appropriate corrective actions required to prevent the incident occurring again

5.3.1 Why look for the "root cause"?

An investigator who believes that occurrences are caused by unsafe conditions will likely try to uncover conditions as causes. On the other hand, one who believes they are caused by unsafe acts will attempt to find the human errors that are causes. Therefore, it is necessary to examine some underlying factors in a chain of events that ends in an occurrence.

The important point is that even in the most seemingly straightforward occurrences, **seldom, if ever, is there only a single cause**. For example, an "investigation" which concludes that an occurrence was due to worker carelessness, and goes no further, fails to seek answers to several important questions such as:

- Was the worker distracted? If yes, why was the worker distracted?
- Was a safe work procedure being followed? If not, why not?
- Were safety devices in order? If not, why not?
- Was the worker trained? If not, why not?

An inquiry that answers these and related questions will probably reveal conditions that are more open to correction than attempts to prevent "carelessness".

5.4 What are the steps involved in investigating an occurrence?

The occurrence investigation process involves the following steps:

- Report the occurrence occurrence to a designated person within the organization;
- Provide first aid and medical care to injured person(s) and prevent further injuries or damage;
- Investigate the occurrence;
- Identify the causes;
- Report the findings;
- Develop a plan for corrective action;
- Implement the plan;
- Evaluate the effectiveness of the corrective action;
- Make changes for continuous improvement.

As little time as possible should be lost between the moment of an occurrence or near miss and the beginning of the investigation. In this way, one is most likely to be able to observe the conditions as they were at the time, prevent disturbance of evidence, and identify witnesses. The tools that members of the investigating team may need (pencil, paper, camera, film, camera flash, tape measure, etc.) should be immediately available so that no time is wasted.

5.5 Preparing to conduct the investigation

It is necessary for the investigation team to meet prior to starting the investigation. This is to cover the investigation process, or the steps that are to be taken during the investigation. Within this discussion they will cover the known facts relating to the incident and specific role of each team member.

5.5.1 Planning tools and equipment

Review the requirements of the investigation with regard to the tools you need, to ensure that they are adequate for the job. These can include torch, tape measure, chalk, etc. It could be a good idea to have an incident investigation kit on hand for all investigations similar to the one depicted below.

Typical items in a incident investigation kit should include:

1. Bound notebook
2. Clipboard/pad, pens and pencils
3. Graph paper
4. Paint stick (yellow/black) / Chalk (yellow/white)
5. Camera, with film and flash
6. Digital video camera with sufficient memory
7. Audio recorder
8. Straight edge rule for scale reference in photos
9. Tape measure - preferably 100-ft.
10. Scotch, masking and duct tape
11. High visibility plastic tape to demarcate area
12. Identification tags
13. Flashlight
14. First-aid kit
15. Appropriate personal protective equipment
16. Sturdy gloves
17. Specimen containers
18. Hazard monitoring equipment
19. Investigator’s checklist and report forms
20. Interview or statement forms

5.5.2 It is important to first understanding the scope of the investigation

The investigation team should understand the scope of the investigation so that each member can be familiarized with the plan of action, their role and the gathering of the necessary resources.

The investigation team is usually picked prior to your task.

5.5.3 The scene of the incident needs to be identified

Team members should become familiar with the scene of the incident and its boundaries, especially if you have not visited the area prior to the investigation. This includes specific environmental issues as well as the machinery and equipment used. Find out what PPE you need to use so you don't put yourself at risk whilst at the scene.

5.5.4 Team members should be both mentally and physically prepared to conduct the investigation.

Once the scene has been identified team members should be aware of the physical & environmental conditions so that they understand the conditions of the scene (i.e. if the scene requires stair climbing the investigators needs the requisite physical ability to do so, or the scene might be underground or at height so the investigators might have going underground or fear of heights, they may also need to wear certain PPE respirators or require vaccination prior to them entering the area).

Investigators should prepare themselves emotionally for the investigation as they the incident might be a serious occurrence or fatality to a friend or colleague.

5.5.5 Injured workers(s)

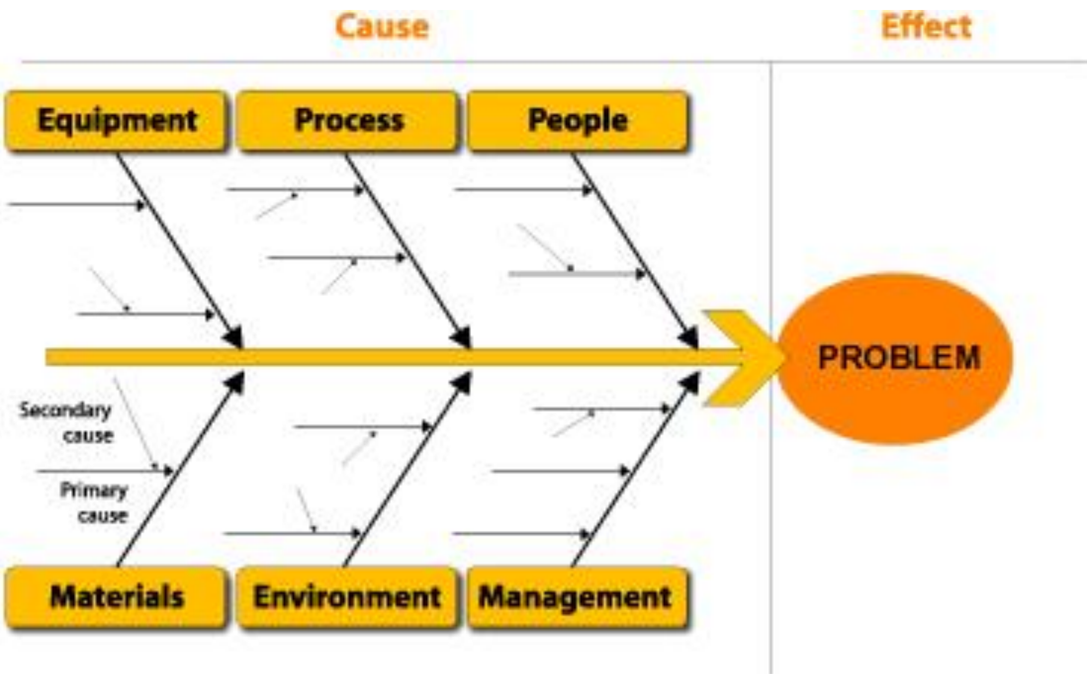
The most important immediate tasks--rescue operations, medical treatment of the injured, and prevention of further injuries--have priority and others must not interfere with these activities. When these matters are under control, the investigators can start their work.

5.6 Incident Causation Models

5.6.1 What should be looked at as the cause of an occurrence?

Many models of incident causation have been proposed, ranging from Heinrich's domino theory to the sophisticated Management Oversight and Risk Tree (MORT).

Ishikawa diagrams were proposed by Kaoru Ishikawa in the 1960s, who pioneered quality management processes in the Kawasaki shipyards, and in the process became one of the founding fathers of modern management. The figure below shows a simple Ishikawa diagram. Note that this tool is referred to by several different names: Ishikawa diagram, Cause-and-Effect diagram, Fishbone diagram, and Root Cause Analysis. The first name is after the inventor of the tool, Kaoru Ishikawa (1969) who first used the technique in the 1960s. It is a graphic tool used to explore and display opinion about sources of variation in a process. The purpose is to arrive at a few key sources that contribute most significantly to the problem being examined. These sources are then targeted for improvement. The diagram also illustrates the relationships among the wide variety of possible contributors to the effect.



The basic concept in the Cause-and-Effect diagram is that the name of a basic problem of interest is entered at the right of the diagram at the end of the main "bone". The main possible causes of the problem (the effect) are drawn as bones off of the main backbone. The "Four-M" categories are typically used as a starting point: "Materials", "Machines", "Manpower", and "Methods". Different names can be chosen to suit the problem at hand, or these general categories can be revised. The key is to have three to six main categories that encompass all possible influences. Brainstorming is typically done to add possible causes to the main "bones" and more specific causes to the "bones" on the main "bones". This subdivision into ever increasing specificity continues as long as the problem areas can be further subdivided. The practical maximum depth of this tree is usually about four or five levels. When the fishbone is complete, one has a rather complete picture of all the possibilities about what could be the root cause for the designated problem.

The Cause-and-Effect diagram can be used by individuals or teams; probably most effectively by a group. A typical utilization is the drawing of a diagram on a blackboard by a team leader who first presents the main problem and asks for assistance from the group to determine the main causes which are subsequently drawn on the board as the main bones of the diagram. The team assists by making suggestions and, eventually, the entire cause and effect diagram is filled out. Causes can be traced back to root causes with the 5 Whys technique. Once the entire fishbone is complete, team discussion takes place to decide what are the most likely root causes of the problem. These causes are circled to indicate items that should be acted upon, and the use of the tool is complete.

The **5 Whys** is a question-asking method used to explore the cause/effect relationships underlying a particular problem. Ultimately, the goal of applying the 5 Whys method is to determine a root cause of a defect or problem.

The following example demonstrates the basic process:

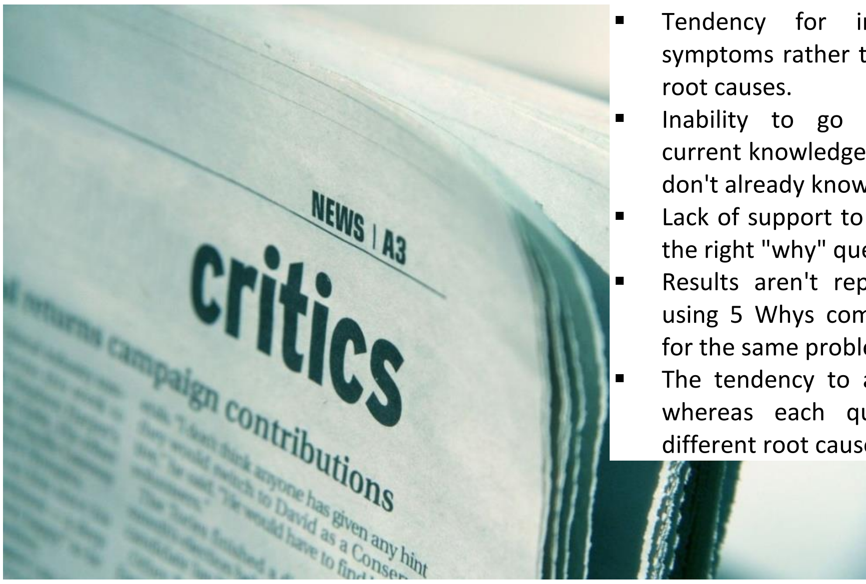
- My car will not start. (the problem)

1. *Why?* - The battery is dead. (first why)
2. *Why?* - The alternator is not functioning. (second why)
3. *Why?* - The alternator belt has broken. (third why)
4. *Why?* - The alternator belt was well beyond its useful service life and has never been replaced. (fourth why)
5. *Why?* - I have not been maintaining my car according to the recommended service schedule. (fifth why, a root cause)

The questioning for this example could be taken further to a sixth, seventh, or even greater level. This would be legitimate, as the "five" in 5 Whys is not gospel; rather, it is postulated that five iterations of asking why is generally sufficient to get to a root cause. The real key is to encourage the troubleshooter to avoid assumptions and logic traps and instead to trace the chain of causality in direct increments from the effect through any layers of abstraction to a root cause that still has some connection to the original problem.

The technique was originally developed by Sakichi Toyoda and was later used within Toyota Motor Corporation during the evolution of their manufacturing methodologies. It is a critical component of problem solving training delivered as part of the induction into the Toyota Production System. The architect of the Toyota Production System, Taiichi Ohno, described the 5 whys method as "... the basis of Toyota's scientific approach ... by repeating why five times, the nature of the problem as well as its solution becomes clear.

While the 5 Whys is a powerful tool for engineers or technically savvy individuals to help get to the true causes of problems, it has been criticized by Teruyuki Minoura, former managing director of global purchasing for Toyota, as being too basic a tool to analyze root causes to the depth that is needed to ensure that the causes are fixed. Reasons for this criticism include:



- Tendency for investigators to stop at symptoms rather than going on to lower level root causes.
- Inability to go beyond the investigator's current knowledge - can't find causes that they don't already know
- Lack of support to help the investigator to ask the right "why" questions.
- Results aren't repeatable - different people using 5 Whys come up with different causes for the same problem.
- The tendency to a isolate single root cause, whereas each question could elicit many different root causes

These can be significant problems when the method is applied through deduction only. On-the-spot verification of the answer to the current "why" question, before proceeding to the next, is recommended as a good practice to avoid these issues.

The Ishikawa diagram, like most quality tools, is a visualization and knowledge organization tool. Simply collecting the ideas of a group in a systematic way facilitates the understanding and ultimate diagnosis of the problem.

How to Construct:

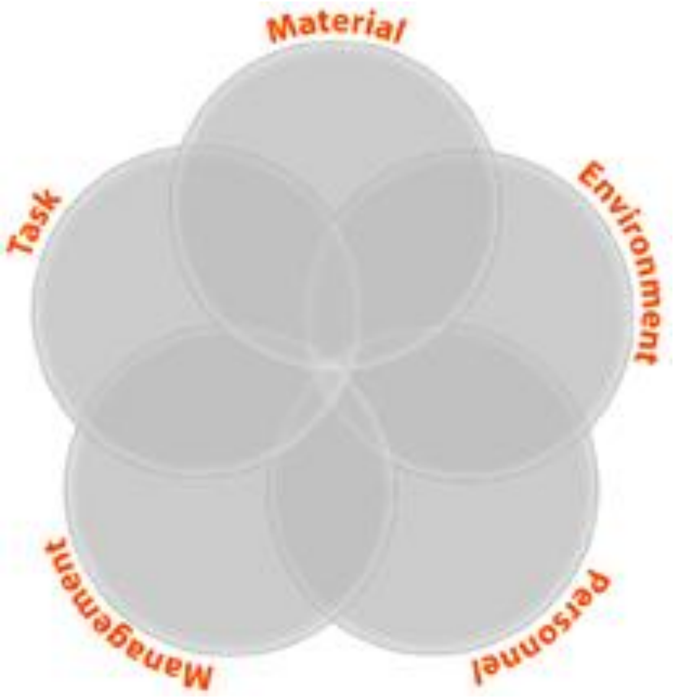
1. Place the main problem under investigation in a box on the right.
2. Have the team generate and clarify all the potential sources of variation.
3. Use an affinity diagram to sort the process variables into naturally related groups. The labels of these groups are the names for the major bones on the Ishikawa diagram.
4. Place the process variables on the appropriate bones of the Ishikawa diagram.
5. Combine each bone in turn, insuring that the process variables are specific, measurable, and controllable. If they are not, branch or "explode" the process variables until the ends of the branches are specific, measurable, and controllable.

Tip:

- Take care to identify causes rather than symptoms.
- Post diagrams to stimulate thinking and get input from other staff.
- Self-adhesive notes can be used to construct Ishikawa diagrams. Sources of variation can be rearranged to reflect appropriate categories with minimal rework.
- Insure that the ideas placed on the Ishikawa diagram are process variables, not special caused, other problems, tampering, etc.
- Review the quick fixes and rephrase them, if possible, so that they are process variables.

The simple model shown in Figure 1 attempts to illustrate that the causes of any occurrence can be grouped into five categories - task, material, environment, personnel, and management. When this model is used, possible causes in each category should be investigated. Each category is examined more closely below. Remember that these are *sample* questions only: no attempt has been made to develop a comprehensive checklist.

Figure: Occurrence Causation



5.6.2 Task

Here the actual work procedure being used at the time of the occurrence is explored. Members of the occurrence investigation team will look for answers to questions such as:

- Was a safe work procedure used?
- Had conditions changed to make the normal procedure unsafe?
- Were the appropriate tools and materials available?
- Were they used?
- Were safety devices working properly?
- Was lockout used when necessary?

For most of these questions, an important follow-up question is "If not, why not?"

5.6.3 Material / Equipment

To seek out possible causes resulting from the equipment and materials used, investigators might ask:

- Was there an equipment failure?
- What caused it to fail?
- Was the machinery poorly designed?
- Were hazardous substances involved?
- Were they clearly identified?
- Was a less hazardous alternative substance possible and available?
- Was the raw material substandard in some way?
- Should personal protective equipment (PPE) have been used?
- Was the PPE used?
- Were users of PPE properly trained?

Again, each time the answer reveals an unsafe condition, the investigator must ask **why** this situation was allowed to exist.

5.6.4 Environment

The physical environment, and especially sudden changes to that environment, is factors that need to be identified. The situation at the time of the occurrence is what is important, not what the "usual" conditions were. For example, occurrence investigators may want to know:

- What were the weather conditions?
- Was poor housekeeping a problem?
- Was it too hot or too cold?
- Was noise a problem?
- Was there adequate light?
- Were toxic or hazardous gases, dusts, or fumes present?

5.6.5 Personnel

The physical and mental condition of those individuals directly involved in the event must be explored. The purpose for investigating the occurrence is **not** to establish blame against someone but the inquiry will not be complete unless personal characteristics are considered. Some factors will remain essentially constant while others may vary from day to day:

- Were workers experienced in the work being done?
- Had they been adequately trained?
- Can they physically do the work?
- What was the status of their health?
- Were they tired?
- Were they under stress (work or personal)?

5.6.6 Management

Management holds the legal responsibility for the safety of the workplace and therefore the role of supervisors and higher management and the role or presence of management systems must always be considered in an occurrence investigation. Failures of management systems are often found to be direct or indirect factors in occurrences. Ask questions such as:

- Were safety rules communicated to and understood by all employees?
- Were written procedures and orientation available?
- Were they being enforced?
- Was there adequate supervision?
- Were workers trained to do the work?
- Had hazards been previously identified?
- Had procedures been developed to overcome them?
- Were unsafe conditions corrected?
- Was regular maintenance of equipment carried out?
- Were regular safety inspections carried out?
- Was a JSA or Take 5 carried out?
- Were the maintenance logs completed and in accordance to the servicing requirements?
- Were any permits, licenses or competencies required to undertake this task?
- Had this issue been reported previously i.e. in any meetings?

This model of occurrence investigations provides a guide for uncovering all possible causes and reduces the likelihood of looking at facts in isolation. Some investigators may prefer to place some of the sample questions in different categories; however, the categories are not important, as long as each pertinent question is asked. Obviously there is considerable overlap between categories; this reflects the situation in real life. Again it should be emphasized that *the above sample questions do not make up a complete checklist, but are examples only.*

5.7 Collecting the Facts

The steps in occurrence investigation are simple: the occurrence investigators gather information, analyze it, draw conclusions, and make recommendations. Although the procedures are straightforward, each step can have its pitfalls. As mentioned above, an open mind is necessary in occurrence investigation: preconceived notions may result in some wrong paths being followed while leaving some significant facts uncovered. All possible causes should be considered.

Collect physical evidence such as photos, videos, broken equipment, damaged insulation etc. Use the investigation tools and all your senses to ensure you take in all the information such as the size and shape of equipment/areas, where the equipment and people were located, what they were doing, etc. If a long time has lapsed since the incident, things could have changed dramatically. Immediate control measures could have been implemented to protect other workers or assets such as equipment or machinery. Make notes of these.

Look for the smallest things: the unexplained marks, the paint scrapes, the oil stains, and the rubbish in the cab. If this data is available, record it. It may not be available later.

Consider people's ownership of the incident. Remember to respect this. The greater the ownership, the more likely the people will be emotional about the incident. Remember that there could be people who have a vested interest who believe they know the 'fix'. Ensure you are not swayed by their biases and pre-determined outcomes. This is also true in the next step of the process - interviewing.

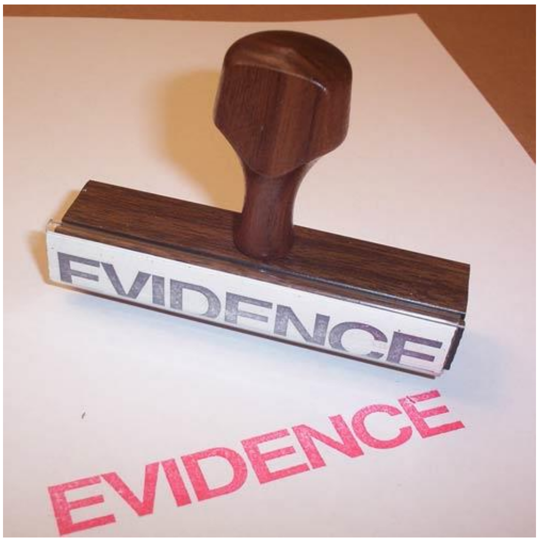
Making notes of ideas as they occur is a good practice but conclusions should not be drawn until all the information is gathered.

Write everything down. Record observations and discuss them with the other investigators and the people at the site. Even if the information seems irrelevant, it could be important when analysing it later. Sometimes the information collected seems different to what you have been told. Make a note of this but do not challenge it at this point in time. Often, people tell their own story of what they believed happened.

5.8 Physical Evidence

Inspect the incident site as soon as possible after the incident. If not done so already, ensure the site is secured by barricading, etc. and limiting access to the site. This not only protects the evidence at the site but it is necessary if the incident is 'notifiable' under the relevant mining and/or safety legislation.

Before attempting to gather information, examine the site for a quick overview, take steps to preserve evidence, and identify all witnesses. In some jurisdictions, an occurrence site must not be disturbed without prior approval from appropriate government officials such as the coroner, inspector, or police. Physical evidence is probably the most non-controversial information available. It is also subject to rapid change or obliteration; therefore, it should be the first to be recorded. Based on your knowledge of the work process, you may want to check items such as:



- names and positions of all witnesses of the incident
- names and positions of injured workers
- equipment being used
- materials or chemicals being used
- safety devices in use
- position of appropriate guards
- position of controls of machinery
- damage to equipment
- housekeeping of area
- weather conditions
- lighting levels
- noise levels
- time of day

You may want to take photographs before anything is moved, both of the general area and specific items. Later careful study of these may reveal conditions or observations missed previously. Sketches of the occurrence scene based on measurements taken may also help in subsequent analysis and will clarify any written reports. Broken equipment, debris, and samples of materials involved may be removed for further analysis by appropriate experts. Even if photographs are taken, written notes about the location of these items at the occurrence scene should be prepared.

Consider the time of day when the incident occurred to better appreciate the lighting level, amount of dust/fumes, the amount of noise, intensity of the sun, number of people, fatigue levels, community and social influences etc.

You should go into the investigation with an open mind. Try to control your biases. Do not draw conclusions or consider recommendations until you have collected and analysed all the facts.

5.9 Taking Photographic Evidence

<u>Tips for useful incident scene photographs</u>

- ✓ Ensure you have sufficient film, memory space and batteries.
- ✓ Take large enough photograph images so that they can be enlarged without losing image clarity i.e. at least 2mega-pixel.
- ✓ Review your photos before moving onto the next image.
- ✓ Ensure that you have a time and date stamp on the images when recording.

- ✓ If able also take some video footage of the scene with the camera.
- ✓ Photograph the scene from all sides.
- ✓ Use long/medium/close-up sequence. First, take a photo to show the general scene, and then move in to show the immediate work areas. Then get a close-up of the damage etc perhaps using other common objects to demonstrate relative size.
- ✓ Consider taking photos of the tape reading measurement, angle incline on the inclinometer, force gauge etc.
- ✓ Photograph important signs i.e. certification plaques, warning information, registration plates, serial numbers, dates of inspection tags etc.
- ✓ Back up your images to a duplicate location as soon as possible.
- ✓ Photograph the entire scene including the equipment and adjoining equipment.
- ✓ Know your camera - use the correct exposure, flash etc to ensure photos are clear.
- ✓ Take a back-up disposable camera in case your main camera is damaged or won't work.

5.10 Eyewitness Accounts

Although there may be occasions when you are unable to do so, every effort should be made to interview witnesses. In some situations witnesses may be your primary source of information because you may be called upon to investigate an occurrence without being able to examine the scene immediately after the event. Because witnesses may be under severe emotional stress or afraid to be completely open for fear of recrimination, interviewing witnesses is probably the hardest task facing an investigator.

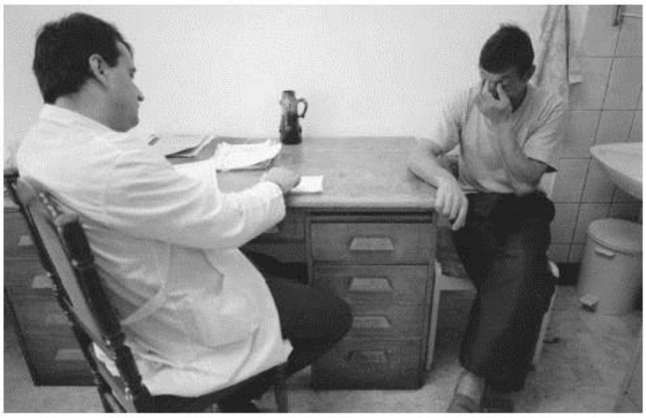
Although there may be occasions when you are unable to do so, every effort should be made to interview witnesses. In some situations witnesses may be your primary source of information because you may be called upon to investigate an occurrence without being able to examine the scene immediately after the event. Because witnesses may be under severe emotional stress or afraid to be completely open for fear of recrimination, interviewing witnesses is probably the hardest task facing an investigator.

There could be people you are about to interview who have been involved in the incident and have emotional concerns. Under no circumstances should you try to intervene in the treatment of the person/s directly involved in the incident who has been injured or who are incapable of recounting the events.

Witnesses should be kept apart and interviewed as soon as possible after the occurrence. If witnesses have an opportunity to discuss the event among themselves, individual perceptions may be lost in the normal process of accepting a consensus view where doubt exists about the facts.

Witnesses should be interviewed alone, rather than in a group. You may decide to interview a witness at the scene of the occurrence where it is easier to establish the positions of each person involved and to obtain a description of the events. On the other hand, it may be preferable to carry out interviews in a quiet office where there will be fewer distractions. The decision may depend in part on the nature of the occurrence and the mental state of the witnesses.

You should also consider the possibility that the people whom you are interviewing may be experiencing Post Traumatic Stress Symptoms which include (but are not limited to):



- Not wanting to talk or talking incessantly.
- Crying or abnormally unemotional.
- Feeling nauseated.
- Angry and argumentative.
- Other abnormal behaviour.

5.11 Interviewing

Interviewing is an art that cannot be given justice in a brief document such as this, but a few do's and don'ts can be mentioned. The purpose of the interview is to establish an understanding with the witness and to obtain his or her own words describing the event:

DO...

- put the witness, who is probably upset, at ease;
- emphasize the real reason for the investigation, to determine what happened and why;
- let the witness talk;
- listen to volunteered information but do not assume any information is conclusive;
- confirm that you have the statement correct (summarize or paraphrase what has been said);
- try to sense any underlying feelings of the witness;
- understand the information before making notes;
- make short notes or ask someone else on the team to take them during the interview;
- ask if it is okay to record the interview, if you are doing so;
- close on a positive note.

DO NOT...

- intimidate the witness;
- interrupt them;
- prompt them;
- ask leading questions;
- don't debate issues;
- show your own emotions;
- jump to conclusions.

Ask open-ended questions that cannot be answered by simply "yes" or "no". The actual questions you ask the witness will naturally vary with each occurrence, but there are some general questions that should be asked each time:

- Where were you at the time of the occurrence?
- What were you doing at the time?
- What did you see, hear?
- What were the environmental conditions (weather, light, noise, etc.) at the time?
- What was (were) the injured worker(s) doing at the time?
- What happened?
- Why did the incident occur?
- In your opinion, what caused the occurrence?
- How might similar occurrences be prevented in the future?

REMEMBER

- **Your major task is to understand what happened**

If you were not at the scene at the time, asking questions is a straightforward approach to establishing what happened. Obviously, care must be taken to assess the credibility of any statements made in the interviews. Answers to a first few questions will generally show how well the witness could actually observe what happened.

Key Questions to ask

Who? Get the names of everyone involved, near, present or aware of possible contributing factors.

What? Describe materials and equipment involved, check for defects, get an exact description of chemicals involved, etc.

Where? Describe exact location, note all relevant facts, i.e. lighting, weather, floor conditions, etc.

When? Note exact time, date and other factors, i.e. shift change, work cycle, break period, etc.

How? Describe usual sequence of events and actual sequence of events before, during and after the incident.

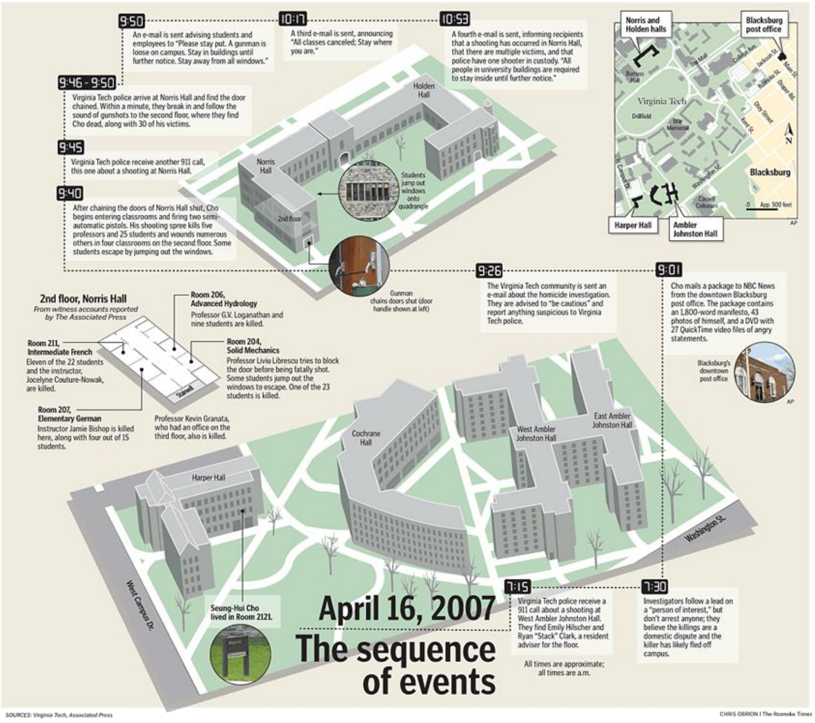
Why? Find all possible direct and indirect causes AND how to keep it from happening again.

5.12 Sequence of Events

Another technique sometimes used to determine the sequence of events is to re-enact or replay them as they happened. Obviously, great care must be taken so that further injury or damage does not occur. A witness (usually the injured worker) is asked to reenact in slow motion the actions that preceded the occurrence.

It is important to understand the **sequence of events that led to the incident** so we can analyse each event within the timeline of the incident. It is important how you describe the sequence of events. Context setting must be objective and free of bias and it is **important that there is no important information missing.** Use a white board or chart paper so the investigation team can easily review the information. Use the information from the description of the incident to piece together the sequence.

Figure: Sequence of Events for Virginia Tech Massacre



Footnote: *The* ***Virginia Tech massacre*** *was a school shooting that took place April 16, 2007 on the campus of Virginia Polytechnic Institute and State University (Virginia Tech) in Blacksburg, Virginia, United States. In two separate attacks, approximately two hours apart, the perpetrator, Seung-Hui Cho, killed 32 people and wounded many others before committing suicide. The massacre is the deadliest peacetime shooting incident by a single gunman in United States history, on or off a school campus.*

5.13 Background Information

A third, and often an overlooked source of information, can be found in documents such as technical data sheets, health and safety committee minutes, inspection reports, company policies, maintenance reports, past occurrence reports, formalized safe-work procedures, and training reports. Any pertinent information should be studied to see what might have happened, and what changes might be recommended to prevent recurrence of similar occurrences.

5.14 Incident Description

This is the time when you need to gather other information that is relevant to the task or activity. This could include **standard work procedures, material safety data sheets, work instructions, process flow charts, etc.**

A **complete description of the incident** must be compiled before the analysis starts. This is to ensure that everything is clear as to what happened and that all evidence has been collected to make an objective assessment following the analysis. This should start by describing the task/situation, as it would normally occur, referring to any relevant standard procedures, etc.

Describe events that occurred or situations that were present prior to the incident, which appear to relate to why the incident occurred, or that may have contributed to the severity of the incident. Cover the full time span through to the recovery and response actions. In the case of an injury, the description should include the transfer of the person to medical aid. Confine the description to the incident at hand. If other information is raised that is important but not related, document and deal with it separately. Otherwise, the investigation report can be discredited.

As part of the description, list for reference all the activities and equipment in use at the time of the incident. Consider those activities directly involved in the incident as well as other activities that may have been happening around the area at the time or before the incident. This helps to identify all the potential issues. As stated before, it **may be necessary to involve 'experts'**. A good example is to involve the site electrician in electrical type incidents as they have the expertise to help better understand this type of incidents.

Use all the relevant evidence collected. If there is evidence that is inconclusive or conflicts with other information, it will be necessary to 'prove' the correct information by re-examining the issue. Sometimes you realise there is missing information. Collect this to complete the description.

Incident Contact

Whenever substandard practices and conditions are permitted to exist, the door is always open for the occurrence of the incident that may or may not result in a loss. The incident is "undesired", since the final results of its occurrence are difficult to predict and are most frequently a matter of chance.

The incident contact refers to the object, substance or circumstance directly involved in inflicting the injury or disease. Australian Standard *AS 1885.1 -1990 Measurement of occupational health and safety performance - Describing and reporting occupational injuries and disease (known as the National Standard for workplace injury and disease recording)* refers to these as the agency of injury/disease and they include:

- Falls from a height
- Falls on the same level (including trips and slips)
- Hitting objects with a part of the body
- Exposure to mechanical vibration
- Being hit by moving objects
- Exposure to sharp sudden sound
- Long term exposure to sounds
- Exposure to variations in pressure (other than sound)
- Repetitive movement with low muscle loading
- Other muscular stress
- Contact with electricity
- Contact or exposure to heat and cold
- Exposure to radiation
- Single contact with chemical or substance (excludes insect and spider
- bites and stings)
- Long term contact with chemical or substance
- Other contact with chemical or substance (includes insect and spider
- bites and stings)
- Contact with, or exposure to, biological factors
- Exposure to mental stress factors
- Slide or cave-in
- Vehicle accident

5.15 Identifying Damaging Energies

The concept of Damaging Energy concept was introduced in the 1960's is that any injury to people, or damage to equipment, is the result of an exchange of energy. In an investigation, it can be useful to look at the types of damaging energies that were involved.

As well as considering the energy that actually did the damage, look at other energies that were present that could have resulted in other injuries, or made the injuries worse.

The basic categories of damaging energy are:

Gravitational	▪ Found wherever objects could fall from a height onto a person or where a person could fall from a height, slip or trip on the same level or fall to a level below ▪ Injuries may range from lacerations to death.
Noise & vibration	▪ Found wherever people are exposed to noise or vibration; ▪ Injuries may range from whole body vibration, white finger to noise induced hearing loss.
Chemical	▪ Found wherever people could inhale, ingest or absorb a range of liquids, dusts, fumes, gases or substances react to cause damage such as fire, explosion or corrosion; ▪ Injuries range from acute to chronic, may have a long latency and could result in death.
Electrical	▪ Found wherever electricity is used to operate equipment; ▪ Injuries range from burns to death.
Mechanical	▪ Mechanical energy is the energy which is possessed by an object due to its motion or due to its position. Mechanical energy can be either ***kinetic energy*** (energy of motion) or ***potential energy*** (stored energy of position). ▪ Found in machinery where there are moving parts that create trapping points or entanglement, or where there may be ejection of parts; ▪ Injuries range from lacerations, amputations, to death.
Thermal	▪ Found wherever there are hot or cold environments or objects e.g. furnaces/cool rooms, hot processes, welding, hot/cold objects; ▪ Injuries range from burns, heat stress/heat exhaustion, hypothermia, hyperthermia, to death.
Pressure	▪ Found wherever vessels/objects are under pressure including boilers, gas cylinders, compressed air; ▪ Injuries range from laceration to death.
Radiation	▪ Found wherever there are x rays, UV radiation, microwaves, lasers

	or welders; ▪ Injuries range from burns to death.
Microbiological	▪ Found wherever people could be exposed to bacteria, viruses or other pathogens such as in body substances, cooling towers; ▪ Injuries may range from acute to chronic, may have long latency and could result in death e.g. HIV, hepatitis, food poisoning.
Biomechanical	▪ Found wherever muscles are used for doing work including lifting, pushing, pulling holding, restraining or where work involves repetitive use of muscles; ▪ Most common injury is muscle strain.
Psychosocial hazards	▪ Found where the way work is organised, the relationships or interactions which operate within the work environment create a potential for harm, or specific events occur that may lead to post-traumatic stress.

A simple hazard identification check list can be compiled using the energy damage concept.

- ☐ Can it move?
- ☐ Can it fall?
- ☐ Is it powered?
- ☐ Is it sharp?
- ☐ Does it make a noise?
- ☐ Is electricity supplied?
- ☐ Is it hot or cold?
- ☐ Is it a chemical?
- ☐ Is it a source of ignition?
- ☐ Does it give off radiations (X-ray UV etc.)?
- ☐ Are there bugs (bacteria, viruses, other)?
- ☐ Are people walking, running, swinging limbs?
- ☐ Are people in awkward or fixed postures?
- ☐ Are people likely to overload muscles or work at high pace?
- ☐ Are people likely to be hit/attacked by another (purposefully or inadvertently)?

5.16 Understanding the Event

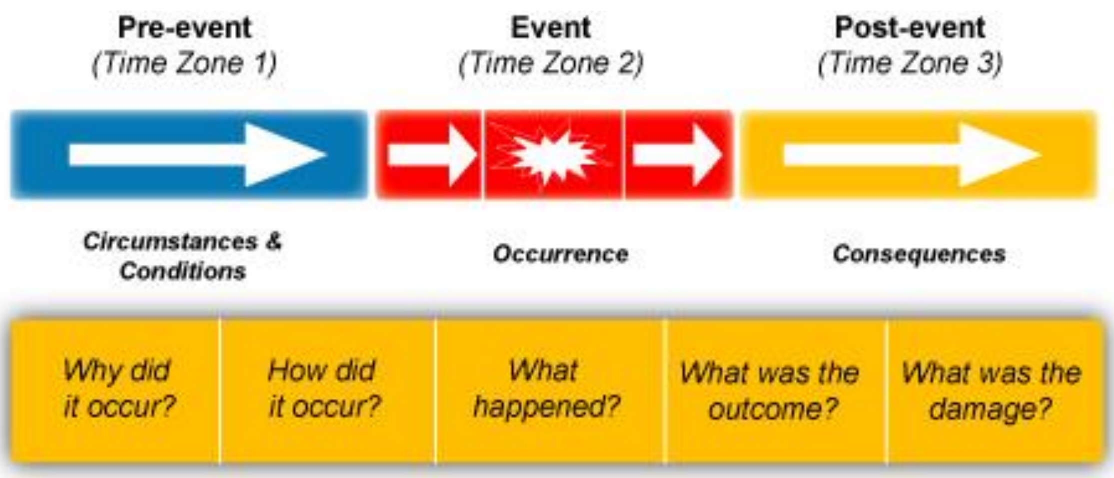
An **event** is the point in time at which control is lost over the potentially damaging properties of the energy source. **(What happened?)**

There are usually many reasons for this loss of control **(How the accident happened?)** and conditions that lead to these reasons for the loss of control over the energy **(Why it happened?)** develop over a period of time.

The reasons why it happened may come directly or through the interaction of one or more of 5 sources:

- the organisational and management environment;
- physical environment;
- equipment;
- procedures; and
- people and human error.

To be proactive, we must identify these conditions and reasons prior to an event occurring, i.e. identify the WHY and take corrective actions to remove the WHY and HOW.



5.17 Root Cause & Contributing Factors

Identifying the **Root Cause and Contributing Factors** of the incident is the next step in the analysis. Root Cause and Contributing Factors are identified through analysis to focus the development of recommendations that will eliminate the recurrence of a similar incident.

The definition of Root and Contributing Factors is:

Root Cause

A Root Cause must be present (or absent) to enable a sequence of events to continue, leading to damage.

Contributing Factors

A Contributing Factor is one that increases the likelihood that the sequence of causes will alter the level of damage (better or worse) but not prevent the sequence continuing.

The Root Causes and Contributing Factors should be examined and **worded in terms of what something was or wasn't 'doing' or 'being'**. The above example relates to the sequence of events mentioned earlier. It is important to write down only facts and not assumptions. There is no blame, no subjective interpretation – just a statement of fact. Remember, a **Root Cause** has to be present (or absent) in order for the incident sequence to continue. **Contributing Factors** are also vital to the investigator. The presence or absence of Contributing Factors make the event more or less likely or more or less severe and therefore are important to identifying areas for mitigating future damage.

When all the relevant facts have been collected and the sequence of events established, it will allow you to analyse all the information and list factors that were involved in the energy exchange, or why the incident occurred. Use a white board or a flip chart to analyse the incident. This allows all the members of the team to see at a glance all the information.

It is important that:

- The investigation team identifies causes as a team process using the white board or flip chart.
- The process is carried out for each time frame of the incident i.e.
  - before the event started (predisposing conditions)
  - situation commences (it has begun!)
  - metastable – could go one way or the other!
  - when the event started through to immediately prior to becoming unstable (getting dangerous but can recover)
  - immediately prior to the situation becoming unstable through to unstable (no going back now)
  - when the event became unstable through to when damage begins
  - when the damage occurred through to when recovery begins (rescue, emergency response)
  - recovery through to end of the emergency.

- Identify all the causes first, then go back and identify the cause that marks the transition.
- Summarise results.

Analyse the event to determine the cause/s

List all the items in the incident involved in the energy exchange under their respective headings:

- **Management**
- **Environment**
- **Materials**
- **Equipment**
- **Process / Task**
- **People**

Under each item, list the **actual damage** that occurred. Then in brackets, list the damage that could have occurred, or the **potential damage**. At the end of the investigation, actions should also prevent the potential damage from occurring in the future.

How to Construct:

1. Place the main problem under investigation in a box on the right.
2. Have the team generate and clarify all the potential sources of variation.
3. Use an affinity diagram to sort the process variables into naturally related groups. The labels of these groups are the names for the major bones on the Ishikawa diagram.
4. Place the process variables on the appropriate bones of the Ishikawa diagram.
5. Combine each bone in turn, insuring that the process variables are specific, measurable, and controllable. If they are not, branch or "explode" the process variables until the ends of the branches are specific, measurable, and controllable.

Tip:

- Take care to identify causes rather than symptoms.
- Post diagrams to stimulate thinking and get input from other staff.
- Self-adhesive notes can be used to construct Ishikawa diagrams. Sources of variation can be rearranged to reflect appropriate categories with minimal rework.
- Insure that the ideas placed on the Ishikawa diagram are process variables, not special caused, other problems, tampering, etc.
- Review the quick fixes and rephrase them, if possible, so that they are process variables.

The following data gathering checklist could also be used to identify possible causal factors.

People	▪ Who was involved in the incident? ▪ What task was being conducted? ▪ What injury, loss or damage occurred? ▪ How did the incident occur? ▪ Who was involved in the incident? ▪ Who saw the incident (witnesses)? ▪ Who instructed or supervised the injured/persons involved? ▪ Were the people trained, qualified, experienced and authorised to do the task? ▪ Were there any behavioural issues (risk taking acts, shortcuts, omitted actions, inappropriate work method, etc)? ▪ What was the emotional state of the people involved (social/domestic pressure, conflict, bullying and job demands)? ▪ When did supervision last see the injured person before the incident? ▪ Was everyone involved in the task fit for work (including alertness, physical ability, fatigue and overexertion)? ▪ Why was the person using the particular work method (doing the task this way)? ▪ How long has this person been doing this job? ▪ How much experience does this person have with this task? ▪ Had the person conducted a pre-start inspection prior to commencing this task? ▪ Was the person wearing the correct protective clothing? ▪ Was the person required to use any permits or tagging to do this task? ▪ When did this person start this shift? ▪ How many shifts has this person worked prior to this event? ▪ Was the person an employee, contractor or visitor?
Equipment	▪ What equipment, tools and plant was being used? ▪ What were the part /model no.s? ▪ What was the equipment being used for at the time of the incident? ▪ Was the equipment appropriate for the job? ▪ What PPE was being used? ▪ What materials were being used? ▪ What and how much damaged or loss occurred? ▪ How old was the equipment? ▪ When was the equipment last inspected/serviced (records)? ▪ Was it inspected/serviced by a qualified person? ▪ Who manages the inspection and services? ▪ Were the machine guards and other protection systems in place and operational? ▪ How effective was the protection systems? ▪ Was the equipment properly designed? ▪ Was the equipment being used according to its specifications? ▪ Where was the equipment located at the time of the incident? ▪ Was the equipment/tools fit for purpose and in safe condition (including PPE)? ▪ Was there any unauthorized modifications or design deficiencies? ▪ Why did the equipment/tools/materials fail? ▪ Had there been any previous reports about problems, defects, issues with this equipment?

Environment	▪ When did the incident occur (date/time)? ▪ Where did the incident occur (location)? ▪ What were the conditions of the worksite and natural environment (i.e. lighting, visibility, glare, hot, cold, wet, dry, ventilation, confined space, noise, vibration, working at heights, working in trenches, driving, vehicle/people interaction and control, working surface, ground state, access and egress, congestion, housekeeping, climate)? ▪ Was repetitive movement, abnormal or strained posture or manual handling tasks involved? ▪ What environmental (worksite or natural) damaged occurred? ▪ Had there been any recent changes to the location of the incident? ▪ Was there adequate space at the incident scene for the task to occur? ▪ Was there any other task or equipment that contributed to the incident? ▪ Did the pre-start or risk assessment allow for environmental issues to be addressed? ▪ Did the risk assessment recognize any environmental issues? ▪ Was housekeeping adequate?
Management	▪ What procedures were in place for conducting the task (JHA, SWP/Permits/MSDS)? ▪ How did the procedures fail? ▪ What instructions were given to the persons involved in the task? ▪ Was the work method appropriate to the task? ▪ Were the procedures available at the worksite? ▪ Were the procedures followed? ▪ Were required authorisations implemented (such as permits and JHAs)? ▪ Who developed and authorised the procedures? ▪ Were the permits followed? ▪ How effective was the task planning and preparation? ▪ How effective was the written/verbal communication? ▪ Were the hazard/risk controls effectively implemented? ▪ Were all hazards identified? ▪ Were all hazards controlled to an acceptable level? ▪ Was supervision adequate? ▪ Was the training provided effective? ▪ Was there a register of training? ▪ Were those involved in the incident trained and competent? ▪ What job demands existed (time constraints, extended hours of work, conflicting priorities) ▪ Were there any resourcing issues (materials, tool/equipment or people)? ▪ Were at risk conditions, practices or behaviours tolerated? ▪ Was the emergency response effective? ▪ Was there compliance with the safe system of work?

5.17.1 Determine Contributing Factors

Several causes often contribute to an incident. Contributing Factors are events or issues that, if corrected, could have prevented an incident from occurring or significantly reduced the outcome. From the facts identified, you must decide what the critical Contributing Factors is.

5.17.2 Determine Root Cause/s

A root cause is the underlying cause of an incident that can be reasonably identified and controlled, and when controlled would prevent the incident from recurring. To determine root cause, we must ask why or how each of the Contributing Factors occurred. If root causes are correctly identified, by eliminating them we can see that the incident would not have occurred. Root causes are often related to underlying systems or processes. Often there is more than one root cause.

6.0 Analysis & Conclusion

What should I know when making the analysis and conclusions?

At this stage of the investigation most of the facts about what happened and how it happened should be known. This has taken considerable effort to accomplish but it represents only the first half of the objective. Now comes the key question--why did it happen? To prevent recurrences of similar occurrences, the investigators must find all possible answers to this question.

You have kept an open mind to all possibilities and looked for all pertinent facts. There may still be gaps in your understanding of the sequence of events that resulted in the occurrence. You may need to reinterview some witnesses to fill these gaps in your knowledge.

When your analysis is complete, write down a step-by-step account of what happened (your conclusions) working back from the moment of the occurrence, listing all possible causes at each step. This is not extra work: it is a draft for part of the final report. Each conclusion should be checked to see if:

- it is supported by evidence
- the evidence is direct (physical or documentary) or based on eyewitness accounts, or
- the evidence is based on assumption.

7.0. Recommendations

Why should recommendations be made?

The most important final step is to come up with a set of well-considered recommendations designed to prevent recurrences of similar occurrences. Once you are knowledgeable about the work processes involved and the overall situation in your organization, it should not be too difficult to come up with realistic and appropriate corrective actions. Corrective actions should be identified for all contributing factors. However, root causes must be addressed in order to prevent the incident from occurring again. In determining the appropriate corrective actions, keep in mind the hierarchy of control.

Corrective actions must be:

- **Specific** - recommendations are activities that can be undertaken by a work group and not general motherhood statements. e.g. “all people to take care”
- **Measurable** - to determine if recommendations are effective
- **Achievable** - recommendations are feasible and practical
- **Realistic** - recommendations must be relevant, proportional to the risk and within our control (e.g. you may not be able to fix the pot hole as it is a public road. However, you can notify the Main Roads Department)
- **Timely** - recommendations must be completed in appropriate timeframes
- **Effective –** does the control reduce to risk of recurrence
- **Reviewed** – reassess controls implemented to ensure they remain effective

Resist the temptation to make only general recommendations to save time and effort.

For example, you have determined that a blind corner contributed to an occurrence. Rather than just recommending "eliminate blind corners" it would be better to suggest:

- install mirrors at the northwest corner of building X (specific to this occurrence)
- install mirrors at blind corners where required throughout the worksite (general)

If the analysis has been done thoroughly and the causal factors correctly identified, developing recommendations will be less difficult. Remember when making recommendations, it can be helpful to ask the ‘why’ questions to ensure that the recommendations you are making are actually addressing the causes of the incident for example:

1. **Why?** – because the driver disobeyed the speed limit
2. **Why?** – because it was common practice – everyone did it
3. **Why?** – to keep the production rate up
4. **Why?** – because production was rewarded, safety wasn’t
5. **Why?** – management philosophy

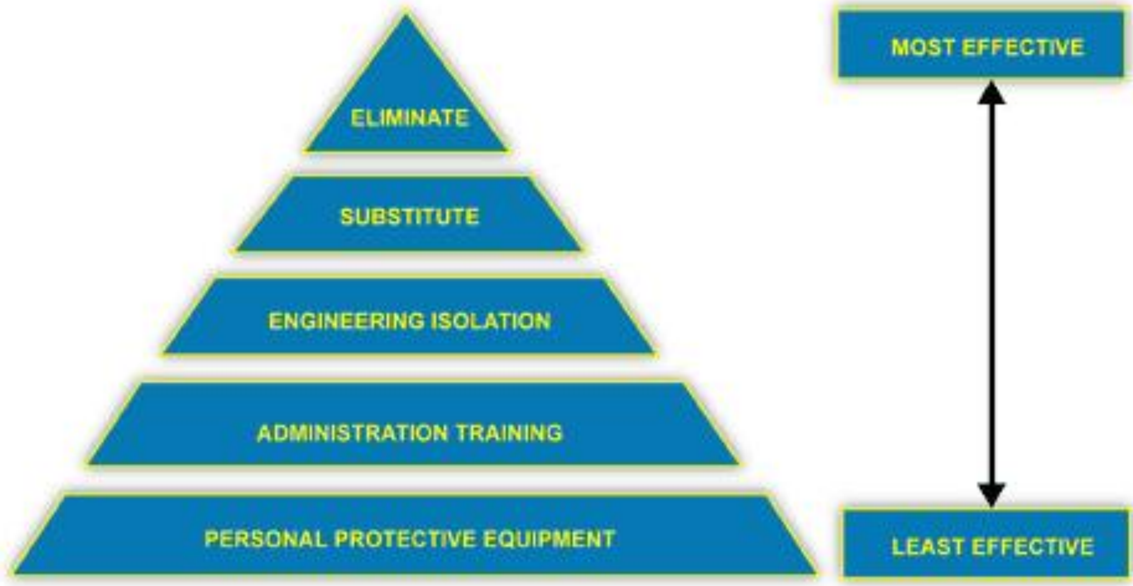
The recommended action ‘tell people to obey the speed limit’ would not be effective, as it would not remove the cause of speeding. A recommended action that management should align reward systems with desired safety behaviours would be more effective.

Actions that focus on the person’s behaviour and the need to write more procedures are less effective than engineering out problems. It is better to install a limiting device on a metal press that does not allow an employee to operate the machine until the guard is in place, than to train the employee not to put his hand near the press action. Remember, when considering recommendations, always start from the top of the Hierarchy of Controls Model to be more effective in eliminating or reducing the possibility of the incident recurring.

The “Most Effective” risk control measures from the hierarchy of control model should be applied to reduce the risk rating to As Low As Reasonably Possible (ALARP). Several control measure identified and implemented may reduce the likelihood and consequence of the event.

PPE and administration controls should not be used as sole control. Each control identify should be risk assessed to verify that controls do not introduce further hazards.

Figure: 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 - 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?

Once a control has been implemented, you must reassess the residual risk associated with that hazard (i.e. repeat the risk assessment). This will enable you to determine how effective the control was in reducing the risk to as low as reasonably practicable. Sometimes, a control measure may actually introduce a new hazard that now needs to be managed.

Controls must be monitored over time to ensure that they remain effective. The workplace also needs to be closely monitored for new hazards. These may both be done through workplace inspections.

Never make recommendations about disciplining a person or persons who may have been at fault. This would not only be counter to the real purpose of the investigation, but it would jeopardize the chances for a free flow of information in future occurrence investigations.

In the unlikely event that you have not been able to determine the causes of an occurrence with any certainty, you probably still have uncovered safety weaknesses in the operation. It is appropriate that recommendations be made to correct these deficiencies.

8.0. Written Report

If your organization has a standard form that must be used, you will have little choice in the form that your written report is to be presented. Nevertheless, you should be aware of, and try to overcome, shortcomings such as:

- If a limited space is provided for an answer, the tendency will be to answer in that space despite recommendations to "use back of form if necessary."
- If a checklist of causes is included, possible causes not listed may be overlooked.
- Headings such as "unsafe condition" will usually elicit a single response even when more than one unsafe condition exists.
- Differentiating between "primary cause" and "contributing factors" can be misleading. All occurrence causes are important and warrant consideration for possible corrective action.

Your previously prepared draft of the sequence of events can now be used to describe what happened. Remember that readers of your report do not have the intimate knowledge of the occurrence that you have so include all pertinent detail. Photographs and diagrams may save many words of description. Identify clearly where evidence is based on certain facts, eyewitness accounts, or your assumptions.

If doubt exists about any particular part, say so. The reasons for your conclusions should be stated and followed by your recommendations. Weed out extra material that is not required for a full understanding of the occurrence and its causes such as photographs that are not relevant and parts of the investigation that led you nowhere. The measure of a good occurrence report is quality, not quantity.

Always communicate your findings with workers, supervisors and management. Present your information 'in context' so everyone understands how the occurrence occurred and the actions in place to prevent it from happening again.

The reporting process must be made in a suitable format. A good report will contain:

- Accurate and complete information
- Clear and complete description of the sequence of events leading to the incident
- Correct identification of all the causal factors
- Clear and complete description of the causal factors
- Corrective actions already taken
- Recommendations for corrective actions to reduce or eliminate the chance of a recurrence of the same or a similar incident, based on:
    - Feasibility
    - Costs
    - Effect on production
    - Time to implement
    - Extent of supervision required
    - Acceptance by employees
    - Acceptance by management
- Recommendations for corrective actions to improve the management system
- Details of the intended review of the implementation
- Dated signatures of the investigation team.

The Department has developed a reporting manual to assist organizations understand how to complete the online reporting required for monthly and annual reporting requirements.

QUEENSLAND MINING INDUSTRY REPORTING MANUAL

INSTRUCTIONS FOR COMPLETION OF ON-LINE INCIDENT REPORT, MONTHLY SUMMARY & ANNUAL CENSUS FORMS

Mining and Quarrying Safety and Health Act 1999

Coal Mining Safety and Health Act 1999

June 2009

Queensland **the Smart State**

Queensland Government
Department of **Mines and Energy**

9.0 Human Error

What should be done if the investigation reveals "human error"?

9.1 Human Error

Human error can be the reason behind both the basic and immediate causes of incidents. Human error can and will occur at all levels of the management of a workplace, since no person is perfect. We all make mistakes, but in many instances within the workplace such mistakes can lead to incidents. Human error in the performance of work tasks typically occur as a result of:

9.1.1 Basic or inherent limitations of people

Each individual has inherent limitations as do people in general. For example people are poorly designed to lift heavy objects from the floor, Workplaces, practices or equipment designed without taking into consideration the human factors will increase the likelihood of error.

9.1.2 Physical and mental stresses that exceed the employee's ability to cope

Physically or mentally stressful environments also increase error rates. Some individuals may be overstressed in jobs or tasks that others perform without difficulty. This is especially true for new employees or employees recently transferred from other jobs. Too much stress increases error rates, so does too little stress. Jobs or tasks that do not require sufficient mental or physical effort to challenge the employee result in boredom and inattention. Noisy, hot and humid, cold and dry and similar environments also result in stresses that overload employees and increase error rates (faulty events) and thus cause incidents.

9.1.3 Management Errors

Management errors, like other errors, result from honest mistakes or lack of knowledge, not from an intentional disregard of what is required. The identification of management errors can prevent recurrences of the same type of problems in the future. Management may err by not detecting hazards, by not providing adequate training for management personnel, supervisors or employees, or by not enforcing safety and health rules.

A difficulty that has bothered many investigators is the idea that one does not want to lay blame. However, when a thorough worksite occurrence investigation reveals that some person or persons among management, supervisor, and the workers were apparently at fault, then this fact should be pointed out. The intention here is to remedy the situation, not to discipline an individual.

Failing to point out human failings that contributed to an occurrence will not only downgrade the quality of the investigation. Furthermore, it will also allow future occurrences to happen from similar causes because they have not been addressed.

However never make recommendations about disciplining anyone who may be at fault. Any disciplinary steps should be done within the normal personnel procedures.

10.0. Follow - Up

How should follow-up be handled?

Management is responsible for acting on the recommendations in the occurrence investigation report. The health and safety committee, if you have one, can monitor the progress of these actions.

Follow-up actions include:

- Respond to the recommendations in the report by explaining what can and cannot be done (and why or why not).
- Develop a timetable for corrective actions.
- Monitor that the scheduled actions have been completed.
- Check the condition of injured worker(s).
- Inform and train other workers at risk.

Re-orient worker(s) on their return to work.

11.0 Statistical Measurement (AS1885.1)

The National Occupational Health and Safety Commission in conjunction with Standards Australia has developed Australia Standard *AS 1885.1 Measurement of occupational health and safety performance - Describing and reporting occupational injuries and disease* (known as the National Standard for workplace injury and disease recording).

The Standard AS 1885.1 deals with the recording of workplace injury and disease, and is intended for use by both large and small organisations. It includes definitions as well as an explanation of the data items which are required to be recorded. A section dealing with interpretation and analysis of the recorded information is included. It provides employers with easy to use methods for the recording of comparable data covering accidents near-miss incidents and diseases at the workplace. These methods include incidence rate, frequency rate, average time lost rate, as well as time series analysis and cross tabulations.

11.1 Incidence Rate

The incidence rate is the number of occurrences of injury/disease for each one hundred workers employed.
The following formula should be applied:

$$\frac{\textbf{Number of workers}}{\textbf{Number of occurrences in the period}} \times 100$$

The **'number of occurrences in the period'** refers to all cases of lost-time injury/disease which were recorded in the specified period.

The **'number of workers'** is defined as the average number of workers who worked in the recording period. Persons who were absent from work on paid or unpaid leave for the entire period should be excluded from his calculation

11.2 Frequency Rate

The frequency rate is the number of occurrences of injury or disease for each one million hours worked.
The following formula should be applied:

$$\frac{\textbf{Number of occurrences in the period}}{\textbf{Number of hours worked in the period}} \times 1{,}000{,}000$$

The **'number of occurrences in the period'** is defined in the same way as for the incidence rate.

The '**number of hours worked in the period'** refers to the total number of hours worked by all workers in the recording unit including, for example, overtime and extra shifts.

11.3 Average Time Lost Rate

The average time lost rate is the average time lost per occurrence of injury/disease. For the purposes of this calculation, an upper limit of 12 months off work should be assigned. This rate provides a measure of the severity of the occurrences being experienced by workplaces over time.

The following formula should be applied:

$$\frac{\textbf{Number of working days lost}}{\textbf{Number of occurrences in the period}} \times 1{,}000{,}000$$

The **'number of occurrences in the period'** is defined in the same way as for the incidence rate.

The '**number of working days lost'** refers to the total number of working days, irrespective of the number of hours that would normally have been worked each day, that were lost as a result of the injury/disease up to a maximum of 12 months for any individual occurrence. For the purposes of calculating the average time lost rate, occurrences that result in a fatality should be assigned a time lost of 12 months (220 standard working days).

11.4 Interpreting and Analysing Data

The main function of health and safety statistics is to measure trends over time so that the organisation can monitor its performance establishing improvement or deterioration. For this reason it is important that the data is maintained for several years. The statistics can also provide information on the effectiveness of any corrective action taken as part of a health and safety program.

Converting information to chart form, particularly monthly figures over a moving 12 month period can highlight the periods where there is an increase in incidents. In addition to these basic statistics there are other calculations, cross tabulations and analysis that can be undertaken to assist in the identification and management of health and safety. The data items which may be included are:

- Gender
- Age
- Shift arrangements
- Occupation
- Department
- Time of incident
- Day of incident
- Month of incident
- Training provided
- Nature of injury
- Location of Injury
- Mechanism of injury
- Agency of Injury
- Immediate causes
- Basic causes
- Prevention strategy
- Rehabilitation

By cross tabulating and analysing the above data an organisation can identify problem or trouble areas and implement the necessary strategies.

When presenting this data consideration should be given to the use of graphs and charts as these quickly and clearly communicate information and highlight the problem areas or promote positive results.

11.5 Incident Costs

Workplace injuries, illnesses and occurrences cause serious economic loss at three distinct levels in society:

- The Macro economy of the wider community, the State or Country as a whole.
- The Micro economy of the individual organisation.
- Individual employees who are injured at work and their families.

Within the Macro environment, it is difficult to assess accurately the costs of work related injury or illness. However such costs include production losses, damage and other consequential costs, insurance premiums and public health/medical facility costs.

The National Occupational Health and Safety commission estimates that the total costs to the Australian economy run as high as 27 billion dollars annually. In our present economic climate, as indeed at any time, losses of this magnitude must be considered intolerable.

At the Micro economic level of the individual organisation or firm, there are many additional, sometimes hidden, cost items that can add significantly to the total financial loss through workplace injury or illness. In broad terms, all work related injury/illness costs fall into either of two categories being:

1. Insured costs - covered by WorkCover and other liability insurance policies.
2. Uninsured costs - covered by the organisation

Injured employees can also suffer in economic terms, in spite of a reasonably generous, no fault, compensation system. Many over-award payments and some allowances are not included in compensation payments. Full compensation payments are often limited in terms of time.

There is of course no easy means of quantifying, in monetary terms, pain, suffering and possibly permanent disability that may result from a work related injury or illness, nor the effect of injury or illness on the worker's family.

11.6 Insured Costs – Workers Compensation

In Queensland an employer is legally obliged under the Workers Compensation and Rehabilitation Act 2003 to have a WorkCover Queensland Accident Insurance Policy.

This Policy covers the costs of compensating a worker who sustains a work-related injury or illness.

11.7 Premiums

Most Queensland employers' premiums are based on a system known as experienced-based rating which is an internationally-used system for calculating workers' compensation premiums.

It links the premium with employer's claims. The more claims an employer has, the more expensive the premium. But more importantly, if an employer has no claims or claims where there are minimal costs, there is a good chance the premium will reduce. Experience-based rating is a fair way to calculate an employer's premium because it gives them a chance to reduce their premium, even if other people in industry have high claims.

Some large employers have been licensed by WorkCover as self insurers or have moved into the Federal Comcare System.

Under this self insurance option employers carry their own risk for compensating workers sustain a work-related injury or illness. However to become a self insurer an employer must satisfy WorkCover that they can manage and fund their own claims. There are specific and strict criteria including the number of employees, assets of the company, provision of a bank guarantee, rehabilitation systems and satisfactory health and safety performance.

11.8 Claims

An employer's WorkCover Accident Insurance Policy insures the employer for the costs associated with compensating one of their workers who sustains a work-related injury or illness. It covers such things as:

- weekly compensation (as income replacement) the amount of which
- depends on their employment arrangements
- medical costs (doctor, physiotherapy, etc)
- hospital costs
- rehabilitation costs
- lump sum compensation for permanent impairment
- costs involved with a common law claim.

An employer will need to pay up to the first four days of compensation once liability is accepted by WorkCover unless they have taken out the "excess buyout" option in their policy.

11.9 Insured Costs – Other

The WorkCover Queensland Accident Insurance Policy provides cover only for employees of the employer. Therefore most companies insure against the financial risk from incidents involving non employees by arranging for public liability insurance.

11.10 Uninsured Costs

In almost all incidents, even those where no injury or illness results, there is a range of other factors that can result in significant costs or losses accruing against the organisation. Listed below are some of the cost/loss factors that can apply to individual organisations over and above the insurance costs discussed above.

- First Aid
- Cost of damage to plant, equipment, materials
- Administrative costs
- Wages not covered by compensation (excess, supervisor, first aider,
- investigator)
- Costs of engaging and training replacement labour
- Loss of production
- Extra overtime costs
- Lowered morale - decreased output
- Industrial reaction
- Contract penalties
- Non insured common law costs
- Public Relations damage

Not all of these factors apply in every case however, and it is not difficult to find examples within most organisations where some or all of these factors have applied in the past.

Cost/loss factors such as these will vary from incident to incident and from organisation to organisation. However, they are very real costs and are generally always significantly higher than the insurance losses associated with WorkCover premiums. Uninsured or hidden costs of incidents can be calculated within individual organisations and a formula developed for general incident costing purposes. The usual method is to develop and apply a multiplier ratio to the direct or insurance losses.

Commonly used ratios vary from 1:3 up to 1:10 i.e. hidden/uninsured losses vary from 3 to 10 times direct or insurance losses. Some studies conclude a ratio in excess of 1:30. However, because of the wide variation between organisations, it is important for individual organisations to develop their own formula for calculating these costs.

Organisations often fail to recognise that not only are there statutory ramifications for workplace incidents there are many other costs both direct and indirect. For example the Incident Cost Calculator (see Figure 1 was created by the UK Safety & Health Executive for organisations to begin to appreciate the actual costs of an incident.

12.0. Rehabilitation

Rehabilitation can include such things as a suitable duties program, physiotherapy, counseling, on-the-job training for new job skills and special assistance for severely injured workers. Under s228 of the Workers Compensation & Rehabilitation Act 2003 Qld, an employer must also take all reasonable steps to help or provide an injured worker with rehabilitation or suitable duties while being paid compensation. If the employer does not then they may face a penalty equal to the compensation paid to the injured worker during the time they did not comply (s.229).

An employer, the workers and the workplace morale will all benefit from having a strong commitment to rehabilitation. If an employer can get an injured worker back on the job, they will benefit from less down time and lost productivity, reduced re-training costs and use of casual staff and, importantly, reduced claims costs.

Injured workers benefit because they have less disruption to their family, social and work life, they build improved physical condition and confidence and feel greater job security. Rehabilitation in the workplace also means regular contact with the worker about their recovery. An injured worker receiving compensation under s.232 of the Workers Compensation & Rehabilitation Act 2003 Qld must legally participate in appropriate rehabilitation and suitable duties. Workers' benefits may be suspended if they do not participate.

If you have wages in Queensland of $6.507 million for the preceding financial year or are in a high risk industry with wages in Queensland for the preceding financial year of $1.981 million they must (according to s.226/227):

- appoint a trained Rehabilitation & Return to Work Coordinator (who is an employee) and
- have Q-COMP accredited policy and procedures for workplace rehabilitation in place.

The Rehabilitation & Return to Work Coordinator position may be full-time or part-time (or outsourced), and they may be a current worker whose job will incorporate the Rehabilitation & Return to Work Coordinator's role