



# **INCIDENT/ACCIDENT INVESTIGATION AND ANALYSIS**

**AIGA 013/05**

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# INCIDENT/ACCIDENT INVESTIGATION AND ANALYSIS

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## KEYWORDS

- PREVENTION
- SAFETY
- SAG

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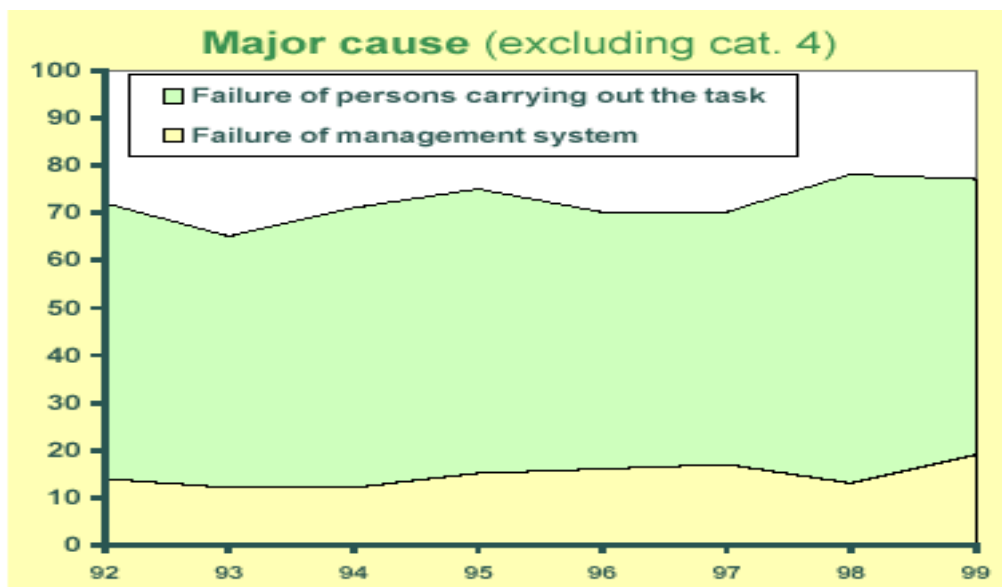
## 1 Introduction

Incident/Accident investigation and analysis are a critical element of safety management. The overriding purpose for an organisation in carrying out incident investigation is prevention of similar incidents as well as seeking a general improvement in the management of health and safety. . The graph below is based on EIGA members' work injury statistics (1992-1999) and it confirms the general experience that in two accidents out of three the cause is blamed on the person carrying out the task. A more careful investigation should have revealed that the accidents were caused by a "lack of management control" due to inadequacies in the SH&E programme, standards, compliance, monitoring of work, etc.

## 2 Scope and purpose

The purpose of this publication is to discuss the key elements of incident/accident investigation, root cause analysis and developing corrective actions to eliminate similar incidents reoccurring.

Typical Industry Data

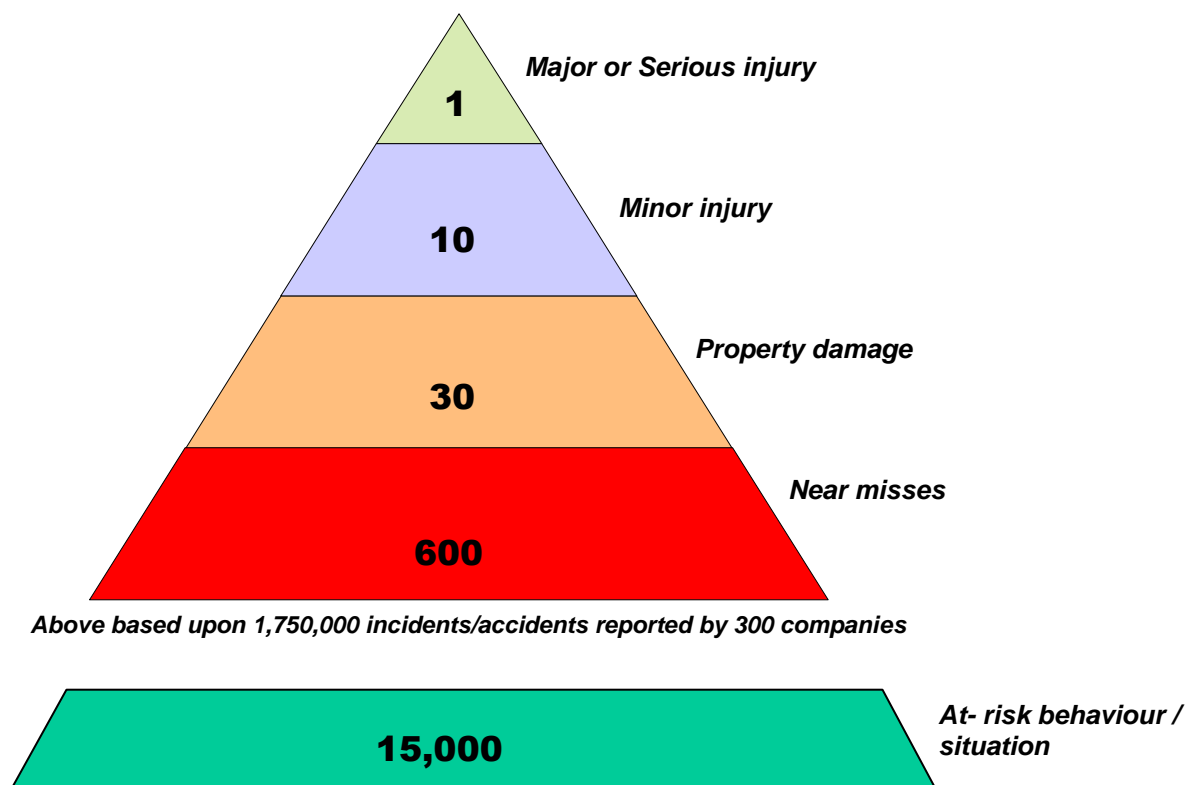


### 3 What are incidents/accidents?

There are a number of definitions of what is meant by the term accident and the similar term incident, which is also sometimes used. Many of these interpretations are included in the definition that an accident is an undesired event giving rise to death, ill health, injury, damage or other loss. An incident is an event that gave rise to an accident or had the potential to lead to an accident.

A number of studies have been carried out showing the relationship between the number of accidents involving fatal injuries, non-fatal injuries, property damage and near misses.

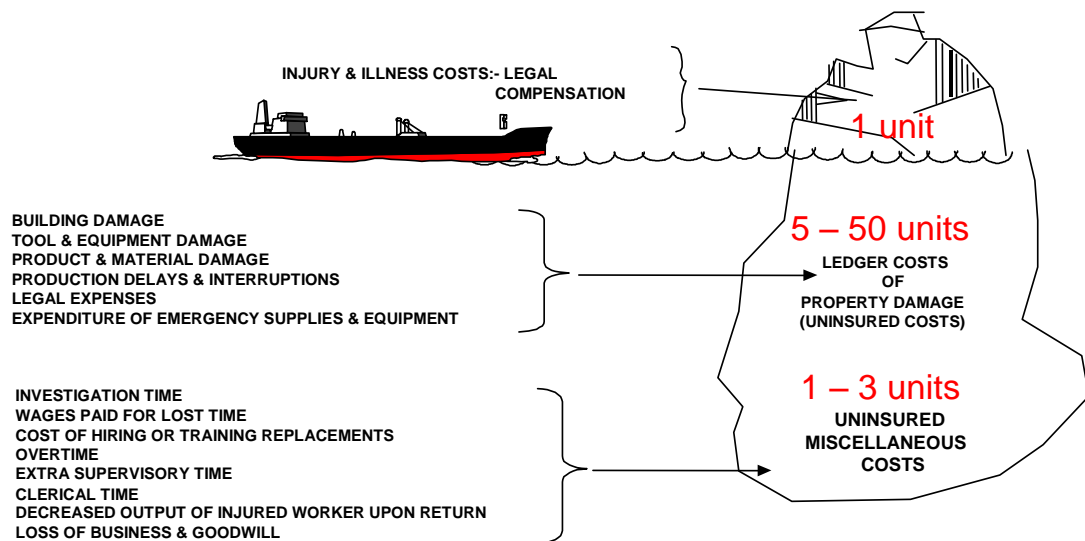
Unsafe behaviour and situation are also considered as contributory causes of accidents. Typical examples are failures to wear the required personal protective equipment (PPE) or to comply with safety rules (e.g. putting on safety seat belts while driving). Statistically, the number of unsafe behaviour or situation observed would be 20 –30 times more in relation to the occurrence of near misses, as shown in the extrapolated base of the triangle.



The severity of the outcome of an accident often depends on chance if organisations fail to identify hazards and control risks properly. There are numerous free learning opportunities for effective control at the base of the triangle and major efforts must be put in this area.

Nothing is more important or more tragic than human aspects of accidental loss, i.e. Injury, pain, sorrow, disability, or death. Adding this overriding human element to the potential of profit improvement, you have the best of both worlds. The figure below (based on the publication by UK Health and Safety Executive report on 'The Costs of Accidents at Work') illustrates many of the hidden costs of accidents which come straight out of profit.

## Incident Cost Iceberg



## 4 Incident investigation

### 4.1 Who should investigate?

Employers have a responsibility to investigate as part of their management of safety. The person leading the investigation should have sufficient authority to implement immediate preventive actions and where necessary to form a team having the required expertise to carry out the investigation. Depending on the size and complexity of the incident, a team may include, for example, a metallurgist, an R&D specialist, a mechanical engineer etc. Companies should also seek external specialist assistance if such expertise is lacking within the organisation. The role and commitment of the supervisor is crucial since he/she represents the first level of management and probably has the best understanding of the local working conditions.

### 4.2 Initial action

There are a lot of things that have to be done when an accident occurs. The success of an investigation comes in the first few moments. A supervisor's initial action varies for every accident. The person on the scene must be the judge of what is critical. These steps are guidelines to apply as appropriate.

- Take control at the scene – supervisors need to take charge, directing and approving everything that is done.
- Ensure first aid is provided and call for emergency services.
- Control potential secondary events – these events such as explosions and fire are usually more serious. Positive actions need to be taken quickly after careful thought of the consequences.
- Identify sources of evidence at the scene.
- Preserve evidence from alteration or removal.
- Notify appropriate management in the organisation.
- Notify regulatory bodies and insurance companies if appropriate

### 4.3 Investigation

It is vital that as much evidence is identified and preserved as soon as possible. If necessary, the whole area should be cordoned off to stop anyone disturbing or destroying the evidence. Some evidence will need to be left in place until all the facts have been gathered, other evidence can be moved as soon as photographs have been taken, sketches drawn, equipment examined and records checked (training, maintenance logs/needs, schedules, job procedures and practices etc.). Electronic digital cameras are particularly useful, since pictures can be taken quickly, studied on the spot and sent to other relevant people in the organisation, thereby facilitating an understanding of the accident.

Interviews are one of the most important means of gaining information about what actually happened. Re-enactments can be useful but should be used carefully by the investigators.

From all the information collected, it is important to identify and select all the significant and relevant facts that may have contributed to the incident and not just to rely on the obvious ones which appear at first sight. It is important to understand 'the big picture' i.e. an orientation to the people, equipment, materials and environment involved in the accident.

In summary the essential elements of collecting the facts for the accident are as follows.

- Identifying sources of evidence at scene;
- Preserving evidence;
- Getting the big picture;
- Making sketches, maps, photographs, videos of the scene;
- Conducting interviews and examinations and material failure analysis;
- Avoiding judgements;
- Checking records.

### 4.4 Analysing accident/incident causes

Numerous accident and root-cause analysis systems have been introduced during recent years.

Following an accident, the immediate causes are easily apparent. They are the circumstances which immediately precede the accident and are often referred to as unsafe acts or unsafe conditions. A more positive outlook is to refer to immediate causes as substandard practices or substandard conditions; the aim of the investigation being to restore standards of safe working practice and standards of safe working conditions. Immediate causes are the symptoms of the problem and tackling these alone will not prevent the problem re-occurring.

The root causes, which lie beneath the symptoms, are the reasons why persons have used substandard practices and why substandard conditions existed.

There are a number of methods of accident analysis of varying degrees of complexity which may be used in an investigation. One method consists of conducting an analysis using the "fault tree method". In this, a sequence of events is plotted starting with the accident and working to the root causes. Next, a cause and effect diagram is drawn to establish means of eliminating the causes. The goal of the study is generate an action plan to eliminate as many of the identified root causes as possible.

### 4.5 Example

*In an oxygen filling plant, Mr Li starts to fill cylinders with oxygen. He notices a leak on the oxygen valve downstream of the pump and atmospheric exchanger. Whilst trying to shut off the valve, he falls over, hitting a profiled section with a sharp edge on the pump frame and cutting his right leg badly.*

A superficial analysis produces the following deductions and measures:

- the accident is put down to lack of care on the part of Mr. Li;
- the valve is replaced with a new one.



A thorough examination and use of the fault tree technique lead to completely different conclusions.

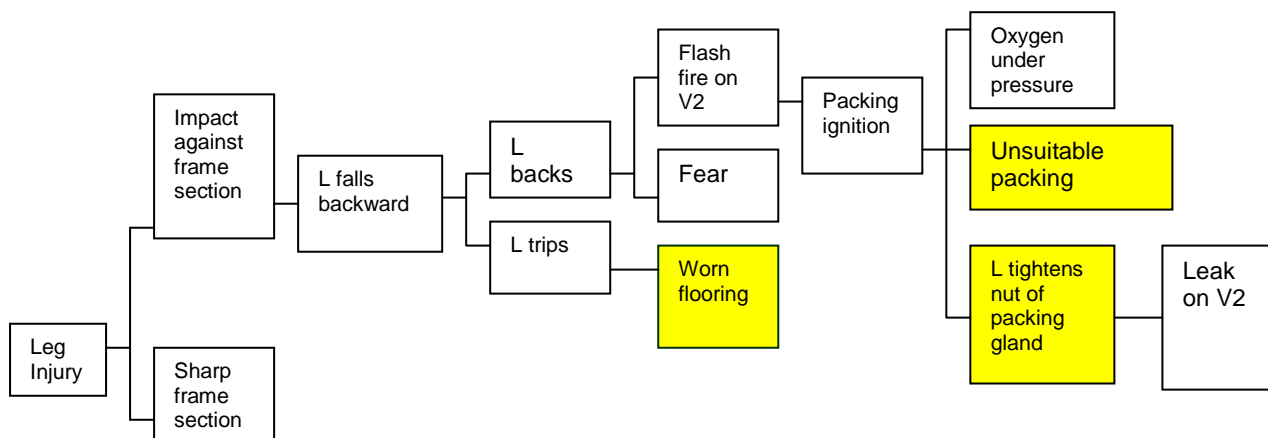
In actual fact, Mr Li began tightening the oxygen valve when a flash fire occurred. He took fright, and moved backwards with a start, tripped on the damaged floor. This is how he came to hit the pump frame. Furthermore, it was established that the material comprising the valve packing was incompatible with oxygen.

In the end, the following preventive measures were taken:

- the valve trim was replaced (with a new packing made of a suitable material),
- the floor was repaired,
- operators were given training (never tighten pressurised parts).

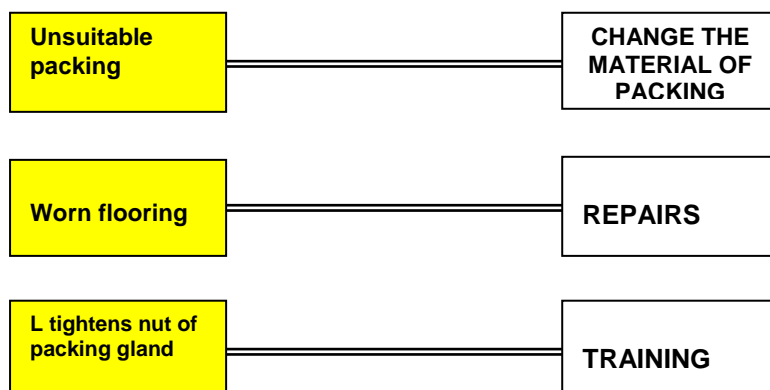
The fault tree revealed by studying the accident is shown below.

### *Tree of Causes – Mr. Li's Accident*



#### CAUSES

#### PREVENTIVE MEASURES



*Cause and effect diagram*

#### 4.6 Report

An investigation report should be written in a timely manner. It communicates facts about the incident/accident. It should identify corrective actions. Most organisations have a standard investigation report form. Using a standard form has several benefits.

1. It raises all the questions that should be answered; i.e. what was the event? What happened? What were the causes? , etc.
2. It provides consistency in data reported. It prompts sharing of information with others. Finally it allows analysis for trend and that helps Safety Management.
3. It provides follow-up corrective actions.

#### 4.7 Developing corrective actions

Adequate corrective actions to minimise or eliminate a problem can only come from a sound investigation, which has truly solved the problem. Otherwise, the problem will occur again and again but with different symptoms.

An action plan must be prepared with target dates and names of people (or department) in charge of the actions. Following up on the action plan up to its completion is essential.

Action Plan Example

Cause/Issues	Action	Responsibility	Completion Date

#### 4.8 Communication

One of the most valuable actions is to circulate information within and outside organisation in an efficient way. The use of photographs is advised since it draws attention and sensitivity of people and helps them to remember.

Communication actions might be:

- Immediate - Safety alerts, training, etc.
- Short term - Newsletters, Group meetings, etc.
- Long term - Changes in Company Standard or Procedures
- Retraining programme

### 5 Summary: – steps in incident/accident investigation and reporting

- Identify what happened and how the incident/ accident could occur;
- Investigate, analyse, report and record accidents and/or near misses utilising the root cause analysis method and other techniques such as brain storming etc....
- Identify all factors contributing to the occurrence (actions, conditions, circumstances etc.,) and management actions/practices necessary to prevent/control future repetition;
- Determine potential areas where current management practices may need further evaluation or action;
- Develop, initiate action plans and strategies to correct deficiencies;
- Capture and track all actions; ensure they are clearly identified and implemented;
- Manage and control, by means of a system providing for a definite assignment of accountabilities

(and completion target dates) that each preventive/corrective action step is implemented.

- Communicate information within and outside organisation.

An internal system should exist and establish that all deficiencies are promptly detected in any other location, plant and activities and that, as mentioned above, suitable preventive/corrective action plans with accountabilities and target dates are enforced to eliminate the identified deficiency.