Incident Investigation: An Advanced Approach

Introduction

A robust and valid incident investigation process is an essential requirement of a health and safety strategy. Understanding the factors that have contributed to business loss and human suffering is key to preventing reoccurrence and promoting more general learning. Given the above it is of no surprise that organisations devote considerable resources to developing their approach to incident investigation. Typically, this involves training people in the required skills and process.

Although organisations are able to choose from a variety of training providers, what is on offer typically follows a relatively similar analytical process. Key features of this process are:

- Establish the facts through various means of data collection (eg interviews)
- Build a time line of the key events
- Establish from the time line the critical factors
- For each of the critical factors establish immediate and root causes
- Generate an action plan to deal with the root causes

The above model has strong "face validity" in that it follows what could be described as a relatively common sense approach to identifying explanations and causes. As human beings, we tend to search for and prefer simple explanations to the events that surround us – particularly when things go wrong. The benefit of this is that we like to think we know why things have happened and therefore to be able to control future events.

The problem with this model is that whilst it may be strong in terms of face validity, the findings that it produces may not be fully representative of actually what happened or, even when they are, they may not promote deep down learning. Instead, they have the tendency to reinforce a relative surface level of explanation. In view of this, the above model may be of questionable validity and may not be as

helpful as we like to think in terms of promoting learning and incident prevention. This may be a factor in why similar incidents seem to reoccur despite remedial action having been applied.

This latter point is something that has been responsible for an increasing emphasis on human factors in the context of incident causation. Recent events such as Texas City have served to reinforce the view that we need to achieve better and deeper understanding as to why we fail to learn from previous events. The Health and Safety Executive (HSE) seem to keen to reposition our focus. In the HSEs Human Factors Toolkit, 3 key concerns are identified. These are as follows:

1. "imbalance between hardware and human issues and focussing only on engineering ones"

2. "focussing on the human contribution to personal safety rather than to the initiation and control of major accident hazards"

3. "focussing on 'operator error' at the expense of 'system and management failures' ".

These concerns, especially 1 and 3, provide the context for this paper. Concern 2 also requires some consideration although our view is that the focus should be on how behaviours have the propensity to cause both individual and organisational accidents.

In the sections that follow, we discuss a variety of themes that we believe ought to be addressed in developing a more rigorous and valid approach to incident investigation. In particular we address three key issues:

- The need for a more **systems perspective**, regarding incidents as the result of a complex web of interactions that take place in organisational time and space

- A greater emphasis on understanding **human failure** as a significant contributor to incident causation
- The requirement to acknowledge and manage the problem of **investigator bias**

In addition to these key issues, an underlying theme of interest is the emotion that is often associated with incident causation and the human tendency to seek to apportion "blame". This creates defensive behaviours and in effect is another form of human failure – a failure that can prevent real and deep learning. Those involved in incident investigation need to understand the wider role they can play in reinforcing a healthier organisational culture, where qualities such as openness and honesty and promoted. Unfortunately, incident investigation is often a political activity, itself driven by the society we live in where there is always an emphasis on identifying who caused the event and actions that need to be taken against them. Unfortunately society often demands such a response. The down side is that this can significantly affect learning and prevention.

Having discussed each of these we then move on to provide an outline of an approach to incident investigation that takes us beyond what we describe as the more traditional approach. In so doing, we hope to provide the basis for organisations to further develop their approach, tools and techniques in this important area, the objective being to achieve deeper and more valid learning.

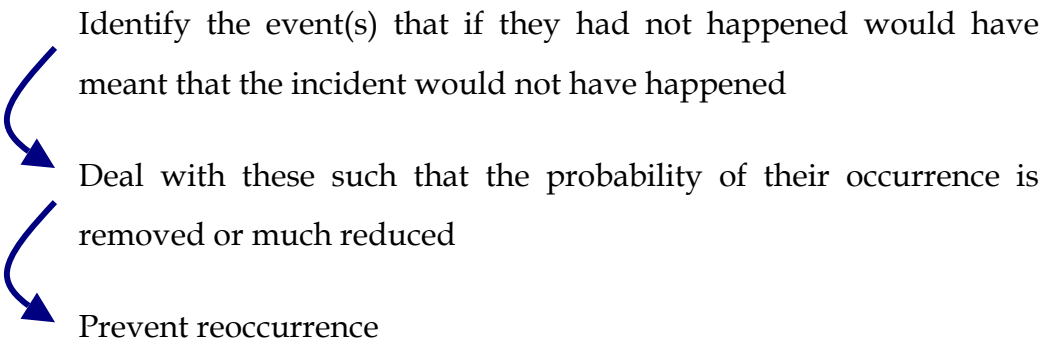
The Nature of Incidents

The traditional "rational" view

A consideration of the above "traditional" approach to incident investigation reveals some implicit and important assumptions. These are:

- The events that lead to an incident are related in a linear fashion separated by time (as represented by the development of the time line of critical events)
- Explanations for the incident can be deduced from the analysis of discrete critical events (through identifying immediate and root / system causes)
- Dealing with the critical event(s) will prevent reoccurrence

These assumptions are strong on logic and reflect a typically rational approach to understanding events:



Our view is that whilst this type of approach and the underlying assumptions can provide reasonable explanations for some events, for many incidents such an approach is overly optimistic and somewhat simplistic. Because of this, the learning that flows from the use of such an approach can be limited. The danger from this can be an initial sense of over-optimism that the problem that led to the incident has been understood and fixed, and a possible sense of surprise when later the same event or a

similar one occurs. At a more macro level, the bigger danger is a sense of over-confidence in the existing approach to incident investigation.

An alternative construction

The "traditional" approach places significant emphasis on the identification of the critical events and seeks to attribute the cause of the incident as a function of these events. In essence, the analysis is concerned with identifying the faulty link(s) within the chain of events, and often these "faulty links" are identified as certain individuals who did something the y should not have done or did not do something they should have done.

An alternative construction is more concerned with the dynamic interaction of events and behaviours and how these together form a system. In such a case, explanations are more concerned with the overall picture, how this has developed, and the dysfunctional nature of the system rather than with faulty links in the chain. The following extract from Peter Senge's book, The Fifth Discipline, provides a metaphor for the issue being addressed:

> "A cloud masses, the sky darkens, leaves twist upward, and we know it will rain. We also know that after the storm, the runoff will feed into groundwater miles away, and the sky will grow clear by tomorrow. All these events are distant in time and space, and yet they are all connected within the same pattern. Each has an influence on the rest, an influence that is usually hidden from view. You can only understand the system of a rainstorm by contemplating the whole, not any individual part of the pattern"

This is a more holistic and dynamic focus and contrasts with the more reductionist emphasis of the traditional approach. Whilst our typical preference as human beings is more for explaining cause and effect in terms of discrete events, research tells us that incidents are often better explained by a consideration of the wider system. (For those interested, the basis for this can be found in the development of what has become known as Attribution Theory.

Given the above, in our attempts to understand incident causation we should be concerned with understanding the dynamics of the system rather than focusing on discrete aspects. Such an approach should promote deeper and more valid learning but by its very nature can be more complex.

As way of an example, investigation of an incident may have revealed incorrect working practise associated with a lack of knowledge as an immediate cause and a lack of training as the root of this. Remedial action might follow that would place more emphasis on competency assurance, and the identification and meeting of training needs. Given what we know about risk management, these actions represent nothing new and reflect what might be regarded as established good practice. Yet the need to re-train is often cited within the recommendations arising out of an investigation when someone has been found to have acted inappropriately. What we might ask is why the original training was ineffective in the first place.

A systems perspective would provide a deeper consideration as to why the known need for competency assurance was given inadequate consideration. In so doing, the analysis would focus on a variety of system determinants such as the social, political and economic and seek to understand the dynamic web of interactions and the nature of the influence being exerted (knowledge inputs, decisions, communication of requirements, unintended influence etc).

Single-loop and double-loop learning

The work of Chris Argyris, although typically directed at organisational dysfunction, is also considered to be useful. Argyris is concerned with learning, and in particular how organisations (and individuals) are not always effective in this respect and even go as far as to develop informal processes that actually impede the learning process. Argyris suggests that organisations typically operate at a surface level rather than get to identify the deeper and more salient issues. In this, he differentiates between single-loop and double-loop learning.

> "… there are at least two ways to correct errors. One is to change the behaviour … . This kind of correction only requires single-loop learning. The second way is to correct errors to change the underlying program … . This is double loop learning." Chris Argyris

The example above citing the tendency to identify re-training as a remedial action is an example of single-loop learning. Double-loop learning would seek to go much deeper and address issues as to why the training was not successful in the first place. In this sense it challenges a key assumption that reads something like "training establishes levels of competence to the degree that the trained person has both the ability and capability to perform as required". Incidents often present a different picture. Double-loop learning is about identifying and challenging some of the key assumptions upon which the existing logic is based – single-loop learning would accept the existing logic.

From the above it is evident that we believe that the incident investigation process should be concerned with establishing a system of dynamic interactions in time and space relating to the loss event, rather than the perhaps easier but less representative focus on faulty links in the chain. Later in this document we will say more about how this can be achieved.

Human Failure

Human Contribution To Loss

It is now generally accepted that human failure features as a significant element in incidents. Many incidents, if not most, are the result of errors or violations. The HSE (Human Factors Toolkit) state that, "studies have shown that up to 90% of accidents are attributable to human failures". In spite of this, the typical approach to incident investigation training includes little emphasis on understanding human failure. We believe that this is a serious weakness.

If those involved in investigating an incident are to make sense of the events they find, then they ought to have some knowledge as to the nature and process of human failure and the conditions that promote it. It could be argued that incident investigation is about understanding human failure and this demands some knowledge of human factors and the conditions, both active and latent that lead to such failure events.

Errors and Violations

There are two distinct broad categories of human failure: errors and violations. Whilst these are quite distinct, they are not necessarily mutually exclusive. As we have already argued, incidents are often the result of a dynamic interaction of a variety of acts and events. In effect, any one incident may involve both errors and violations. Despite this, some understanding of each of these can be useful. (The HSEs HSG48 provides a useful guide to this area.).

Errors

Errors are unintentional in the sense that they do not result from some conscious choice to act in one way in preference to another. Errors result from our inherent inadequacies with respect to cognitive storage, retrieval and processing of

information. From time to time, we all get things wrong. An important name in the understanding of error is Rasmussen. Rasmussen distinguished between three different types of error:

- slips and lapses (skill-based errors)
- poor analysis / problem solving (rule-based errors)
- incomplete information (knowledge-based errors)

Whereas Rasmussen has focused on different error types, others have created models relating to deficiencies in information processing. This knowledge is often used as the basis for what is known as Human Error Analysis. Such analysis is concerned with the potential failure points in the processing of information. These relate to:

- Perception (intake of information, information person is aware of / selects from all that is going on around him / her – error possibility: may not be aware of some important event / item of information)
- Memory (storage of information and learning, retrieving important facts and knowledge – error possibility: forgets important piece of information, remembers critical information but in the wrong order)
- Decision (processing and selection, applying learnt rules, problem solving etc – error possibility: links issues in the wrong way, comes to the wrong conclusion when weighing up facts available)
- Action (response, what the person does – error possibility: chooses the wrong action, intends to do one thing but does something else due to distraction)

Error may result from a deficiency in any of the above or a combination of them.

Errors are inherent within us. We are all prone to errors. This provides some challenge to the often quoted position that "all accidents are preventable". There are some who argue that this is not always a helpful statement and that there are some incidents that are best explained as "random events" and as such are difficult to eradicate totally. (See Robert Whittingham "The Blame Machine").

Norman Perrow has written an interesting book titled "Normal Accidents". In this book her argues that that the very complexity of some of the activities we design, such as the generation of nuclear power, and the fact that they reflect relatively new practices, make accidents inevitable or, in his words "normal".

Our position is that all accidents are preventable … in hindsight. This is an important caveat, for it emphasises that we can make our world a safer place but it also recognises that error is something that is impossible to fully eradicate. Indeed, there have been many significant developments in the development of the human race that have been prompted by the learning that have arisen from errors made.

Violations

Violations are intentional in the sense that they result from some conscious choice to act in one way in preference to another. However, we should not from this assume that violations reflect a deviant character. There are times for example when a worker may take a short cut in order to achieve some important business targets – in effect the choice is made with reference to doing a good job for the company.

Three types of violation have been identified:

- **routine**: behaviours that have been custom and practice – a rule exists but no one follows it
- **situational**: these are a function of pressures or constraints associated with a particular job or situation – in effect the specific nature of the situation induces the violation
- **exceptional**: these are rare and occur when something has already gone wrong and people feel the need to improvise so as to correct the problem.

Active and Latent Failures

James Reason makes a significant distinction between active and latent failures in the context of incident causation. Active failures are often the focus of remedial actions although it is the latent failures that may be more significant with respect to wider and continuing risk exposure. Active failures are the errors and violations that occur in close proximity to the incident and are often described as the immediate cause. Latent failures are more distant from the event in organisational time and space and may or may not be easy to identify. As such, they may or may not feature as system or root causes as a result of an investigation.

However, the requirement must be that we both identify and address all of the latent failures that played a part in the causation of the incident. Only then are we likely to optimise the chances of preventing re-occurrence of the same type of incident but also, importantly, other potential events that may be quite different to the event being investigated but nevertheless a function of the latent failures identified. (There are obvious links here with the Chris Argyris's emphasis on single-loop and double-loop learning).

Clearly, any successful incident investigation process must have the capability to identify the key latent failures and address these so as to maximise the learning opportunity and to prevent reoccurrence and the wider risk issues.

"Stop" Rules

Andrew Hopkins in his dissection of the 1998 Esso gas plant explosion at Longford in Australia discusses the issue of the utility of various levels of explanation. This relates to the distinction between immediate and root causes and in so doing Hopkins describes the "but for" rule. In essence, the use of "but for" points to higher order factors that "but for" their existence the incident would not have occurred. In this context Hopkins refers to Rasmussen's "stop rules" which serve to define how far we should go in our attempts to explain incident causation.

Hopkins suggests that we should "stop when the cause in question is of no practical significance". This avoids explanations that relate to high order causes such as societal factors that whilst they may have a bearing, do not lend themselves to meaningful action. The implication is that for any incident investigation we ought to define the limits of causal explanation in order to ensure that we are able to derive a set of meaningful actions.

Emotionally Driven Attributions

Incidents typically, by their very nature, are emotional events. Likewise accident performance often is a subject that creates a lot of emotional energy in organisations. The demand for a "no accident" performance driven from the top of an organisation, and the consequences in place for not achieving this, affect how people behave. At times the emotion can create unwanted reactions such as defensive behaviours and the result can be barriers to learning. As we will later discuss, these emotional issues can lead to politically driven behaviour and a tendency to need to lay the "blame" at someone's door. This is a further kind of human failure – our inability to be open to

the contribution we all make when things go wrong. Incident investigation teams are themselves open to political influence or even interference. The integrity and strong-will of those involved can be a key feature in ensuring that the real deep-down learning results. This point raises the issue of investigator bias and error and is something that we will consider in more depth in the next section.

Linked with the above is the need to widen the perspective with regard to the causes of human failure. Most often accidents are explained in terms of technical or human (psychological) failure. However, in the search for answers we ought to entertain explanations that include social, political and economic dimensions. This can get very complex. James Reason, for example, shows how the actions of the regulator can serve to make some accidents more likely.

Investigator Bias

Getting to the Truth

We would like to think that the purpose of any incident investigation team is to get to the truth of why things happened in the way they did and to make recommendations so as to prevent reoccurrence. However, as we have already alluded to, expediency can play a part in shaping how incident investigation is addressed either in terms of imposing various operational constraints or even preventing the discussion of certain events or issues. The danger is that the exposure of causal factors can serve to damage the organisation and certain individuals and this can lead to pressures that prevent such exposure. This can be an organisational truth although one that cannot be discussed. Argyris refers to this as the "undiscussability of the undiscussable".

These are social or political biases. There are other biases that further serve to impede our ability to get at the truth. These biases relate to our inability to gain all of the information when the belief is we have a full account of what happened, the way in which we interpret information and how we set about making decisions.

Common biases / distortions

In addition to the social / political biases, the following are tendencies that we ought to be conscious of when investigating incidents. If we recognise such biases then we are more likely to control for them.

Satisficing: from the work of Herbert Simon. We make decisions that serve to satisfy rather than one's that represent the complete answer. In addition, we may recognise what we now and what we don't know, but we may fail to recognise that we don't know what we don't know.

Heuristics: from the work of Kahneman & Tversky. This work identified a number of tendencies. In particular the representativeness heuristic (like causes like) and the

availability heuristic (things are judged to be more frequently occurring the more easily they can be recalled).

Confirmatory evidence: we have a tendency to seek data that confirms the picture we are building up rather than information that will serve to disconfirm. This results in us looking for and finding data to justify our conclusions and even making more of the data we have collected in order to do so. We prefer to be right than proved wrong.

Mental models: we develop theories about our world, which helps us make sense of it. These mental models are our own constructions rather than representing any reality. In effect, we all view the world through our own eyes. This can mean that we favour particular explanations rather than others and this will in turn provide the frame of reference for our investigation of any event.

Groupthink: this is a phenomenon in which a team shares and promotes the same thinking, and the consensus serves to reinforce the view that the shared thinking must be right. What is missing in this type of scenario is an alternative construction and with it challenge. Incident investigation teams could be prone to this phenomenon and the result could be a strongly supported but inaccurate conclusion.

Hindsight: although an incident investigation may, in hindsight, be able to replicate the events that came together to create an incident, this is not necessarily the same as understanding the dynamics that took place during the actual situation. This is something that Sidney Dekker addresses. His argument is that we ought to try and put ourselves in the position of those involved in the event. He uses the metaphor of a tunnel to describe their position – unable to see all of the events around them and certainly unable to see the outcomes. Unless we are able to put ourselves in the same position, then we will struggle to understand the mechanisms that influenced the outcomes. The beauty of hindsight might not always be helpful in preventing reoccurrence. The implication is that we need to be careful about the assumptions we make based on a position of hindsight.

All of the above can play a powerful part in the information we seek to find and our interpretation of it. None of us are free from these biases. Our need is to recognise them and to ensure that we control for them as much as we can. Part of this will involve critical examination of all of our attributions and placing emphasis on seeking to disprove that we are indeed correct in our analysis.

Blame or No Blame?

As we have already suggested, the emotional energy associated with an incident investigation can in itself lead to certain behaviours that may impede the investigation. In this context is the dilemma regarding whether there is a case or otherwise for "blaming" individuals for their actions and the outcomes they create. Our emphasis on the complex nature of behaviour and the preference for a system explanation suggests that blame is inappropriate. This in itself is an over-simplification.

The prime purpose of an incident investigation is to achieve a full understanding of the events and from this identify what needs to happen going forward so as to prevent reoccurrence. Holding people accountable for their actions has a time and place within this, especially in those circumstances with the behaviour has been shown to be premeditated and malicious. However, the search for the blameworthy, with its emotional baggage, is something that can affect an incident investigation process.

In view of this, our position is that attributing blame and applying justice should be handled separately by a different body. This should serve to preserve the integrity of the incident investigation process. Having come to this conclusion, our overall position is that few acts, in the context of incident investigation, when fully understood will be considered blameworthy.

Incident Investigation – An Advanced Approach

The issues raised so far are intended to underline the complexity of the task that an incident investigation team faces. Not only do we need to take into account an understanding of the contributory human factors, we also need to understand how the same human factors have the potential to distort the process and efficacy of the findings. Because of this, our view is that there is a need to advance beyond common practice and further develop how incidents are investigated.

In the paragraphs that follow we present an outline of a more advanced approach. This outline is something that can be developed in the context of how your organisation currently approaches the incident investigation task and build on this so as to advance its practice and achieve deeper learning.

There are a number of key elements to build in to the development of an advanced approach to incident investigation. These are as follows:

- Incident investigation **process**
- Investigator **skills** required (knowledge and abilities)
- Specific **tools** (eg. immediate and root cause, human error analysis)

Incident investigation process

This is concerned with the steps involved – the emphasis is on a systematic approach that will increase the probability of an accurate formulation and lead to an appropriate corrective action plan. The process as set out below probably reflects what most organisations already have in place. Key steps in the process will include:

- An initial appraisal
- Formulating the investigation plan
- Research / data collection
- Data analysis

- Reporting conclusions
- Formulating an action plan

Investigator knowledge and skills

Those involved in the investigation process will require specific skills in order that they have the ability to carry out an investigation that results in an accurate report from which can be identified the key corrective actions required to prevent reoccurrence. In addition to a range of skills required by members of the investigation team, there is also a need for specific team leader skills. It is this area where most development is likely to be required with the need to create more of a human factors approach of central importance.

Knowledge / skills to be developed include:

- Basic requirements in incident investigation (process, protocols, preserving evidence, sensitivities)
- Leading an incident investigation
- Understanding of human failure (types of error and violation, human error analysis, analysis of motives)
- Understanding of potential biases, and how to control for these, in incident investigation
- Hypotheses generation, linking events, distinguishing between correlation and causality
- Data collection techniques, including interviewing
- Building time lines and identifying critical events / behaviours
- Testing the evidence (seeking confirming and disconfirming evidence)
- Describing key linkages in time and space (linking together in a relationship / influence web the chain of events)
- Determining immediate and root causes

- Report writing and action formulation

Developing specific tools

An effective process of incident investigation will include a number of specific tools. These will be required to support the process. These will include:

- A process map and associated guidance
- A set of proformas to support the process (eg planning aids, data collection sheets, event timelines)
- Interview schedules
- Immediate / root cause taxonomy
- Human error analysis / analysis of motives procedures
- Relationship / influence web building protocols

The above is intended to develop a more rigorous approach and from this to produce better learning. The key to this is a greater understanding of the nature of and contribution played by human factors. In the case of large and complex incidents, this itself may not even be sufficient and in such cases there is an argument to directly involve a human factors specialist.

Recommended Reading

1. HSE (1999) **Reducing Error and Influencing Behaviour** (HSG48).
   Published by HSE Books ISBN 0-7176-2452-8

2. HFRG (2000) **Improving Maintenance: A Guide To Reducing Human Error.**
   Published by HSE Books ISBN 0-7176-1818-8

3. James Reason (1990) **Human Error.**
   Published by Cambridge Univ Press ISBN 0-521-31419-4

4. James Reason (1997) **Managing The Risks Of Organizational Accidents.**
   Published by Ashgate Publishing Ltd ISBN 1-84014-105-0

5. James Reason and Alan Hobbs (2003) **Managing Maintenance Error: A Practical Guide.** Published by Ashgate Publishing Ltd ISBN 0-7546-1591-X

6. Charles Perrow (1999) **Normal Accidents: Living With High-Risk Technologies.** Published by Princeton Univ Press ISBN 0-691-00412-9

7. Andrew Hopkins (2000) **Lessons From Longford: The Esso Gas Plant Explosion.** Published by CCH Australia Ltd ISBN 1-86468-422-4

8. Sidney Dekker (2002) **The Field Guide To Human Error Investigations.**
   Published by Ashgate Publishing Ltd ISBN 0-7546-1924-9

9. Barry Strauch (2002) **Investigating Human Error: Incidents, Accidents and Complex Systems.** Published by Ashgate Publishing Ltd ISBN 0-7546-4122-8

10. Robert Whittingham (2004) **The Blame Machine: Why Human Error Causes Accidents.** Published by Elsevier, Butterworth, Heinemann. ISBN 0-7506-5510-0

11. Aubrey Daniels (2000) **Bringing Out The Best In People.**
    Published by McGraw-Hill ISBN 0-07-135145-0

- The Aubrey Daniels book provides a good introduction to Reinforcement Theory (antecedents, behaviour and consequences, ABC Analysis). Readily available from Amazon and the like.

- The Ashgate books are best sourced direct from Ashgate (www.ashgate.com) - 25% discount.

- The HSE Human Factors Toolkit can be found in the COMAH area of the HSE website – downloadable Adobe document.

- Chris Argyris has written widely – but his work can be heavy going. The Peter Senge book (The Fifth Discipline) refers to Argyris's work and is a good read although is not about safety.

- The James Reason books are excellent. Human Error is not so practically orientated but provides a good coverage of what we know about human error. Reason makes significant reference to the work of Jens Rasmussen.

Contact Us

This document provides an overview of the PsychaLogica advanced approach to incident investigation.

Should you wish to learn more about how we can help your company to improve its practice then we would be delighted to hear from you.

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