VALUE ADDED ACCIDENT ANALYSIS - HOW TO PROFIT FROM ACCIDENTS

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SUMMARY

Most companies record information about accidents, to some extent. Very few actually use the data for proactive safety management. Often the data is just used to compile statistics, which while they may show trends in accident prevention performance, do little in the creation of prevention programmes.

This paper looks at accident analysis and suggests that even statistical data can be presented more usefully. We go on to suggest a model for accident causation which links directly with risk management system failures. Accident analysis using this model would avoid the 'logical jump' that normally occurs when accident data is used to suggest accident prevention initiatives. We review two well known accident analysis systems and conclude that they are fairly unfriendly and require considerable skill to use and that the interpretation of the outputs, require specialist knowledge. Finally we suggest a new approach, based on the accident causation model, which require little skill and can lead directly to very useable conclusions.

INTRODUCTION

Accidents not only cause suffering, they also cost companies and the country a great deal of money. The UK HSE found that, typically, accidents cost companies up 37 times the directly insured losses (HSE, 1993). So preventing accidents also makes good business sense.

Once an accident unfortunately happens, it is in everybody's interest, not only to make sure that that exact accident never happens again, but also that the maximum amount of information and understanding is derived from investigating it, to make sure that lessons are learnt and changes take place which act to prevent many other similar accidents occurring. For this reason, many companies investigate accidents and gather information. The government agencies do the same. However it is often the case that the investigation process seems unrelated to direct prevention. Often it just seems to be a way of gathering statistics. The forms used only seem to ask what happened and how it happened, **not why did it happen**.

In this paper, in the interests of clarity, we refer to 'accidents' when we really mean all causes of loss, harm or occupationally caused ill health, to workers. It is important that any 'accident' analysis system considers the totality of detriment, loss or harm.

SO WHAT?

When faced with the results from a series of accident investigations which show that:

- 40% of falls of ground occurs during barring down; or,
- most people being injured have worked there between 2 and 8 years; or,
- that most injuries on continuous miners occur during maintenance;

there is a great temptation to leap to conclusions based on our subjective assessment. When we find that 40% of Lost Time Injuries are due to knife accidents, we could easily 'jump' to the conclusion that they could be prevented if all employees were trained in the safe use of knives. We are, in fact, just falling into the old accident prevention trap of trying to treat the symptoms, not the 'disease'.

In fact, the best response to such data is to say "so what". So what, if more people are injured between 2 and 4 on a Friday afternoon, so what if most accidents involve human error. These data do not, on their own, lead to any sound conclusions as to underlying (root cause). This 'logical jump' is even more dangerous when it is made at some central location, such as a Head Office, or by a government agency and yet most government agency programmes are initiated and justified by such data. It is right and proper that an overview is maintained of frequency and severity trends of accidents by some central person or body - however, as the conclusions they draw and the actions they then require, can have great impact at an operational level, it is imperative that this is based on sound causation data. Otherwise its a matter of 'garbage in and garbage out' and even the imprimatur of the 'Centre' will not make the medicine work.

NORMALISATION - RISK MAPPING

We have all seem the trick of 'diluting' high accident rates by dividing by a large population composed of mostly those in low hazard occupations. For example, if your company employs a large number of sedentary, office workers, these can be counted in when calculating LTIFR (Loss Time Injury Frequency Rate). This may produce comforting results, but the loss of definition hides valuable detail.

One way of getting more value out of accident data, is to turn it into pseudo risk figures by normalising against the numbers exposed in particular jobs, areas or functions. For example, by using the normal age distribution to normalise the distribution of accidents by age, or by dividing accident numbers by those exposed in different occupations. Figure 1 shows some results for underground coal mine accidents, where we have normalised the data by machine number and type. For example, while there were less accidents involving Scoops, there were fewer of these machines and also fewer people exposed, whereas in fact, the drivers were exposed to very high levels of risk.

Figure 1 *Incident Rates, Population Numbers and Risk Rates*

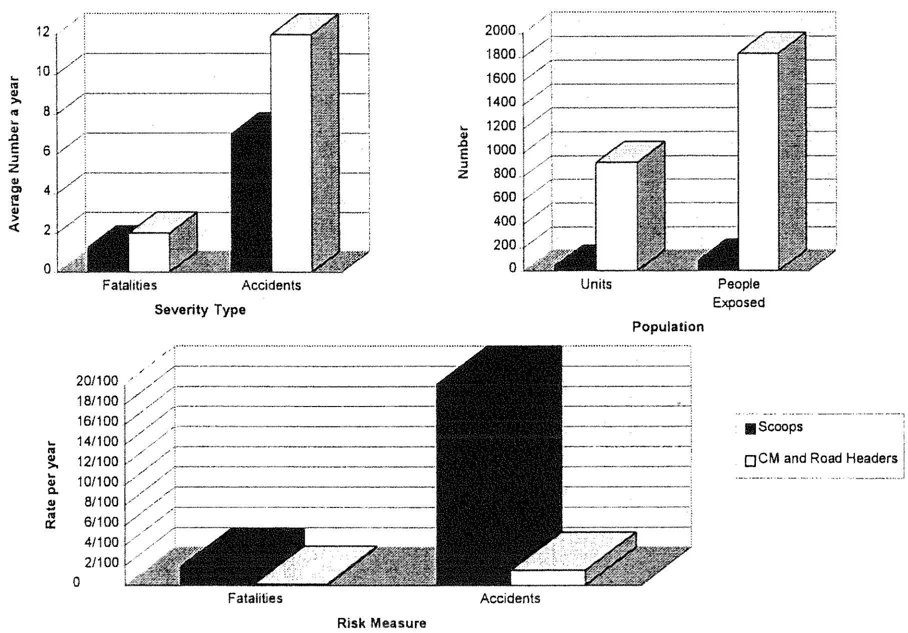
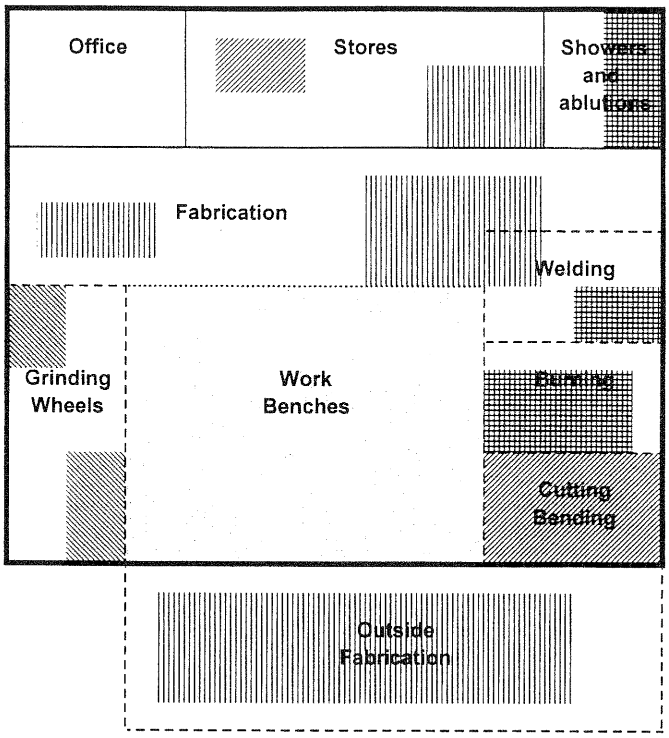


Figure 2 shows a risk density diagram created by dividing the number of accidents by the number of employee in each department and the time spent there.

This 'normalisation' approach certainly cleans up the data and helps identify trends, and can then lead onto more confident, focused investigation. The proper analysis of accident and incident data is also a very important part of risk assessment. The primary purpose of risk assessment is to support better (risk) management decisions - to help all those involved by being well informed and confident in the decisions they make to satisfy 'duties of care'. The normalisation of accident data is a very good way of starting the assessment of risks.

The identification of hazards provides the foundations for risk assessment, which, in its turn, provides the motive force which drives forward risk management. Therefore, the undertaking of comprehensive and systematic hazard identification, is a core requirement for setting up any risk management system. Hazard identification must involve, equal measures of 'hindsightedness', in carefully learning the lessons of the past, and 'foresightedness' by prudently predicting the potential causes of loss or harm in the future. Often, risk analysts concentrate on the more 'glamorous' predictive approaches, and sometime forget how valuable a careful understanding of past incidents can be, to provide an understanding of root causes, or hazards.

Figure 2 *Risk Density Diagram for an Engineering Workshop*



AN ACCIDENT CAUSATION MODEL

It is suggested that the starting point for the design of an accident analysis approach lies in understanding how all accidents happen. Of course, there will always be the totally unexpected, 'acts of God' that even the 'reasonable man' could not have foreseen. While these may not have any root causes, it would still have been prudent to have been prepared for such events so that injuries and suffering could be minimised by the effective execution of an emergency response.

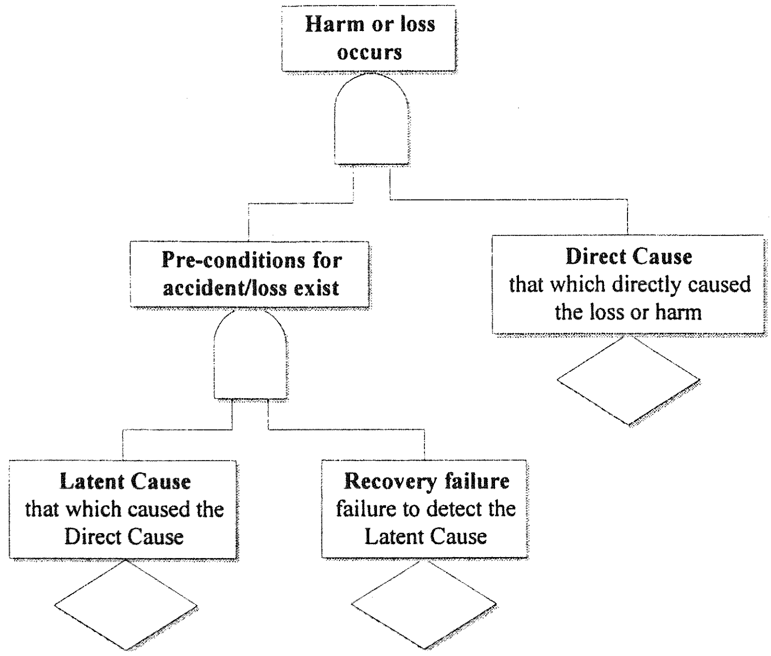
For all accidents, a very simple model seems to describe an appropriate causation taxonomy. The Fault Tree below in Figure 3 shows a simple model of accident causation. The accident is manifested by the 'Direct Cause(s)', that which create the harm or loss at the place and time of the accident. Most accident reporting systems concentrate on these obvious causes and expend a great deal of effort in establishing, for example, the source of ignition for an explosion. More valuable would be the identification of the 'Latent Cause(s)' would have been present for some time, which would have created the preconditions for the incident - an "accident waiting to happen". These Latent Causes relate directly to failures of risk management and can be linked to the risk management model adopted by a company as part of its safety management system. For example, The Queensland 'Safeguard' system (DME,1996, the ISRS, the NOSA system or more generic approaches based on ISO 9002.

No organisation can be perfect in its adoption of standards and regulatory requirements, and all rely on mechanisms such as audits, standards and checks, to detect Latent Causes, before they become manifest as accidents. An incident can only occur once a Latent Cause is present and there has been a failure of such 'Recovery' actions. These Recovery actions are, also, an integral part of a good risk management system.

From this simple model, we can therefore develop a 'perfect' accident analysis tool - one that does not just accumulate Direct Cause data which then requires a leap of faith, or logical jump, to deduce root causes. This tool can, **by the asking of the right questions at the time of the incident**, lead directly to the correct diagnosis of the Latent Causes, and the Recovery Failures for each incident, **at the time of investigation**. It can also provide sound data for any global analysis looking for company or industry wide prevention focussed initiatives.

The essence of this approach is that the questions asked at the time of the accident have been previously developed to reveal the risk management system failures, it is not a case of trying to relate from accident data to system failures afterward. This 'backwards' approach provides confidence in the analysis and avoids logical jumps.

Figure 3 *Accident Causation Model*



ACCIDENT ANALYSIS SYSTEMS

One of the earliest systems, still in use, is MORT (Management Oversight and Risk Tree) (DOE, 1983). In 1970, the US Atomic Energy Commission, commissioned Bill Johnson, on his retirement as General Manager of the National Safety Council, to review "emerging concepts of systems analysis, accident causation, human factors, error reduction, and measurement of safety performance" to develop an "ideal system" for the higher order control over hazards. His report introduced four key innovative features basic of the MORT program:

- an analytical 'logic tree' or diagram which arranges safety programme elements in an orderly, coherent and logical manner;
- the schematic representation of a idealised safety system model using fault tree methodology;
- a methodology for analysing a specific safety programme through a process of evaluating the adequacy of system elements;
- a collection of philosophical statements and general advice about safety management.

The MORT diagram is a large, idealised fault tree with over 1500 'basic events' which underlie nearly 100 different generic problems in broader areas of safety management and accident prevention. Fundamental to the successful use of MORT for accident investigation is its application by technically qualified, competent MORT practitioners (MORTicians). This is one of the major problems with the system, in that it requires a great deal of skill to apply and interpret. Often users are just put off by its complexity. Furthermore, some of the concepts are now looking rather dated.

Frank Bird developed a systematic accident analysis tool called SCAT (Systematic Cause Analysis Tool), based on his 'domino' loss causation model (Bird and Germain, 1985). SCAT assumes a basic pattern of cause and effect which can be applied to most accident situations. The process starts with identifying the loss which results from a transfer of energy above the threshold limit of the body or structure, or contact with a substance.

The analyst then seeks to identify 'Immediate Causes' categorised as either 'Unsafe Practices and 'Unsafe Conditions' (now called Sub-standard practices and conditions) which can be attributed to 'Basic Causes'. These Basic Causes are either 'Personal Factors' or 'Job Factors'. By using a question form, the analyst is pointed towards either inadequate 'Programmes' or 'Standards' or a failure of 'Compliance'.

Again, the effective use of SCAT requires well trained personnel. In this case they also have to have an understanding of the Bird philosophy on loss control as expounded in his Book, 'Practical Loss Control Leadership' (Bird and Germain, 1985), and as formulated in the International Safety

Rating System (ISRS). Without this understanding, the use of the tool is limited.

SCAT is widely used in ISRS companies but is less well accepted elsewhere because of its use of terms which are not easily understandable, outside the context of the other Bird products.

A NEW ACCIDENT ANALYSIS SYSTEM

We have developed a new system for the analysis of accidents, which has been designed to satisfy a range of criteria:

- it enables root cause analysis, at the time of the incident, leading then to a diagnosis of risk management system failure;
- it can be used with little prior training and should be largely self explanatory;
- it should also enable, over time, a site or company wide profile of risk management performance to be created;
- it should be tailored to each company and location, so that while the underlying technology is preserved, the format of the questions relate to the company or location frame of reference.

The underlying model is that shown in Figure 3. In this case, to avoid the logical jump, the basic ingredients of a risk management system are used to derive the questions. This means that the system can be back-fitted onto any system which the site uses - whether it be ISO 9000 related such as the Queensland 'Safeguard' System, to proprietary systems such as NOSA.

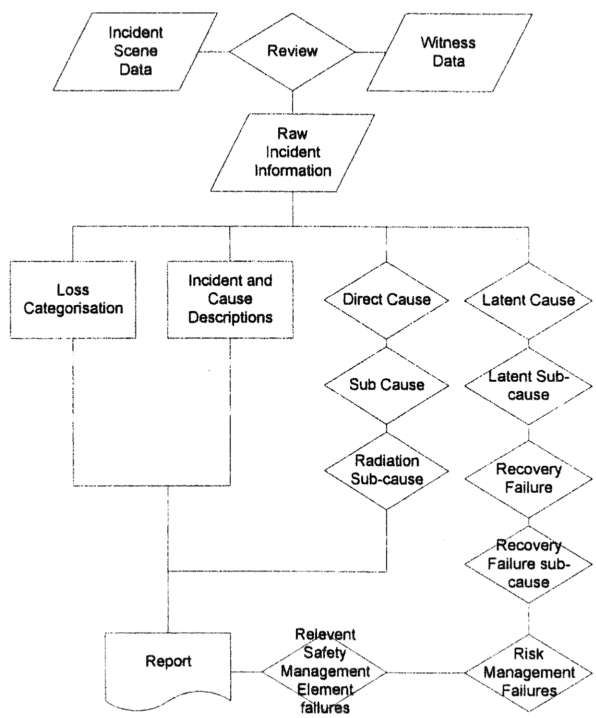
TRISCA is based on a need for companies to act to treat the 'disease' and not the 'symptoms' revealed by accidental losses and harm. The system involves asking a series of additional questions, at the time the accident is investigated, to establish:

- how the accident happened;
- why it happened; and,
- what could be done to prevent if happening again?

The questions on Direct Causes are associated with the means the loss or harm occurred. These are not as exhaustive as some other techniques as this part of the analysis is actually of less importance. The major purpose of the Direct Cause questions is to begin to focus and orientate the analyst's attention. The questions under Latent Cause relate to a life cycle - of an item, machine or procedure. A common approach is used to chart the potential failures which have contributed to the accident, from conception, through execution to wear-out and replacement.

Finally, the Recovery Failure Questions are selected on the basis of Latent Cause. If the analysis reveals a latent cause, the analyst also has to question where a Recovery system was either not present, failed or was ineffectively applied. This process is shown in Figure 4.

Figure 4 TRISCA Process



The system can be deployed on paper, or as a computerised application which not only prompts the next question based on the reply to a previous one, but also adds the analysis to a database. This can be used to obtain the site risk management performance profile, or the company-wide profile, if the data is gathered at a central point. Figure 5 shows how this can operate and Figure 6 is a potential profile.

Figure 5 *System for Performance Profiling*

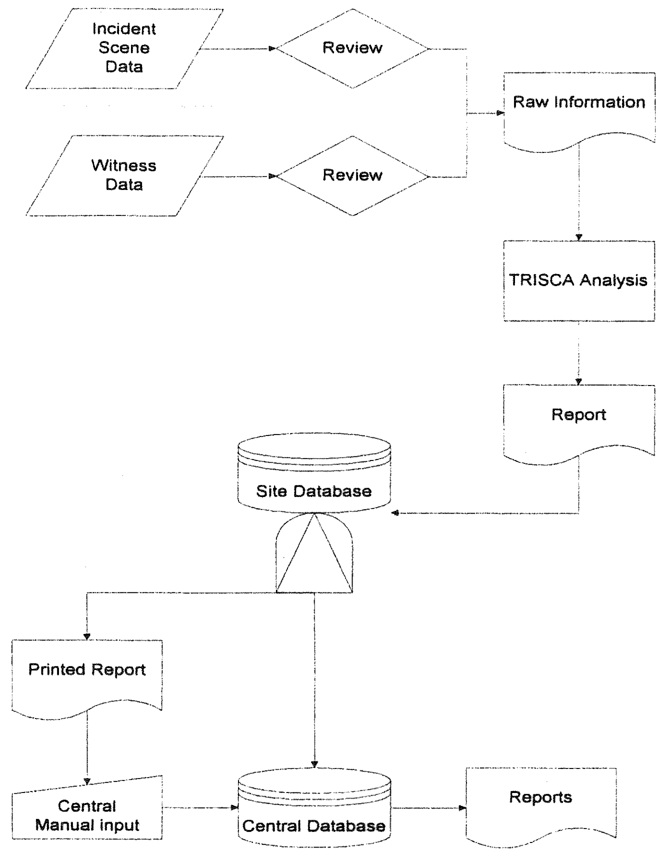
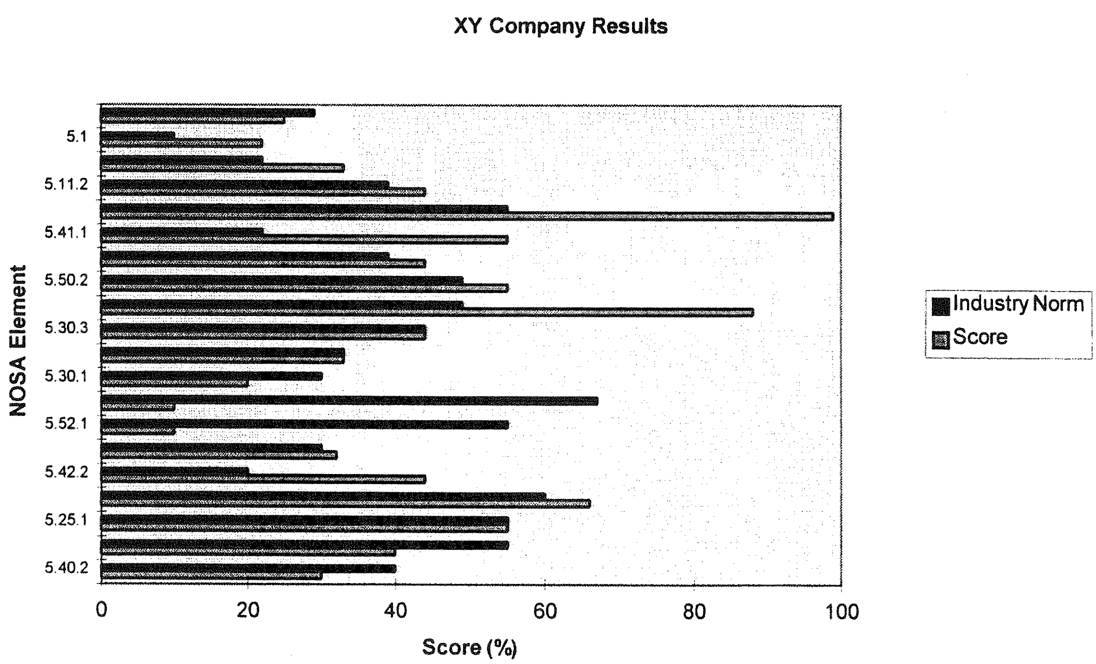


Figure 6 *Site Performance Profile*



SUMMARY

We have suggested that accident investigation and analysis is best done soon after the incident, near the incident site, by a team who are involved with the management of that workplace, While they should receive training, it is important that the accident analysis system is useable and the results are easily understandable by the people applying it. The major purpose of accident analysis should be to objectively and dispassionately find out how the accident happened, why it happened and, most importantly, what to do to prevent it happening again. Accident statistics which merely relate the number of accidents of a particular type of accident or injury location, should be challenged by saying "so what".

It is important that the accident analysis system does not involve a logical leap from the analysed causes to the solutions to prevent a recurrence. The most appropriate way to prevent this is to ensure that the analysis system is based upon risk management system failures and a simple accident causation model has been suggested which achieves this.

Two existing accident analysis systems have been reviewed and it has been noted that both require a great deal of skill in use and interpretation. A new, simpler system has been suggested which would encourage 'ownership' of the results and would avoid the investigation and analysis team 'hunting for the guilty'.

Sound accident investigation and analysis, is as important as risk assessment to drive forward and focus a safety management programme. An accident provides an opportunity to learn how our safety management system really works. This opportunity must not be lost and the benefit wasted. We owe it to the people who have been injured, to properly learn the lessons so that we can make sure that that accident, or any other with similar root causes, never happens again.

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