POTENTIAL SOURCES OF DATA FOR USE IN HUMAN FACTOR STUDIES.

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Techniques such as HAZOP, Quantified Risk Assessment, Task Analysis, and Human Reliability Analysis are all used to improve industrial safety. All are useful tools but are based on historical design information, details of how jobs *should* be done rather than how jobs are *actually* done, or rely on reliability data gathered from sources outside the company, or even the industry, concerned. It is rare that up to date, site specific, data is available, although this would be desirable.

Through contact with a range of companies in the process industry, visits to onshore facilities, an extended study of an offshore oil production platform and a review of safety and human factors literature, a number of information sources have been identified with a realistic potential to

Keywords

Accident Reporting, near miss reporting, incident investigation, log books, data sources, human factors, safety studies.

1. INTRODUCTION.

A large number of techniques are available for improving safety in industry. They generally provide a structured approach to analysing such things as reliability, human factors, hazards and safety management systems to determine potential for accidents, to suggest actions to prevent them, and to ensure that available resources are allocated most effectively. They have undoubtedly prevented serious injuries, fatalities and property damage but accidents still occur every day and major industrial disasters are still far too frequent. All these techniques require accurate and relevant data for the system being analysed. The problem is that up to date, site specific data is not usually available because of the problems in collecting it.

This paper describes how some of the commonly used techniques could be improved with data collected on the site in question. This data could be derived from information concerning past events and by consideration of what actually occurs, regularly and occasionally on the site, rather than what is assumed to occur. It then summarises the findings of a study that was conducted to determine systems, such as accident reporting, near miss reporting, incident investigation and log books, which could provide this type of data.

2. SOME TECHNIQUES USED TO ANALYSE SAFETY.

2.1. Quantified Risk Analysis.(QRA)

QRA is a structured approach to assessing the potential for accidents and expressing this numerically as a probability of loss *(King [1])*. The results are used to assist management in deciding the best approach available for improving safety. The analysis involves the identification of potential hazardous events, development of possible accident scenarios, estimation of the likelihood of events and assessment of consequences and possible losses.

Most accidents that occur involve human actions to some extent. The influence they have on the sequence of events is very important but not easily handled during QRA studies. Information from past events can be used to show how people could have caused accidents or where their actions actually prevented them. This is useful for suggesting sequences to be considered during the QRA or for validating some of the assumptions that are made.

Reliability data is also important during QRA and this is very sensitive to the actual conditions and operations to which equipment is exposed. It is also very dependant on the quality of maintenance and inspection which requires very site specific data.

The consequences of any accidents depend on how people and property come into contact with hazards. Evidence about where people are likely to be at the time can be obtained by considering what the personnel are likely to be doing. Information is required about routine tasks and how people may be involved in the events leading to the accident. Also information from past events may show how far widespread effects were felt and the outcomes at that time.

2.2. Task Analysis.

Task analysis is used to describe tasks including the purpose, information requirements, time requirements, communications, tools and materials requirements, training provided and feedback of success *(Gertman and Blackman [2])*. The results are used for developing training programs, writing procedures and as inputs to other safety studies.

Data for Task Analysis is generally collected from procedures written for the task, interviews with people who perform the tasks or through observation of the task being performed. Deficiencies in the analysis are likely to occur if procedures are not closely followed at all times or if different people perform the task in their own ways. For more accurate analysis information is required about problems encountered during the task due to equipment failures, plant disruptions and distractions. Analysis of how these problems affect the way the task can be performed is also needed. Finally information is also needed about all the people who do the task and how often, hence their familiarity with it.

2.3. Human Reliability Analysis. (HRA)

HRA is used to assess the failure of humans in response to an event that may result in an accident. The possible sequence of events is considered to take into account errors of omission,

simple errors of commission and recovery actions *(Swain and Guttman [3])*. Probabilities of failure are included at each stage which are combined to give an over all human error probability. The biggest problem with these analyses is the human reliability data. Some is available but it is usually derived from laboratory experiments, simulator studies and occasional industrial studies. Information about the plant in question may be able to provide the actual data or at least to verify data used from other sources.

Information from the site in question about events that have occurred in the past can be used to show what factors make human error more likely, how problems are dealt with when they occur and how successful the solutions are. These depend on the design of equipment, quality of procedure and instructions, how people are trained and how they are able to work in teams.

2.4. HAZOP

HAZOP studies are used to assess the design of new plant to determine if deviations from the intentions of the design can occur and the likely consequences *(Chemical Industries Association [4])*. The success of the method depends on:

- the accuracy of drawings and other data used as the basis of the study,
- the technical skills and insight of the team,
- the ability of the team to use the study as an aid to assessing possible deviations,
- the ability of the team to maintain a sense of proportion concerning possible events and the seriousness of hazards.

Information about past events at the site in question will provide useful insight into how the systems in place actually perform, can be used to identify possible deviations, validate assumptions made about causes and consequences and may suggest possible solutions to problems encountered in the HAZOP study. Also future reports may highlight unforeseen problems or solutions that are implemented but do not perform as required, which could be used in future studies

3. POSSIBLE SOURCES OF DATA.

Below is a summary of a study into possible sources of data. They are all systems that are widely used throughout industry but have generally been developed to perform a single function rather than as methods of collecting data that may be useful for more general safety studies. They have been examined to determine their usefulness as they stand and how they could be developed to provide more data.

3.1. Accident Reporting

It is a legal requirement for most companies to report certain accidents. This means that most companies have developed accident reporting systems which are likely to involve the gathering and storing of information which can be used to assess safety management systems and could provide data that may be useful in safety and human factor studies.

To be of real value for improving safety a reporting system must exceed the demands of regulations and collect information about all accidents that occur rather than just the most serious ones *(OIAC [5])*. The first task, when developing a reporting system, is to define which events are to be recorded as accidents. For these accidents the system must specify what information is to be gathered about the people and equipment involved, the circumstances at the time and the causes of injury and damage. The system must also include procedures to allow the analysis of accidents to determine root causes and identify any changes or modifications that would prevent their recurrence. The details of the accidents reported need to be stored in a readily accessible form for future reference.

As there is no one standard reporting system in use by all companies a survey was conducted of the reporting systems that have been developed by companies in the process industries *(Brazier [6])*. The study shows that most accident reporting systems are based around an accident report form. The design of these forms will determine what information is collected and how the system will perform. A number of forms have been reviewed.

The main features of the accident report form are determined by what the reporting system aims to do. Apart from complying with the law, the stated aim of most companies is to prevent the recurrence of accidents by removing their causes. Other aims include providing statistics to allow analysis of accident rates and trends in safety performance and to provide a mechanism of ensuring actions required to improve safety are completed.

Accident reporting systems can provide useful data for analysing safety but it is limited to the information that is recorded to achieve the aims mentioned above. The most useful data will probably be included in the description of the accident. Apart from details about injuries and damage the description usually includes details of the following:

- date and time of occurrence,
- personal details of the people involved including age, occupation and nationality,
- the work being done by those involved, how much experience they had at doing it and how long they had been working during the shift,
- what equipment was being used,
- who was working in the area,
- which permits had been issued,
- who was supervising the job,
- environmental conditions present that may have contributed to the incident.

These details give us an idea of what was happening at the time the accident occurred. This information provides a limited amount of data but to be more useful a wider view of events is needed covering overall activities on the plant during the time leading up to the accident. The description of the accident in some examples is extended to include:

- events before the incident,
- conditions present,
- any contributory factors,
- any hazards present,
- safety equipment and devices being used,
- protective clothing being worn,
- the exact location of the incident,

- procedures being used,
- equipment failures and defects.

Most accident reports also include details of the causes of accidents. Direct causes are usually fairly obvious to detect as injury or damage has occurred due to contact with hazards. It is the root causes, however, that are more useful to know about and report. They are an indicator of the performance of safety management systems and of conditions present that may cause other accidents in the future. Unfortunately they are difficult to detect as they tend to be hidden, only appear periodically or are apparently unconnected to the accident that has occurred. It is the lack of efficient methods of determining root causes that limits the use of accident reports, when viewed alone, for providing useful data for safety assessments and studies.

The final significant factor is the way information is reported or how the questions on the report form are answered. The most obvious way to describe an accident is with free text responses to the questions asked. The problem here is that it is very difficult to standardise these descriptions making comparison between accidents difficult and resulting in the quality of the reports being very variable. It is also difficult to store this information in a way that is easily searched at a later date. The danger is that while a lot of information is available, it is not readily accessible.

Another method commonly used is multiple choice answers. For each question asked, a series of possible answers is provided. This is a useful way of recording information allowing easy analysis of incident trends but it is not possible to describe every incident fully in this way and information will always be lost because many answers will not be a simple yes or no. This method of answering questions has really been developed to help with storing information on computers and the loss of information seriously reduces the usefulness of the accident reports.

A compromise method used for describing accidents in some reporting systems is to suggest a set of key words that should be used. This helps standardise free text answers whilst keeping a certain amount of flexibility. It is important to ensure that the meaning of these keywords is understood by all that are required to use them and that they are can be used easily without making completing a form even more difficult and time consuming.

A low accident rate is obviously desirable but it does limit the amount of information available from accident reporting to monitor and improve safety. A lack of a standard approach to incident reporting and company confidentiality means that a company can only learn from its own accidents. The reporting system must be well designed to ensure all important information is collected.

The accident reporting systems in place in most companies could be used to provide some data for use in safety assessments and other studies. Most, however, are aimed at preventing the single accident in each report from recurring. Designing systems with emphasis on more widespread data collection, determining root causes and understanding the human factors involved would improve the data available and increase the benefits of reporting accidents.

3.2. Near Miss Reporting

A company that experiences few accidents may, quite rightly, claim to have a good safety record but this does not mean that they are always going to be safe in the future. It is very

unlikely that errors and failures do not occur every day. Near miss reporting can be used to provide information about these common events to indicate potential safety problems and deficiencies in safety management systems and to provide data for safety studies about the types and rates of failures occurring

The first task when developing a near miss reporting system is to define what events should be reported. A useful definition of a near miss is "A situation where the sequence of events could have caused an accident if it had not been interrupted" *(Van der Schaaf [7])*.To identify such situations requires an appreciation of the system's potential to cause injury and damage. This includes a knowledge of hazards present, how they are controlled and how that control can be lost. A suitable accident model is also required that takes into account the fact that most accidents are caused by a combination of relatively minor events that, when they occur independently, have little or no consequence and so can be considered as near misses.

Any system that has a human input to its operation will be subjected to a large number of errors due to human behaviour. These events are likely to form the majority of near misses recorded. An effective reporting system must be designed with this in mind.The main aim should be to find the root causes of those errors by considering organisational and managerial aspects rather than concentrating on just the technical components and human behaviour that may have been the immediate cause of the incident. *(Van der Schaff [8])*.

The aim of a near miss reporting system is to learn as much as possible about the errors and failures that occur to get a full and accurate picture about how well safety is controlled and how safety management systems perform. This will involve people reporting their own mistakes. Everybody makes mistakes but it is not part of human nature to admit this. To encourage reporting the management of the company must guarantee that there will be no recriminations.

The beauty of reporting near misses is that there will have been no injuries or damage. This means that there are far fewer interested parties whose interests lie in accident compensation, legal action or other liabilities *(Shillito [9])*. This greatly simplifies the reporting process. It does mean however that there is unlikely to be much evidence showing that an incident occurred. If near misses are not reported when they occur, the information is probably lost forever.

There are two different methods generally used by companies to allow people to report near misses that they are either directly involved in or witness to. The accident reporting system may be extended to cover near misses or a separate system may be developed.

Using an accident report form to report near misses has a number of attractions. A new system does not have to be developed or maintained, people do not need to know how to complete another form or have them available, so paper work does not appear to increase, and the link between near misses and accidents may be more apparent. The problem is that different approaches are required to get the full benefit from both systems. An accident report needs to contain information that may be required if an investigation is necessary or if certain liabilities have to be acknowledged. Near miss reports do not have to cover these aspects and should concentrate on gathering useful information

Developing a dedicated system is likely to provide extra and more useful information. Most systems use a very simple report form asking for a brief description of the event and what prevented it from becoming an accident. Reports are analysed to determine if any immediate action is required and details are stored on a data base. Over time situations that develop affecting

safety can be identified and any worrying trends can be monitored. The forms have to be readily available, quick and simple to complete.

When reporting near misses it is useful to analyse what accidents could have occurred or what the potential was to cause injury or damage. This must take into account the nature of the plant and processes, especially hazards present and methods employed to contain them or mitigate their effects. This information helps identify significant events and indicates how serious the accidents could have been.

Near miss reports may also uncover information about deficiencies in management and safety systems that make accidents more likely *(Woods [10])*. These are especially important as they may exist throughout the company and cause wide spread and apparently unconnected problems. They are often difficult to identify because they are well hidden and have entered the systems in the past but they are likely to be uncovered during incidents. Near miss reports should reveal these deficiencies and provide evidence of the changes that need to be made. Below are some examples.

A complex system will provide a greater potential for small failures to combine resulting in more serious consequences. A near miss may be an event where several systems interact. If these interactions were unexpected or can not be explained, the accident potential is likely to be serious.

A near miss report may uncover latent errors in a system that have remain unnoticed. They can add extra problems during an incident if triggered by unusual conditions resulting in magnified disturbances, reduced redundancy or making it impossible for the system to achieve a safe state.

Human factor problems may be uncovered such as distractions, inexperience, mental or physical overload, poor information or feedback that would make error more likely. Human failures may result from situations that occur for which plans are not available or are not accurate enough. The chances are that if such conditions are found to occur, there is likely to be a deficiency in these areas throughout the company due to management, training or personnel selection.

It is not just details about failures that are useful from near miss reports. The actions that were taken to recover from near misses and that prevented accidents occurring are a useful indication about how the company systems work.

3.3. Incident Investigation.

Ideally all incidents that occur would be thoroughly investigated to determine all the causes *(Ferry [11])*. With limited resources this is not possible and it is generally only the serious accidents, where people have been injured or there has been substantial property damage, that are fully investigated. This means that relatively few incidents are investigated at any one site and this immediately limits the amount of data that is going to be available.

With this in mind it would seem reasonable to expect that the investigations carried out would follow some of the structured techniques that have been developed to ensure accurate and consistent reporting of the events leading up to, and during the accident in question. The feature of most of the techniques available is that they are generally based on accident causation and human error models. *(Hollywell and Whittingham [12])*

From discussions with people in industry and observations made in the literature *(Benner [13])* it is found that most accident investigations follow a fairly relaxed process of interviewing people who were involved and simple analysis of what happened. The people who perform most investigations, except for the most serious, are often untrained in the use of available techniques or are not provided with the time and resources required. This can result in investigations being of variable quality with emphasis on individual accidents rather than on more general patterns that could provide the type of data we need. In fact it is probably the more complicated accidents, where a definite cause is not obvious and the investigating team have to dig more deeply, that provide the most useful information about the general situation in the company, assuming the investigation team are persistent enough to find all the causes.

Due to confidentiality rules in most companies it is difficult to obtain copies of completed accident investigation reports which could be analysed for their actual content but limited details can be determined from accident report forms and the contents of safety management procedures. Most of the systems seem to follow the traditional approach of considering unsafe (or sub-standard) acts and conditions as the cause of accidents. These acts include operating equipment without authority, failure to follow rules or procedures, failure to observe warnings and misuse of tools whilst the conditions include failure in communication, inadequate protective equipment, poor house keeping and unsafe access. The general result will be suggestions about how new rules can be applied and how physical barriers can be constructed to prevent further accidents. The problem is that it is not possible to prevent all unsafe acts or remove all unsafe conditions and so more wide spread consideration and action is usually required.

More useful data would be available if some of the techniques were followed. Most of the techniques are based on a multi-causality accident model. This highlights that very few accidents arise from a single cause but occur because of a combination of active and latent failures whilst human errors, when they are part of the cause of an accident, have their origin in the top level of management. The types of human error considered are unintended slips and lapses along with wrong intentions due to rule or knowledge based mistakes.

Kletz [14] suggests a method of identifying what happened. The sequence of events is arranged in time order. Each event is considered in "Layers" to determine how it could have been avoided. There are three layers to be considered, the first is "Immediate technical recommendation," the second is "Ways of avoiding the hazard," and the third is "Ways of improving the management system." This is considered as an engineers view of accidents and has been developed to ensure that the most important information about why things happened is uncovered.

Reason [15] suggests a method of identifying why an accident happened by considering active and latent failures. The accident is described as a sequence of events and active failures. For each in the sequence contributing conditions and latent failures are sought. This is considered as a psychologists view of accidents and results in recommendations directed at decision makers, line management, individuals and system defences

The final method considered here is Root Cause Analysis which examines how system changes caused the accident to occur *(Whittingham [16])*. The approach looks at changes between "design or intent" and "normal" practice which can be considered as a root causes and changes between "normal" and "actual" practice which would be the direct cause. The significant changes identified will suggest how accidents can be prevented in the future.

A number of major disasters have been investigated as part of a public inquiry. The time and resources available to carry out these investigation means that they are very detailed. The result is that most of the likely causes of the accident will be found. From the reports factors can be identified that are likely occur in other accidents. It is these types of causes that should result from all investigations and they are likely to provide the most useful data. Some examples are given below. *(Human Reliability Associates [17])*

The inquiry into the Challenger Space Shuttle disaster showed that the explosion was caused by the failure of 'O' ring seals. It had previously been recognised that the temperature at takeoff was critical to the safe operation of the seal and that their failure could cause the loss of both the crew and the spacecraft. The management were not prepared to listen to this information and this breakdown in communication meant they were unable to make effective decisions where safety was concerned. It also came to light that several years before the disaster the seals had been found to leak and, although a new design had been considered, no action had been taken.

The Herald of Free Enterprise capsized because its bow doors had been left open. This occurred because the Assistant Bosun, whose job it was to close them, was asleep in his cabin. It was in fact the Chief Officers responsibility to ensure the doors were closed but he was also required to be on the bridge 15 minutes before departure but there was only negative checking of items meaning he was only told if the doors were open, if someone actually knew this to be the case. In fact the Bosun had seen the doors open but it was not his job to close them. The problems, however, run much deeper. The design of the ship meant that it was top heavy and hence unstable whilst the management had put pressure on the crew to leave port early whenever possible but had not sanctioned the fitting of warning lights, that would indicate if the doors were open, even though the cost would have been about £400.

The Piper Alpha oil platform exploded because a pump, on which maintenance had not been completed, was started causing a gas leak which ignited. This occurred because communication between shifts was unsatisfactory and training of personnel, including the operation of the Permit to Work System, was performed on the job through observation with little regard for safety procedures. The fire that occurred was able to spread because the deluge system was badly blocked and fire pumps did not start automatically because it was usual practice to put them on manual control when divers were in the water. Emergency training was considered totally inadequate and far fewer people would have died if they had left the platform before it became impossible. The management were severely criticised as although it was accepted that they were concerned about safety they did not actually act to improve it. Previous accidents, including a fatality the year before, had simply resulted in memos being sent.

Further inquiries could be considered but certain factors keep coming up including:

- poor communication leads to important, safety critical, information not being passed to those who need it or can act upon it,
- most accidents have been preceded by similar near misses that should have been a warning about deficiencies in the safety management system,
- priority for production leads to less consideration of safety,
- procedures and equipment are not designed for the people who have to use them,
- responsibility of safety is not clearly defined and so no one is in place to ensure action is taken.

Most of these factors have been highlighted by major accident inquiries, it is this type of information, that should be uncovered by investigation, about all accidents that could provide the data we need.

3.4. Log Books.

Personnel at most process plants maintain log books to record significant events occurring during their shift. These events are either tasks they have performed, information about the equipment they are responsible for or situations on the plant that affect their work.

The main use of log books is at shift handover. They are consulted by the oncoming personnel to ensure that they are quickly updated about the status of the plant, have the necessary information to allow them to make decisions relating to their jobs and responsibilities and so they know about and are prepared for the tasks they may have to perform during their shift ahead.

Log books are considered essential mechanisms for passing on important information between shift personnel and studies have been conducted about how this information can be communicated most effectively. Little work, however, has been published about what information is actually recorded. Generally this includes details about routine tasks, plant upsets, equipment failure and general conditions, all of which could provide useful data when performing safety studies. To find out more a survey was conducted on an offshore oil production platform. Each department was visited, people who keep logs were interviewed and copies of each were taken for a seven day period in the recent past.

The first conclusion drawn was that a huge amount of information is recorded which immediately causes a problem. To find useful data thorough searching and analysis of all the records would be required. A lot of the information is duplicated, especially for supervisor and management reports but although taking this into account will reduce the amount of information to be searched, these reports can not be ignored as they often contain extra details about information that came to light after the event.

During the survey it was found that log books are kept by process operators, maintenance technicians, control room personnel, radio operators, construction contractors, laboratory, medics and safety personnel. Supervisors write shift summaries, about the events that have occurred during the shift and current status. Platform management write daily, weekly and monthly reports concerning major work, serious production problems with comments on personnel, safety and general organisational issues included.

The information recorded obviously depends on the job done but a number of distinct categories have been identified that could provide useful data for performing safety studies. Failures experienced and witnessed are recorded but the beauty of log books, and what makes them unique as a source of safety data, is that successful events are also recorded along with plenty of information about routine tasks.

Routine tasks recorded include plant tours and simple checks, testing of equipment, adjustments to valves and instruments, starting and stopping equipment, changing filters and topping up chemical tanks. For reliability studies the number of times these tasks are performed successfully is as important as the failures that occur. Test intervals will also available to be included in any computation. For tasks performed to maintain efficiency and production of

certain equipment, the timing of these is recorded and any noticeable differences in performance can be analysed.

Where risk analysis is concerned it is important to consider the number of times certain tasks, that have the potential to expose personnel to hazards, are performed. The log books contain information on what jobs are performed that may involve hazards, how often they are performed and any occurrences during the task that may increase the risks.

Human errors are identified in logs.They can be difficult to recognise and may be in logs of unexpected areas as they are often observations or situations that have been found by chance. In the survey ten errors were identified occurring during the seven days in question. All are minor but are likely to be useful for reliability studies and risk analysis. They may indicate the rate of errors, situations where errors often occur or simply used to validate studies by showing that suggested ones do actually occur from time to time.

The errors identified included simple operator slips or mistakes, inadequate maintenance, communication problems and management failures. Examples include:

- valves that have been closed when they should not have been, discovered when problems were experienced later on,
- testing of equipment after maintenance finding that all parts had not been put back and that gaskets had not been fitted properly,
- modifications had been made to equipment but not tied in to all appropriate systems,
- replacement parts had arrived incomplete,
- errors were found in job packs and instructions that had been issued for non-routine tasks,
- up to date drawings were not available when required.

If an incident is considered to be any undesired event with the potential to cause injury, damage or loss to production, a number of incidents were identified. The types of incident include equipment failures and trips which severely reduce redundancy, equipment discovered to be inoperable where failure to detect may have caused problems later and safety systems that failed to operate as required.

Examples of incidents include one of two power generating turbines tripping for no apparent reason, if the second had not taken the load the platform would have been shut down resulting in lost production and increased risks associated with starting up the plant. A chemical dosing system was found to have tripped with the result that equipment was deprived of its corrosion protection for some time, problems would have occurred if this had continued for a longer time. An emergency shutdown valve which failed to operate during a plant shut down because it had seized indicating that better preventative maintenance may be required.

A number of comments made in the log books and handover reports concern problem that have been encountered, the possible causes considered at the time and solutions tried to clear these problems. Obviously this type of information will be useful if similar problems are encountered in the future. The solutions found may suggest different ways of doing jobs that may be better than current practice. These improvements could be included in new procedures that may be written or they may suggest problems that exist with the plant due to design failures or operations regime. The problem solving techniques also indicate how such situations are dealt with and how resources are used under such circumstances.

The results of the log book survey have shown the type of information that is being recorded. As a data source they provide a unique source of information about what really happens on a plant which can be used as a basis for data used in safety studies. It is also clear that a major problem of accessing this information remains. Certain events are reported by a large number of people, showing how useful it would be to transmit this information more widely around a company when they occur. Other events are only mentioned in one log book which may not be an expected one, this information may never be seen by those who would find it most useful. If data is to be used, all logs have to be checked to ensure the picture of events created is accurate and tells the full story.

4. CONCLUSION.

A number of techniques widely used for assessing the safety of certain aspects of industrial sites have been described. Possible improvements have been identified if more up to date, site specific data was available. Information gathering systems that are currently used in industry have been studied to determine if they could provide this data.

The conclusion is that there is a need for more data and that this could, and should be collected on site. Each of the systems examined already do collect some useful information and could certainly be modified to collect more. The major problem is that there is likely to be a huge amount of information collected that needs to be stored. Computers are an obvious way of achieving this and they are already used in some situations. It is important to ensure, however, that the use of computers does not reduce the amount of information available which is the case when multiple choice answers are used to describe events. A data base system is required that stores all the important information in a way that can easily be searched.

The amount of useful data available depends on the number and range of events being recorded. It is also important that the system covers all aspects of the operation of a company. This requires a thorough understanding of which events are significant and what information should be recorded. The reporting systems must be well understood, easy to use and consistent with other management systems in place. Including event reporting in other systems such as part of permit to work, maintenance schedules, work plans or process computers may help to maximise the data available.

5. Acknowledgments.

This work is funded by Elf UK as part of the Elf Safety Lectureship.

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