THE ACCIDENT DATABASE: CAPTURING CORPORATE MEMORY

M Powell-Price[*], J Bond[+], B Mellin[†]
[*] Institution of Chemical Engineers, Davis Building, 165-189 Railway Terrace, Rugby, Warwickshire, CV21 3HQ.
[+] 25 Canonsfield Road, Welwyn, Hertfordshire, AL6 0PY.
[†] 7 Mayals Road, Blackpill, Swansea, West Glamorgan, SA3 SBT.

Accident databases are means of capturing corporate memory. The design and structure of data for such software tools has been subject to much research and this paper presents the results of such investigations. The Institution of Chemical Engineers are committed to the dissemination of information in process safety, loss prevention and environmental protection, and as a result have produced a database known as The Accident Database which fulfills a number of key objectives. These include: focusing data sets on previously unpublished materials from company data banks; the inclusion of a 'lessons learned' field which reveal the recommendations and lessons the company learned after the accident or incident and the use of a novel keyword mechanism based on the concept of 'case-based reasoning.'

Case-based reasoning uses formalised rules to try to identify and use information on past cases to provide help with new problems. It softens the all-or-nothing approach used in conventional database matches by retrieving cases that have some degree of relevance to the keywords specified by the user, without matching exactly. In order for the system to know how keywords are related, a domain model is required for each database field.

The paper closes by looking at the future developments of The Accident Database and additional features that users requested from the IChemE.

Keywords: Accident database, lessons learned, case-based reasoning, corporate memory, domain models.

INTRODUCTION

On the 14th December 1785 an explosion occurred in the bakery shop of Senior Giacomelli in Turin (1). The explosion was a dust explosion caused by flour released from a silo. The explosion was not too serious but it was investigated by Count Morozzo who wrote a remarkable report. His explanation of the incident was interesting in an historical sense but it is his final words that are as relevant today as they were 200 years ago:

> 'Ignorance of the fore-mentioned circumstances, and a culpable negligence of those precautions which ought to be taken, have often caused more misfortunes and loss than the most contriving malice; it is therefore of great importance that these facts should be universally known, that public utility may reap them from every possible advantage.'

More recently safety guru Trevor Kletz pointed out in his book (2) 'Lessons from disaster: how organisations have no memory and accidents recur':

> 'It might seem to an outsider that industrial accidents occur because we do not know how to prevent them. In fact they occur because we do not use the knowledge that is available. Organisations do not learn from the past, or rather individuals learn but they leave the organisation, taking their knowledge with them, and the organisation as a whole forgets.'

WHY SHARE ACCIDENT DATA?

There are many 'soft' reasons for sharing data in the loss prevention field — improvements to company image, PR benefits, improved employee relations etc. can all be cited — but perhaps one of the most powerful reasons comes from real practical experiences. A member of the IChemE who spent many years working as a safety advisor in a major chemical company put it like this:

> 'I well remember wishing to circulate information within my own company of an incident I investigated. I had not been aware that some stainless steel flexible hoses were silver soldered to a flange, I assumed they were all welded. When I used a stainless steel hose to off-load a road tanker of 10% nitric acid the hose parted from the flange because of the attack on the silver solder. At the time I was told not to write a note as *we do not advertise our mistakes.*'

In Germany in 1976 and the UK in 1978 two accidents occurred which involved:

- the same chemical;
- the same licensed process;
- built by the same construction company;
- the same start-up stage of the process;
- a contractor doing the same job; and
- on the same piece of equipment.

In both cases a solution of a toxic chemical was discharged to the open settling vessel and the contractor was killed.

One wonders how many identical accidents do we have to have before we share lessons learned from accidents?

CORPORATE MEMORY

Way back in the early 1970's the Institution of Chemical Engineers (IChemE) recognised the existence of the corporate forgettory, the 'well that's never happened before' syndrome and began publishing the Loss Prevention Bulletin. This publication had, and still has, three primary aims — to capture accidents and incidents, to report the sequence of events that led to an occurrence, and to offer recommendations to help organisations learn from the mistakes of others. Since 1974 the Loss Prevention Bulletin has published over 1000 comprehensive case studies and, no doubt, saved many lives and prevented much economic loss.

The shocking impact of events such as Feyzin (1966, 15-18 dead), Flixborough (1974, 28 dead), Seveso (1976, massive contamination), Mexico City (1984, over 500 dead), Bhopal (1984 over 2500 dead), Piper Alpha (1988, 167 dead) and many others have stimulated significant improvements in the safety performance of the process and allied industries. This transformation is arguably down to three main changes:

- the arrival of fully-integrated safety and environmental management systems which engender a culture of continual improvement;
- the recognition that if you cannot measure it, you cannot manage it; and
- improved reporting and investigation of accidents and near-misses — the capturing of the corporate memory.

In the UK the Chemical Industries Association publish, under the Responsible Care programme, a series of annual performance indicators (3). The data relating to Loss Time Accidents (LTA's) has shown continual improvement since the 1980s both for own employees (of member companies) and contractors. Whilst one can argue over the validity of LTA's as an indicator of safety the results are nevertheless impressive — see figure 1 and figure 2.

However, there inevitably reaches a point where the accident rate will start to level off and, worse still, perhaps increase. The next paradigm shift is linked to the sharing of accident data within industry sectors. Whilst many companies have huge amounts of information stored away about minor incidents and near-misses there has not been a culture of sharing information within industry sectors.

Surveys and reports such as that carried out in 1994 by Keller and Pineau (4) have shown that potential users of accident databases wanted a number of key features, these included:

- Identification of accident scenarios;
- Identification of design deficiencies;
- Evaluation of emergency response;
- The accident sequence;
- Chemicals involved;
- Human and management aspects;
- Technological aspects;
- Property and plant loss;
- Environmental impact.

There are a number of accident databases (5) in existence or under development including major initiatives such as:

- Major Hazard Incidents Data Services (MHIDAS) — sponsored by the UK Health and Safety Executive, and managed through AEA Technology.
- Analysis, Research and Information on Accidents (ARIA) — a system set up and operated within the French Ministry of Environment.
- Major Accident Reporting System (MARS) — set up as a requirement under the 'Seveso' Directive.
- Failure and Accidents Technical Information System (FACTS) — a commercially available database of incidents which involve hazardous materials which is maintained by TNO.

Most of these are focused on previously published data sets. Thus the IChemE wished to focus its resources in developing a database that captured the corporate memory of organisations and made that memory available to others, not simply recreate what already existed. Therefore the IChemE Accident Database is concentrating on publishing the data that companies have never made available to the wider audience — so called 'in-company' reports.

THE ICHEME ACCIDENT DATABASE

The IChemE have for a number of years been collecting and publishing accident data. This 'public domain' information provided a very valuable platform onto which to build a large quantity of 'in-company' data. Thus two years ago the IChemE carried out a survey of its safety specialists to discover the features that they would wish to see in a CD ROM based electronic data source and to also ask responders whether they would consider donating data to such a resource. The results of this survey gave the IChemE the information it needed to take the next step to develop a database which had the functionality necessary to meet the needs of a safety professional.

More significantly the survey led to the donation of 1000s of records from companies who shared the same vision of information dissemination. All this data had previously been unavailable to the broader safety community and we now had the opportunity and, as a professional body the obligation, to make this information available to all.

Database structuring

As we have seen, surveys have showed what was wanted from an accident database. IChemE's own survey also started to put figures on the quantity of information that was required. As well as numerous small fields such as date of accident, number injured or killed, location etc., the inclusion of two major field were proposed:

- Abstract — the survey stated that this field should be no more than 500 words long but capture the accident sequence, chemicals involved, human, managerial and technological aspects and where known the actual loss to plant and property. This abstract should be appropriately keyworded so that the database user is most likely to find the accident most relevant to his/her enquiry.
- Lessons learned — this field was suggested again to contain no more than 500 words and capture the stated lessons learned from the original report. This latter point is vital, IChemE were not in the business of the reinventing the lessons learned with the 'benefit of hindsight'; thus 'lessons learned' are taken directly from the original report.

One of the greatest challenges on this project was developing a methodology for the keyword structuring. Traditional databases usually rely on a simple alphabetical listing that the user must scroll through and pick prior to commencing the search. This methodology is prone to error particularly when the keyword sets are large. Originally the IChemE database had the following keyword structure:

- chemicals (over 1000);
- equipment (800);
- type (200); and
- cause (500).

However, many of these keywords were duplicated as they represented synonyms. For example, one accident might be indexed using the equipment keyword 'incinerator' and a different accident might use the keyword 'thermal oxidiser'. It is important when indexing a database to use a consistent approach. This required some rationalisation of the keywords. Coincidentally, a project in the department of chemical engineering at Loughborough University was already looking at how to improve retrieval of information from accident databases. The work of rationalising the database keywords was taken up as part of this project with expert input from the IChemE.

The Loughborough University project is initially looking at the use of case-based reasoning to improve accident information retrieval.

Case-based reasoning uses formalised rules to try to identify and use information on past cases to provide help with new problems. It softens the all-or-nothing approach used in conventional database matches by retrieving cases that have some degree of relevance to the keywords specified by the user, without matching exactly. In order for the system to know how keywords are related, a domain model is required for each database field. Part of the domain model for the activity field is shown in figure 3.

The keywords for the IChemE database were rationalised and organised into domain models (with the exception of the chemical keywords). The number of keywords in the keyword hierarchies is now:

- equipment hierarchy (450);
- cause hierarchy (275);
- consequence hierarchy (65); and
- activity hierarchy (40).

The consequence and activity hierarchies have been developed from keywords in the incident type field.

This is where the Accident Database really comes into its own. If, for example, you were worried about storing a particular substance in a particular place you would start with activity and then select storage. From there you can select the chemical concerned, the type of packaging it comes in, the equipment used to move it and so on. Using a Windows-style drag-and-drop facility you can build up mini-databases based on your own keywords and then save them for ease of future reference. As the Database grows, the number of specific topics could be extended.

Definitions

The hierarchies are defined as follows:

- Substance: the substance could be a raw material, chemical, intermediate or final product involved in the accident. The substance may be a specific chemical or a generic material such as 'plastics', based on Sax's Dangerous Properties of Industrial Materials, but not brand names or commonly used names.
- Activity: the activity being carried out when the accident occurred.
- Equipment: the equipment that is involved in the accident.

- Consequence: the result of the accident including; damage to equipment, injury or harm to personnel, damage to environment, financial loss and will include near-misses.
- Cause: the events which resulted in an accident, incident or near-miss. These may be basic causes and/or underlying causes. Experience shows that underlying and particularly management system failures are seldom reported.

Data quality

The IChemE Accident Database in its first release contains approximately 8000 records, 3000 of these are previously unpublished and approximately 2000 have associated lessons learned. Many of the reports on which the entries are based are lengthy reports which contain excellent well researched data. Some of the data is of a lesser standard. However the management group that controls the database developments believe that all the data included in The Accident Database is useful and will help others to learn from the mistakes of the past.

Confidentiality

One of the hurdles that had to be overcome with regards to the 'in-company' data was the issue of confidentiality. There seems little advantage to be gained from publishing companies names and the exact location of each incident. Quite the reverse in fact; it is unlikely that a company would wish to 'wash its dirty linen' in public. To address this issue the IChemE adopted a management system which meant that each incident from in-company sources went through an abstraction process guided by a panel of experts who form a group run by the IChemE, known as the ADMG (Accident Database Management Group). The process is a simple one and involves taking out specific locations and any trade names and avoiding the inclusion of reference to company procedures. In addition individuals are never named. It has also been agreed that the full report will not be made available to a user unless agreed by the donating company.

This compromise does not reduce the value of the data and enables the IChemE to ensure that each entry contains the maximum of quality information such that the user will be able gain information that satisfies the 'wish list' highlighted earlier in this paper.

Medium of release

Initially The Accident Database is being provided in a CD ROM with an annual update. However the IChemE are presently researching into the viability of using the Internet as the host for the data. This has a number of advantages not least the ability for the data to be kept as up to date as possible without the need to wait for the new release.

THE FUTURE

The IChemE are in the process of contacting representatives of all the chemical companies and allied companies in the UK to invite them to donate records to the database. The Chemical Industries Association Responsible Care programme is so convinced that sharing of data in such a way will lead to further improvements in their members safety performance that they have lent their support to this initiative. The initial survey carried out by the IChemE showed that 65% of responders would consider donating reports to the database. This figure would seem to suggest a cultural change has taken place. As well as inviting companies to donate data IChemE are also providing standarised incident reporting training material (6) which will help in the developments of both its own database but also companies' own reporting systems. The Accident Database will grow year on year with a focus on data that has never been published before. By acting as an 'honest broker' in this way IChemE can bring information that has yet to be seen to the broad safety community and help the process industries to continue improving safety performance.

Finally, remember the old adage 'a wise man learns from his own experience, a wiser man learns from the experiences of others' or put simply, sharing data on accidents saves lives.

FURTHER INFORMATION

For further information about The Accident Database contact the Institution of Chemical Engineers:

John Duffy
Head of Marketing (Safety, Health and Environment)
Institution of Chemical Engineers
165-189 Railway Terrace
Rugby CV21 3HQ
UK

Tel: +44 1788 578214
Fax: +44 1788 560833
E-mail: john@icheme.org.uk
URL: http://www.icheme.org

REFERENCES

1. Bond, J., 1996, The hazards of life and all that, Institute of Physics.
2. Kletz, T., 1993, Lessons from disaster: how organisations have no memory and accidents recur, Institution of Chemical Engineers.
3. Chemical Industries Association, 1997, The UK indicators of performance 1990-1996.
4. Keller, A.Z., Pineau, J.P., October 1994, Initial assessments of the strengths and weaknesses of current accident databases, European Safety and Reliability Data Association Conference.
5. Bardsley, A., Cole, J., Lelland, A., Overview report on the use of data on past incidents on process plant: in particular use to aid hazard identification and control, European Process Safety Centre.
6. Incident reporting, investigation and analysis — training package 026, 1996, Institution of Chemical Engineers.

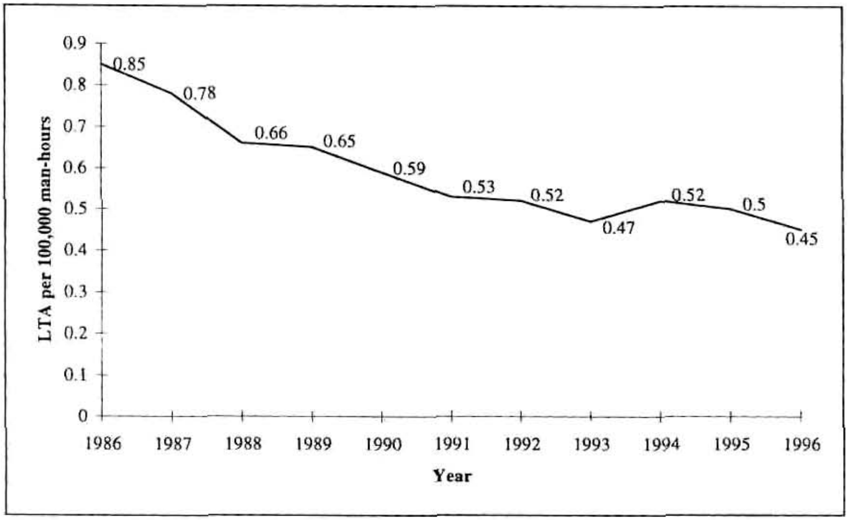

Figure 1: Lost time accidents per 100,000 man-hours — own employees

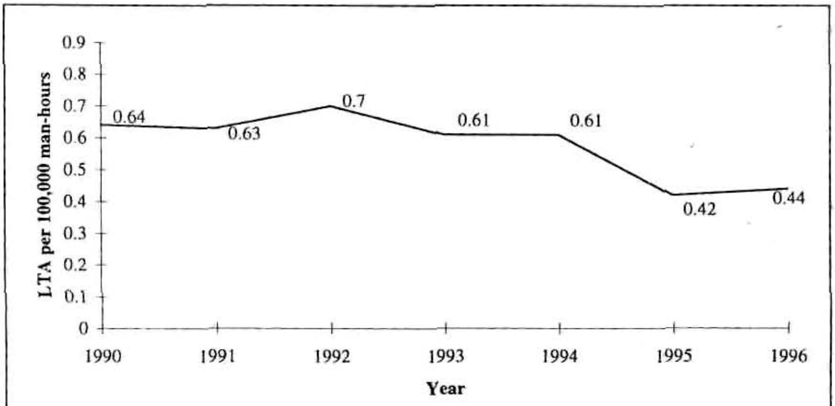

Figure 2: Lost time accidents per 100,000 man-hours — contractors

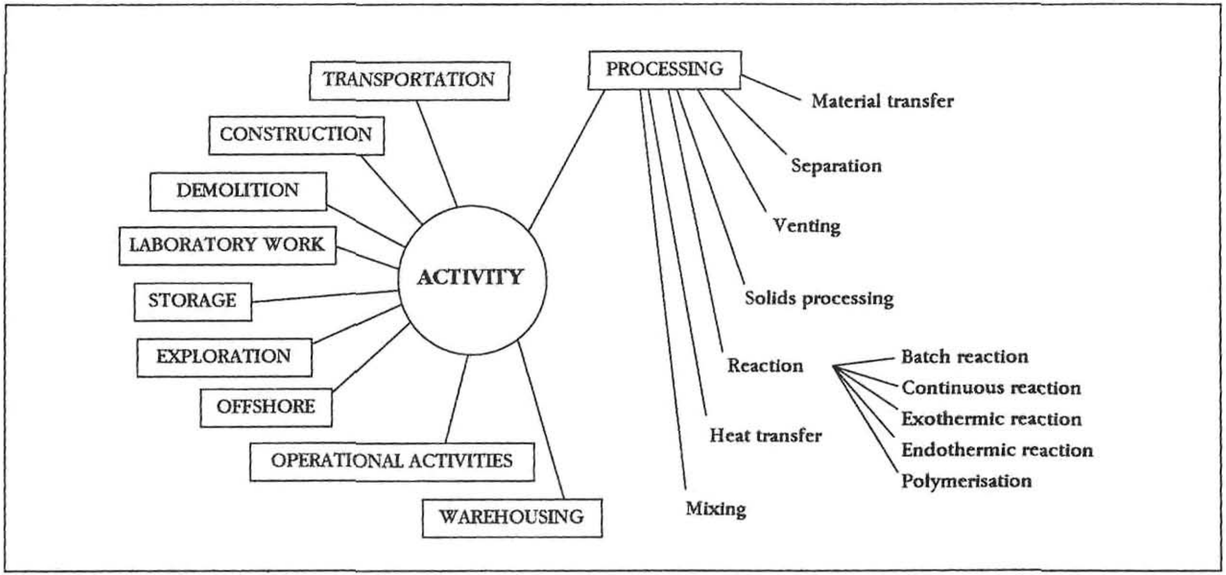

Figure 3: Part of the domain model for 'activity' from the IChemE Accident Database