DEVELOPING A MAJOR HAZARDS LEARNING CULTURE — INTERPRETING INFORMATION FROM THE CIBA SPECIALTY CHEMICALS, BRADFORD NEAR MISS REPORTING SYSTEM UP TO 2003

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Historically, near miss and incident investigation reports from the Ciba Specialty Chemicals Bradford site were managed using paper records. A new computerised database near miss recording system was introduced in 2001. The system scope was expanded in 2002 to cover quality as well as EHS events. 400 records were made in 2001, rising to 2200 in 2003. A significant amount of this data is useful for managing major hazards, providing insights into real plant maloperations, human errors, control system/instrumentation failures, mechanical failures, control of chemical reactions, system failures and loss-of-containment incidents. This paper systematically analyses the near miss data to (1) analyse failure rate data for major hazard precursor events so they can be compared to the data which is used in risk assessments, (2) identify useful measures of major hazard performance which could form the basis of a safety management system performance target and (3) identify specific learning points which would have a use in the industry as a whole. In some cases, it is clear that repeat near misses have occurred, indicating a lack of corporate learning. Some of the reasons for this lack of learning are identified by investigating records from real events and by interviewing staff performing different roles in the company. This allows the main barriers to effective learning to be highlighted.

KEYWORDS: frequency analysis, learning from accidents.

INTRODUCTION

> *"Identify, report and quantify risks to the greatest possible extent. Use historical risk and loss databases and identify risks precisely rather than generally"*

This is one of the key factors identified by PricewaterhouseCoopers and the Economist Intelligence Unit in 2002 for promoting a world class risk management culture[1]. In an EHS context, accident investigation reports often reveal that warnings were missed before the major hazard event occurred: the significance of precursors to the main event were not always realised; the significance was realised but no action was taken; or organizations suffered a repeat of historic accidents.

A wealth of useful information must therefore exist within organisations which could be used to improve EHS performance and develop an EHS learning culture. Indeed, useful knowledge can also be obtained by analyzing accident reports from other industries. Beale[2] has shown how many of the factors contributing to recent high profile accidents in the rail industry have identified causes which are very similar to those affecting the process industry in areas such as:

- structural and organisational aspects.
- safety management systems.
- design aspects.
- operational aspects.
- hazard management.
- emergency response and management.

Evidence suggests that most organizations do not in practice demonstrate true learning from incidents and near misses. Barriers exist to developing a learning culture. In some cases, critical information is often not spread effectively around the organisation and gets concentrated in a small number of people. When they leave, the information is lost. In other cases, the overall significance of isolated data is not recognised. The organisation collects individual data sets but does not analyse the data sufficiently critically to identify trends and patterns.

Improvements have been made over the last ten years at the Ciba Specialty Chemicals Bradford site aimed at improving the extent, quality and usability of incident and near miss data to allow staff to gain a more accurate understanding of EHS performance and to produce a framework for learning from accidents. This is consistent with the agenda that is being developed by the Health & Safety Executive (HSE) to improve understanding about the precursors to major accidents in the chemical industry. Key information is now being reported to the HSE on a confidential basis as part of an HSE research project to collate and analyse data about the precursors to accidents.

Ciba Specialty Chemicals recognise the benefits to the business that flow from developing learning about accidents and aim to actively promote a learning culture throughout the organisation using tools like:

- Issuing internal safety alerts to all sites whenever incidents occur to warn all sites about potential problems, hazards and methods of controlling risks.
- Holding regular EHS workshops to discuss key topics with specialists from around the world.
- Discussing important incidents with EHS staff at a regional level (eg. all UK sites).
- Reporting precursor data at a corporate level via the corporate EHS department (this initiative was started in 2003 and is still being developed).

Incident reports from global Ciba Specialty Chemicals sites can also be accessed from corporate databases. This data tends to cover the more serious incidents. A wealth of important near miss data also exists at a site level.

This paper reviews the information contained in the near miss reporting system for the Bradford site, identifies useful EHS performance measures based on the data which has been collected and summarizes some of the learning points which can be extracted from the data.

BACKGROUND

THE BRADFORD SITE NEAR MISS REPORTING SYSTEM

The Bradford site operates a computerised database incident reporting system. This allows statistics to be collated about the frequency of different types of accident and allows people at the site to learn from accidents and prevent their recurrence. Figure 1 illustrates the database system using an information systems model.

NEAR MISS REPORTING SYSTEM OUTPUT

A range of different outputs are produced from the system including the monthly accident summary reports which are used for identifying data trends and normalised data such as Lost Time Accident Rates (accidents per 100,000 working hours). The reports are formally reviewed by the management committee and by the senior production managers and are published for use by all employees.

In common with most of the chemical manufacturing industry, Ciba Specialty Chemicals use lost time accident rate data as a key measure of EHS performance. The Water & Paper Treatments business segment (which includes the Bradford site)

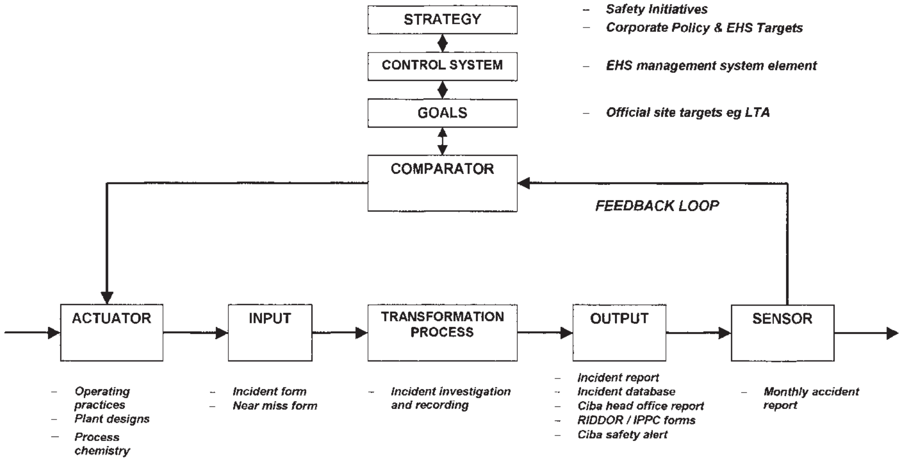

Figure 1. Database incident/near miss reporting system overview using an information systems model

started to measure process safety indicator data in 2003 as a tool for making further improvements in EHS performance. Monthly reports are sent to senior managers in the business segment and the data is measured against defined targets. The system is still in it's infancy and will evolve over time. The main problem with the new system has been ensuring that correct and accurate data is input to the system for each incident/near miss. Some staff have been collecting incomplete data records, typically describing the impacts of the incident rather than the causes. As such, all staff with responsibility for incident investigations have been retrained on a new incident/accident investigation course. One of the aims of the course is to improve the quality of the incident data that is collected and the data analysis.

NEAR MISS REPORTING DATA – AN UNDERUTILISED RESOURCE?

The rate of database incident reporting is continually growing. There were 414 records in 2001, 1380 in 2002 and 2208 in 2003. By reviewing the incident records, it can be seen that site risks are not necessarily increasing. Staff are simply using the system and reporting near misses and minor losses that were not previously reported. This is a positive measure of how the site is developing a learning culture. This is supported by the continuous improvement in EHS performance recorded at the Bradford site.

It is, however, clear that the learning culture is not developing universally across the site. A large proportion of the near miss records are from two production areas and the warehousing operations. The five other production areas only seem to record incidents or serious near misses. These areas are missing learning opportunities. Near miss and minor incident statistics are therefore likely to be under-reported within the database as they are dominated by areas covering about 30% of the site operations.

FAILURE FREQUENCY ANALYSIS

Organisations constantly make risk based decisions using assumptions about the likelihood of accident precursor events. One of the most accurate methods of measuring frequency is to analyse incident records covering actual losses suffered by the organisation.

This information is held in a number of areas within Ciba, with recent loss records being recorded systematically in the database incident reporting system. This covers losses and near misses since December 2000. As time has progressed, the site has evolved from simply recording EHS incidents to recording EHS near misses and then to recording quality near misses. The more recent data is therefore much more extensive and detailed.

Loss records that predate December 2000 are held in a variety of non-systematic areas, ranging from the unwritten knowledge of experienced staff to operator log book records to formal incident investigation reports. Over time, staff tend to forget the near misses and subtle learning points and focus on the more serious incidents.

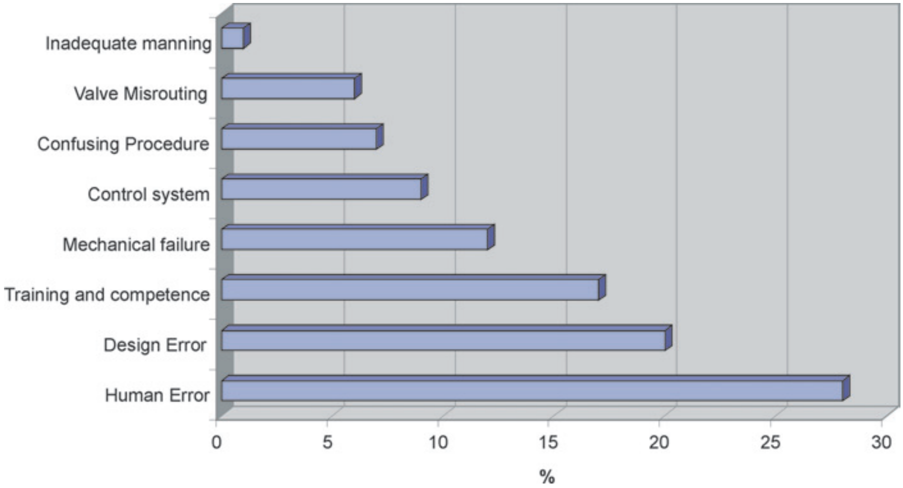

Figure 2. Identified causes of reportable loss-of-containment incidents 1992–2003

Figure 2 summarises the identified causes of the more serious reportable chemical loss-of-containment incidents over the wider time period of 1992–2003 based on database records and a review of published incident reports. This suggests that the dominant causes of incidents at the site are human errors, design errors and inadequate staff competence.

A summary of the detailed database records for 2001 and 2002 is included by accident cause in Table 1. There are about 20 plants on the Bradford site. Relevant data is therefore also presented as the number of incidents/near misses per year per plant assuming that incidents are spread uniformally across all plants. Other data is related to the number of staff on the site and has been presented as the number of incidents/near misses per year per person. This assumes that 500 people work in the chemical manufacturing areas and 1000 people work on the site.

Three of the categories of near miss report which are particularly important for managing major hazards are analysed in greater detail: plant maloperation caused by human error (Table 2), mechanical equipment failure and permit to work system errors. This information is very useful as resources can be directed at reducing the dominant causes of failure to manage risk levels down. It can also be used as background data for human error studies and risk assessments to influence new plant designs. A comparative trend analysis has not been carried out as the detailed records suggest that there are more recorded incidents in 2002 because staff are making use of the system for near miss reporting. Data for the two years is therefore not directly comparable.

Table 1. Near miss reporting system cause analysis 2001–2002

Category Description	N/yr (2001)	N/yr (2002)	N/mth (2001)	N/mth (2002)	N/yr/plant (2001)	N/yr/plant (2002)	N/yr/staff (2001)	N/yr/staff (2002)
Vehicle/road tanker/fork lift truck involved.	52	138	4.3	11.5	–	–	–	–
Maloperation of plant inc. human error.	75	356	6.3	29.7	–	–	–	–
Mechanical equipment failure.	45	116	3.8	9.7	2.3	5.8	–	–
Instrumentation/control system failure.	11	60	0.9	5.0	0.6	3.0	–	–
Uncontrolled reaction/ chemical instability.	5	34	0.4	2.8	–	–	–	–
Slips, trips, falls or contact with object.	43	118	3.6	9.8	–	–	0.04	0.12
Manual handling.	21	31	1.8	2.6	–	–	0.04	0.06
Contractors.	9	70	0.8	5.8	–	–	–	–

NOTE

N = number. yr = year. mth = month.

Bradford site includes 20 plant/operations areas. 500 staff work in chemical manufacturing areas. 1000 staff work on site.

Table 2. Plant maloperation/human error summary 2001–2002

Major Hazard Risk Measure	N (2001)	N (2002)
Failure to do management of change assessment.	0	2
Inadequate manning levels.	1	10
Failure to wear designated personal protective equipment.	1	19
Failure to do safety checks.	0	25
Unsafe handling of samples.	1	27
Incorrect/confusing recipe sheets or procedures.	2	22
Incorrect chemical labeling.	7	39
Container lids/blanks not fitted properly.	6	26
Access/escape route blocked by chemical storage.	0	15
Failure to control plant.	13	35
Storage of incompatible chemicals in same location.	3	26
Failure to follow agreed procedures.	7	16
Operator did not respond to alarm.	2	7
Operator charged too much chemical.	3	5
Operator charged wrong chemical or right chemical to wrong place.	5	14
Operator double charged chemical.	2	2
Operator distracted when multi-tasking. Error occurred.	1	3
Operator forgot to charge a chemical.	0	2
Interference with plant when running live (opening pipes etc).	1	0
Incorrect valve positioning, routing or plant set up.	8	42
Chemical storage in unsafe location (containers).	2	23
Operators not told that plant changes had been made.	0	5
Operators not told that chemicals were being transferred to plant.	0	1

NOTE

1. N is the number of incidents/near misses that occurred in the year.
2. Failure to control plant means that the plant went beyond its safe control envelope.

MECHANICAL EQUIPMENT FAILURE

Data has been collected for a wide range of small loss of containment incidents in 2001 and 2002. The top five categories of mechanical failure were (as a percentage of the total records):

1. Flange or gasket leak (22%).
2. Intermediate Bulk Container (IBC) or drum leak (13%).
3. Pipe leak (11%).
4. Pump seal leak (8%).
5. Fitters or maintenance error (7%).

IBC/drum leaks occurred on average with a frequency of 0.25 per plant per year. The reported causes of these leaks were container leaks, valve leaks, overfill and containers being punctured by fork lift trucks.

Five causes of road tanker loss of containment incidents were identified: poor hose connections, incorrect use of dry link couplings, movement of tanker during offloading operation, driveaway of road tanker when connected and overfill when loading.

PERMIT TO WORK SYSTEM

Seven failures with the permit to work system (a critical system which is used for managing non-standard maintenance and fitting activities) were recorded in 2001. 19 failures were recorded in 2002. The following types of system failure were identified for the combined years of 2001 and 2002:

- 52% involved a failure of the permit acceptor to work accurately to the agreed permit, including the correct reversal of isolations at the end of the job.
- 16% involved errors by the permit issuer or a lack of awareness by plant staff that work was being carried out under permit in their plant area.
- 16% involved cases where work was being carried out without a permit when a permit should have been issued.
- 12% involved fitting equipment back to front.
- 4% involved not obtaining the required signatures on the permit.

USEFUL PERFORMANCE MEASURES FOR MAJOR HAZARDS

The main corporate risk measure used within Ciba is the lost time accident (LTA) rate. This measures the frequency of accidents that result in a member of staff being unable to attend work for more than one day. The LTA rate is the main risk measure that most chemical companies use and is one of the main indicators used by the Chemical Industries Association[3]. LTA's are viewed as serious incidents within Ciba and have to be reported at group board level. Senior managers perceive that sites with good LTA records have good risk management.

Two LTA's have been reported at the Bradford site in 2003. One involved an office worker slipping down some steps on a freezing morning. The other LTA involved a laboratory tester slipping on some spilt tea in a tea room. These two incidents were reported at group board level. Neither of these accidents were related to process chemistry.

The LTA rate consistently measures slips, trips and falls injuries. These occur relatively frequently but have relatively insignificant consequences in the context of the business as a whole. The worst case accident could involve an employee fatality and a large fine. Ciba's reputation would be damaged but the business would survive.

A large chemical release would seriously damage Ciba's reputation. A large fire would threaten the site's entire operations. Plant maloperation or an uncontrolled chemical reaction could lead to a major fire or explosion, again threatening the viability of the entire site. The Ciba risk measures are therefore mainly targeting the lower consequence events. Risks with catastrophic consequences are not being measured unless they occur. By their nature, these risks only materialise infrequently, even on a poorly run site. A wider range of corporate risk measures including the precursors to catastrophic events is therefore required.

Hopkins[4] observed that the Esso Longford site in Australia had an exemplary lost time injury record which had been reduced to zero. The gas plant blew up in 1998 causing the state of Victoria to lose its energy supplies for over a fortnight. An almost exact repetition of the accident occurred one month earlier but it was not recorded in the management system as a serious incident. Hopkins concludes that using lost time accident rates as a performance indicator for major hazard industries is a fallacy and breeds complacency.

Trevor Kletz, a renowned safety expert, summarised the errors made by the senior managers at Esso by stating[5]:

> *"In the company as a whole, the outstandingly low lost time accident rate was taken as evidence that safety was under control. Unfortunately, the lost time accident rate is not a measure of process safety"*

Based on the databse analysis in Section 3, the following 9 measures of major hazard risk could easily be used for the Bradford site as a tool for managing risk:

- Spills of hazardous chemicals.
- Bursting disc failures.
- Fires and smouldering materials.
- Vehicle accidents involving hazardous chemicals.
- Mechanical hardware failures involving hazardous chemicals.
- Instrumentation and control system failures.
- Uncontrolled reactions and chemical instability.
- Plant maloperation caused by human error.
- Staff competence (% staff training completed relative to training needs analysis).

The Water & Paper Treatments business segment (which includes the Bradford site) has been measuring a wide range of quality and process safety parameters since 2003. Data is currently collated in the following categories:

- Process safety.
  - Contact with harmful substance.
  - Incorrect chemical storage.
  - Engineering/equipment problem.
  - Blockage.
  - Damage to building/structure.
  - Explosion.
- Occupational safety.
  - Manual handling.
  - Exposure to cold/heat.

  - Contact with electricity.
  - Contact with moving vehicle.
  - Ingestion/inhalation of harmful substance.
  - Asphyxiation/drowning.
- Quality.
  - Incorrect data entry/paperwork.
  - Delivery/transport problem.
  - Incorrect weighing.
  - Product contamination.
- Other.

The largest number of records (more than twice as many records as the next category) are in the 'other' category. This suggests that staff are being lazy in their use of the reporting system or that the category definitions need to be improved. The reporting categories are therefore likely to be modified as more experience is gained with the system.

GENERAL LEARNING POINTS

An analysis of the reportable incidents involving chemical handling has identified the following nine interesting learning points.

COMAH IMPROVEMENTS WHICH CAUSE ACCIDENTS

A range of hardware improvements have been identified in the COMAH Safety Report[6] in order to achieve ALARP risk levels. There are risks in implementing the improvement plan as breakings are required to plants, people are involved in the changes and good communication is required. About half of the larger loss-of-containment incidents experienced by the site since 2000 were related to errors in implementing planned risk reduction improvement projects. In these cases, risks have increased in the short term during project implementation in order to achieve a longer term reduction in risk levels.

THE PRACTICAL MEANING OF ALARP

ALARP decisions tend to be focused at a strategic level to address the theoretical requirements for plant hardware. Detailed decisions about line routing, alarms and interlocks tend to be made by experienced staff in teams. These teams do not always effectively use option analysis. In one recent case, small low cost control measures were missed because the project team had focused their ALARP assessment on strategic issues such as inherent safety and fire protection systems at the expense of the detailed and practical issues of individual instruments and interlocks. ALARP assessments need to work at both a strategic and a detailed level that is relevant to project teams.

GASKET FAILURES

There is a growing trend of small leaks caused by gasket failures. The proven and reliable compressed asbestos fibre (CAF) gaskets had to be phased out several years ago. This was recognised as a major management of change situation affecting almost every area of the site. New types of gasket were identified for each area in consultation with specialist suppliers and in-house expert chemists based on the properties of the chemicals being handled and the environment in which they were used. Initially, there were very few leaks caused by gasket failure. Recently, there has been a trend in gasket failures on some plants where the operating environment is harsh. The replacement gaskets are less resilient than the old CAF gaskets. Their performance is extremely sensitive to the quality of gasket fitting. Any misalignment, under or over tightening may cause failure modes to develop and some chemicals are able to impregnate the porous gasket material to cause degradation and failure. New gasket specifications have therefore had to be developed for some chemicals and installation, inspection and maintenance regimes have had to be developed in response to the emerging situation. The site now uses a strict gasket management system, more akin to that used in the petroleum industry than that used in the chemical industry. The system focuses on staff training, gasket selection criteria, engineering fitting standards and performance monitoring.

CONTROL SYSTEMS CAN FAIL

Chemical leaks caused by control loop failures with a simultaneous failure of an independent protection system interlock are relatively rare. In 2003, a level control system failed because a storage tank level transmitter failed to an intermediate (half full) state. The plant operators expected the tank to be half full but were not aware that the tank was actually filling from a recycle line from a production plant. The tank also had an independent high level overfill protection interlock. The high level switch was triggered but then reset itself. The incident investigation concluded that the level transmitter and level switch failed for different reasons and common mode failure did not occur. If plant operators had been monitoring the plant more thoroughly rather than simply responding to alarms and interlocks, the incident could have been prevented. It is important that plant operators realise that independent protection systems do not provide a guarantee that accidents will not occur.

OPERATORS IGNORING ALARMS AND WARNING SIGNS

As plants become more automated, there is evidence that plant operators start to place excessive reliance on the plant control system rather than monitoring plant conditions visually using sight glasses, local instrument readings and plant walkarounds. Problems can then occur if abnormal operating conditions occur. Operators may convince themselves that faults are caused by instrument failure rather than an actual incident and there is evidence that some warning alarms have been ignored, particularly in cases where contradictory information was being provided by the control system. In one example, the operator ignored a high level switch alarm because it was common knowledge that the level switches were unreliable on some vessels. The sight glass showed that the vessel was empty. In fact, it was full with a colourless liquid. In another example, the operator assumed that a bang from a bursting disc activation was caused by a roof worker dropping a scaffold pole.

TRAINING AND COMPETENCE

People play a critical role in preventing many chemical releases. In major accident situations, a well designed plant should include a range of hardware safety systems to back up the human system of operating procedures. Different people have different levels of competence based on formal training, working with colleagues and historic experience. Minimum levels of competence are required for running major hazard plant. Do staff simply follow procedures or do they really understand normal and abnormal plant operations? If the system for demonstrating competence to perform defined roles is too informal, there is a risk that key staff may not have the right level of competence for working on the plant.

A structured training plan is therefore required based on a training needs analysis for all staff. The training needs to cover underlying process knowledge, operating the process in normal and abnormal conditions and emergency situations. Critical process steps need to be highlighted, with an explanation of the potential consequences of failing to properly complete each critical process step. Staff then need to demonstrate competence based on an analysis of the key process steps using questions and observations.

SUPERVISION AND WORKING PRACTICES

Procedures are not fool proof and can become ambiguous because different shifts work in subtly different ways. Each shift believes that their custom and practice is superior and they ignore the official written procedures. Procedures are also subject to change in the aftermath of a plant modification. The first procedure will be theoretical and is likely to evolve as plant experience grows. If the procedure is modified too frequently following the change, people can become confused. If the procedure is modified after too long a time lag, ambiguity can arise because of discrepancies between the actual procedure and the formal written procedure.

Different teams respond in different ways to organisational change. In one area, staff may act consistently with the theoretical planned changes, following procedures and accepting responsibility. In other areas, quite the reverse outcome could occur. Staff may develop working practices to suit themselves at the expense of company goals. This emphasises the fact that the right people need to be used within a specific organisational structure and culture if the organization is to perform successfully.

LISTENING TO THE OPERATOR'S VIEWS

Decisions about plant changes are often made in good faith by a project team, including plant representatives. In some cases, people outside the team are aware of a design flaw, such as an unreliable level switch for a particular application or a modification that was tried and rejected in the past. These views are not always fed back to the project team and a flawed change is made to the plant. These problems sometimes occur because of the poor communication skills of individual people or because the bureaucracy and inertia within the project management system fails to react to opinions from outside the project team.

FAILURE TO LEARN FROM HISTORIC NEAR MISS WARNING SIGNS

Amongst the thousands of database records there is clear evidence that warnings about future incidents are embedded in the details of some near miss reports. Staff have either failed to understand the significance of the near miss or remedial action has not been taken. In some cases, the same near miss has been logged on a regular basis. The challenge for Ciba is to make better use of the near miss information to prevent future incidents.

BARRIERS TO LEARNING

The main factors which are considered to inhibit effective learning are considered to be associated with:

- Technical limitations with the current system.
- System dynamics and time lags.
- Missing information which is not entered into the system. And.
- Communicating system information and feedback to site staff.

TECHNICAL LIMITATIONS

The modern database system supercedes many older legacy systems, some of which have been based on manual data collection and others of which have been based on obsolete simple software packages. Data from many of these older systems cannot be accessed from the new database and cannot easily be retrieved. Useful information about site incidents before 1999 is therefore difficult to obtain.

The system has also been structured to allow the analysis of hard quantitative data. It is difficult to input and access softer qualitative data. The qualitative data is often the most useful data for influencing future site performance as it can be used by staff in real situations to improve EHS performance.

SYSTEM DYNAMICS

From Figure 1, it can be seen that the system includes many elements. There is a time lag associated with each element. The control loop from the occurrence of input data to completing corrective actions through the actuators therefore produces a large time lag. A typical time lag for the complete loop would be:

- One day to complete incident form (input).
- Three days for an incident investigation (transformation process).

- One day to produce incident reports (output).
- Up to one month to produce a summary report (sensor).
- One week to review the report at the management committee (comparator).
- One day to several months to change plant operations (actuation).

Overall, there could be a time delay of six weeks to several months for the whole management control loop to function. The overall impact of these time lags is to delay the system response for responding successfully to known problems.

MISSING INFORMATION

The system can only control information which is input to the system. There are at least three sources of information which do not fall within the scope of the system. This information is not managed by the system and includes information which is:

- Not reported by personnel due to ignorance of the system, laziness, deliberate non-reporting or because some staff think that the input forms are too complex.
- Held manually in systems which do not interface with the database system. For example, the fire crews and plant operators maintain separate hand written log books which do not interface with the database system and are therefore not readily available to other people within the company.
- Generated outside the site by other Ciba sites and other chemical companies.

COMMUNICATION

System information can be difficult to communicate because of the level of detail which is input to the system. Hard quantitative data can be communicated easily but softer information is often lost because the information is input in an overly summarised form. This restricts the ability of users to interrogate and understand some of the more complex areas, such as the causes of complex incidents.

This makes it easy to communicate numerical information such as lost time accident rates around the company but makes it difficult to store, retrieve and summarise learning points from real incidents, which require sophisticated descriptions. This restricts the effectiveness of some of the key feedback mechanisms within the information system.

CONCLUSIONS

It is difficult to analyse major loss data for a site for individual years because there are such a small number of events. Data for small time periods can easily be distorted by the occurrence or absence of one single event. The precursors to major loss events can, however, be measured over the relatively short time duration of a year to aid continuous improvement, highlight problem areas, identify trends and learn from accidents and near misses.

The major hazard incident data for the Bradford site are dominated by human errors and problems with staff training and competence. Design errors also contribute significantly to the frequency of serious incidents. In the initial phases of the COMAH regime[6], risk reduction efforts were very much focused on plant hardware improvements. Efforts were then made to improve human performance because real plant data suggested that human factors issues underpinned many of the near misses and incidents that were occurring at the site (see Figure 2).

Over the past year, the Water & Paper Treatments business segment has started to measure a wider range of EHS key performance indicators (see Section 4) so that risks can be reduced by directing resources at the areas where performance is weakest. Behavioural safety tools are being used to achieve EHS and quality improvements and improve performance with a focus on:

- Demonstrating senior management commitment and involvement, achieving visibility at the plant level.
- Ensuring that staff adhere to procedures.
- Emphasising the role that individuals play in identifying and remedying problems associated with site systems, operating procedures and the work environment.
- Harnessing the detailed pool of plant level knowledge to improve EHS and business performance.

The following improvements are now needed to gain real benefit from the database incident/near miss reporting system:

1. Addressing failures within the existing system, particularly regarding long time lags and missing information.
2. Exploiting new technological developments to make the system more user friendly and to make it easier to retrieve soft non-numerical data.
3. Removing confusion about how the system works, encouraging all staff to use the system for recording near misses and interrogating and using the output data to use in their day to day activities.

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