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Learning from Accidents

Organisational Learning – Industry and Authorities

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Abstract

It is undisputed that learning from accidents is an essential and important part of major accident control; however there appears to be less clarity about who should be learning and that the learning activity needs embedding into a structure to ensure that it becomes a sustainable activity. Hazardous establishments are operated by companies with a wide range of size and organisational complexity. Many of these organisations do not belong to the traditional chemical manufacturing or petroleum refining industries which have a long history of not only experiencing major accidents but also developing technical and organisational systems to manage their risks. Establishments which use or handle chemicals within, but not as the main focus of their business operations, may not be fully aware of the major accident potential, and are also likely to face barriers to developing organisational learning around learning from accidents.

Public authorities are a second set of organisations which are closely involved in the prevention of major accidents. The way in which authorities assess permitting applications, land-use planning issues as well as the execution of inspections, and carrying out and following up on accident investigations has a significant impact on the major accident risk landscape. Whilst inspectors are not as a rule responsible for the initiating events of a major accident, they can play a significant role in ensuring that effective risk management activities are carried out and also in communicating the lessons learned from accident investigations to a wider clientele.

This paper will discuss the need to learn from accidents by both industry and authorities, and that the learning activity needs to be embedded into a management structure to foster the development of organisational learning.

Organisational learning

An organisation is defined by the process of organising people to carry out particular tasks. Thus it is not the people (who may come or go over time) or products or technologies themselves which make up the organisation, but the social interactions between the people, that enable them to carry out the activities which fulfil the organisations purpose. There is a parallel between individual learning and organisational learning. Individual learning takes place when a person decides, based on their experience, to alter some aspect of their behaviour. Organisational learning takes place in that individuals decide, based on their experience, communication and other interactions, to change part of the processes governing the organisation and interaction of the people.

This important to understand because in the same way as organisational learning can be developed it can also be undone by decisions to reverse or change these same organisational processes. Not all changes are fully thought through and often they can have unforeseen consequences.

Organisational memory is the body of data, information and knowledge which an organisation has accumulated over its existence. As with human memory, organisational memory can only be applied if it is accessible. This means that practices and processes are required within an organisation's regular activities which make use of this information and knowledge thus maintaining its accessibility. This retrieval of information and use of knowledge and data is dependent on the individuals which make up the organisation. As a consequence sudden changes in an organisation which result in personnel changes (including structure, responsibilities, etc.) will have an effect on the organisational memory. In particular measures such as outsourcing, early retirement incentives, and job rotation and flexibility can lead to a rapid degradation of organisational memory. The lack of awareness of the need to maintain the organisational memory is highlighted in Trevor Kletz's book *Lessons from Disaster*. Although this was published in the 1990's there have been a number of incidents which indicate that either the lessons had never been remembered or had since been forgotten.

One particular case which is perhaps worth highlighting is the link between Flixborough in 1974 and BP Texas City in 2005. In the Flixborough Disaster a massive explosion occurred at 4.53 pm on Saturday 1st June 1974. The explosions and fires led to the deaths of 28 people, 18 of these within the control room (no one escaped) which had not been built to withstand the force of an explosion. In the Report of the Court of Inquiry (Department of Employment, 1975) recommended that, although further investigation was outside the terms of reference for the Court of Inquiry, that issues including "the siting of offices, laboratories and the like well removed from hazardous plant" should be urgently considered by a special committee. At BP Texas City the explosions and fires on 23rd March 2005 killed 15 people and injured another 180. (CSB, 2007) Those killed were contractors working in and around temporary trailers sited at around 40 m from the source of the vapour cloud. Since 2005 the petroleum industry in particular has revisited the issue of siting of temporary buildings and offices in relation to refinery operations. Many who today work in the petroleum, petro-chemical and chemical manufacturing industries know nothing of the recommendations of the Court of Inquiry.

Organisational memory only exists in the collective individual memories of those people present in an organisation at any one time, together with the documentation and organisational processes for

recording, retrieving and utilizing that documentation. A company or an inspector body does not remember.

Learning from Accidents within EU Major Accident Regulation

From the very outset the European so called “Seveso Directives” have required that major accidents be reported by operators to the respective competent authorities and that an analysis of the accident, together with recommendations be made by the competent authorities. The Member States are required to report the occurrence of major accidents including a specific set of data to the Commission. The Commission was required (Art. 12) to set up a register of accidents including an analysis of causes, experience gained and measures taken to enable Member States to use this information for prevention purposes (EEC, 1982). With the Seveso II Directive and the introduction of the requirement for operators to establish Safety Management Systems there has been an increased focus on the need for operators to develop procedures for the reporting and investigation of accidents and near-misses and to follow-up with measures on the basis of lessons learnt (Annex III (c) (vi)) (EC, 1997). This process of regulatory development is continued in the Seveso III Directive, which is to be implemented in the Member States by 31st May 2015. A review of past accidents with the same substances and processes used, considerations of lessons learned from these, and explicit reference to specific measures taken to prevent such accidents is to become part of the Safety Report prepared by the operators of upper tier sites (Annex II 4 (c)). The requirements on reporting of major accidents and near misses, together with lessons learnt to a central database maintained by the Commission remain.

The Major Accident Reporting System, now known under the acronym eMARS, has been established and exists as not only the legal reporting database of the European Union, but also the voluntary reporting system for the Member Countries of the OECD and the countries of the UNECE Transboundary Effects of Industrial Accidents Convention. Over the years there have also been a number of analyses carried out by the Joint Research Centre, Major Accident Hazards Bureau. Initially, before the MARS database was established as an electronic system, a series of printed reports were published focussing on lessons learned from accidents within a particular Member State. More recently a series of reports has been launched which provide a synthesis of lessons learned related to a particular topic or particular hazard or hazardous activity. This recognises that many accidents are repeated in a similar fashion regardless of international borders and it is therefore important to recognise and understand the hazards, together with appropriate measures to manage those hazards effectively.

Organisational Learning for Industry

Major chemical companies have, over the past years, developed structures and mechanisms to try and tackle the issues of organisational learning. This has developed from the field of Occupational Safety covering the usual slips, trips, falls from height, etc. which had the aim of reducing workplace

injuries to employees. One of the techniques that has been adopted by many companies is that of “Learning Experience Reports” (LER). The concept here is to improve safety performance by sharing knowledge through the analysis of events and the exchange of experiences.

Depending on the severity and complexity of the incident, e.g. occupational safety vs. process safety; near miss vs. major consequences; the investigation of the incident may be carried out at local level or involved resources from external sites or from group or corporate level. Once the investigation is completed an appropriate measures to prevent a reoccurrence have been decided on, a report is produced for communication internally within the organisation. Typically there will be a pre-defined distribution list which ensures not only that there is a general communication, but that plant and facilities operating similar processes or handling similar materials are aware of the incident, its causes and the consequences. Similarly not only operating, but also design, maintenance and risk assessment groups within the organisation will be informed.

Often these LER are held on company computer systems and can be accessed throughout the organisation. However it is not only the free accessibility of the reports which is important, but also organisational requirements which ensure that LER are accessed when carrying out design work, plant safety reviews, site audits, training etc. Additionally internal business meetings are required to include (or start) with a “safety moment”, that is a short review or presentation of a safety relevant aspect. This may take various forms, but in a large corporation this would typically cover recent accidents or process safety “near misses” either from their own site or another location within the company. There are some who criticise this as being superficial and mechanical, however those companies which practices this approach see a clear need to make safety (including process safety) an integral part of the corporate culture. Something which is shared by every employee at all levels and which runs through all business aspects of the corporation.

The conviction that safe operation and sustainable success in business cannot be separated together with the consequences of getting control of major hazards wrong that has been observed, led the OECD Working Group on Chemical Accidents to develop guidance for senior leaders in high hazard industries “Corporate Governance for Process Safety” (OECD, 2012). Herein it is clearly stated that Leaders need to understand the risks posed by their organisation’s activities, and balance major accident risks alongside the other business threats. This can only happen if leaders recognize that they are operating a hazardous activity, that unforeseen events do occur, and the need to be prepared to take the necessary action early on.

The lessons from past incidents demonstrate that strong process safety leadership is vital in preventing catastrophe, and it is essential that these lessons are learned and adopted across all sectors to prevent the same failings leading to more accidents in the future.

This Guidance contains a self-assessment questionnaire for senior leaders covering the five essential elements of corporate governance for process safety.



Learning from accidents is a topic which has foundations in all five of these elements and will ultimately be driven by commitment from the highest level within the corporation.

For Small and Medium sized Enterprises (SMEs) and those industries outside of the chemical manufacturing and petroleum sectors the solutions may look a little different. The senior leader commitment is just as crucial; however the awareness of the importance of this role may not be uppermost in the minds of the individuals who carry out these duties. A further barrier to learning for these companies is very often, that they do not have sufficient levels of hazardous activities to experience process safety accidents or “near misses”. Therefore the opportunity for learning from their own experience is severely limited. This is particularly critical, as SMEs are often highly vulnerable entities. A major fire or explosion could destroy the company’s only production facility, putting the company out of business. Many businesses never recover from a major event.

Given the vulnerability of these enterprises what are the alternative sources of learning events? A key role can be played by third parties such as industry and trade associations, chambers of industry and commerce, major chemical companies within the supply chain and government inspectors. The strategies of SMEs need to be directed to learning from the experience of others. This also means that these third parties need to establish their own internal information gathering and dissemination processes in order that they can fulfil the roles expected from them.

Organisational Learning for Authorities

Learning from accidents is also a critical activity for inspectors and inspection authorities. Attention has been drawn to this in work by the UK HSE which considered the role of HSE’s Offshore Division (Saw, J.L., Wilday, J., Harte, H., 2010). This work also gives insights into how the concept of a learning organisation encompassing the regulatory authority might be achieved.

Accident and near miss reports are useful in highlighting potential hazards in an establishment. Having knowledge about which accidents have occurred and the measures taken as a consequence

are fundamental to the assessment of the safety report. Emergency planning is carried out on the basis of scenarios; therefore awareness of which accidents have already occurred in similar establishments may give an indication of which scenarios are relevant for the development of both the on-site and the off-site emergency plans.

Given that accident reports and the lessons learned from accidents are core elements of an inspectors assessment and inspection activities, what organisational processes are in place within the inspection authority to support organisational learning? It would be poor information management if the organisational memory of the inspection authority was reduced to the collective of the individual recollections of the current inspectors. This would rapidly deteriorate over time as inspectors do not generally supervise the same set of companies or same branch of industry for their entire career. In addition the question arises as to how new recruits should develop their knowledge of past incidents.

There are a number of opportunities and possibilities available:

- **Exchanges of experience amongst inspectors** e.g. IMPEL Lessons Learnt from industrial accidents, which is organised regularly under the EU Implementation of Environmental Law (IMPEL) exchanges by the French Ministry for the Environment. The focus on an international exchange and discussion on accidents is a very valuable event for disseminating knowledge, particularly as the reports which are prepared are provided on an internet portal in both French and English.
A further example is the EU Mutual Joint Visit programme (MJV) which within its seminars usually includes examples of relevant accidents to highlight the issues being discussed. At national, regional and local level similar exchanges may also take place.
- **Automatic bulletins via e-mail:** This is not just a tool for inspectors, but is a low-level way (in terms of resources required to gather it) of obtaining information. Examples include:
 - the notification service of the ZEMA database in Germany. The reader is required to register online (<http://www.infosis.uba.de/index.php/de/aim/index.html>) and then information is provided when a reportable event occurs.
 - The French Aria database also has a Newsletter function which provides e-mail notification of recent occurrences.
 - CCPS Process ety Beacon – this is a resource, which does not report individual accidents, but rather highlights specific process safety messages and is designed for manufacturing and operating personnel.

The major chemical companies have institutionalised the concept of including safety as a discussion item at every business meeting. Do authorities address process safety with the same intensity? One of the recurrent problems within the authorities who carry out inspection under the Seveso Directives is that of resources, regardless of whether these are financial, personnel or time. This may raise the question as to whether the hierarchy are sufficiently aware of the role played by inspectors in the prevention of major accidents. This is particularly relevant, when there has been a long period without a major accident and other topics arise on the political agenda. Only if inspectors are aware

of the occurrence of process safety incidents are they able to address them in the permitting, inspection, safety report assessment, on- and off-site emergency planning discussions, land-use planning consultations, and accident investigation. Only if the inspection authority hierarchy are aware of these activities and are committed to their effective implementation will the necessary resources be provided. There are voices which claim that the OECD Guidance on Corporate Governance for Process Safety is not just for industry, but may equally be applied to the inspection authorities.

Resources for learning from accidents

The following provides a brief and incomplete list of available resources with a description of their availability for learning from accidents.

eMARS (<https://emars.jrc.ec.europa.eu/>)

The Major Accident Reporting System is the official database of the European Commission for the collection of reports of major accidents under the Seveso Directives and for the dissemination of lessons learned. The database is also the reporting mechanism for the OECD Member Countries and the UNECE Transboundary Effects of Industrial Accidents Convention on a voluntary basis. Currently over 760 accidents are listed.

ARIA (http://www.aria.developpement-durable.gouv.fr/index_en.html)

The ARIA portal provides access to a database of accidents containing over 40 000 entries. It also hosts the published reports of the IMPEL Seminar “Lessons Learnt from industrial accidents” as well as analyses of accidents by activities and by themes. Whilst the web portal is primarily in French much of the material is available in English, including the database access.

ZEMA (<http://www.infosis.uba.de/index.php/de/zema/index.html>)

The official major accident and reportable incident database under the German Major Accident Ordinance hosted jointly by the Federal Environment Agency and the Federal Institute for Materials Research and Testing. Currently over 650 reportable incidents are listed, the earliest being from 1980. In addition there are 28 incidents recorded from the Commission for Plant Safety, Committee for Incident Analysis which record events outside the scope of the Major Accident Ordinance but which are still of importance for learning. The entries are only available in German

Health & Safety Executive, Investigation Reports (<http://www.hse.gov.uk/comah/investigation-reports.htm>)

The UK COMAH Competent Authority (i.e. the HSE and the Environment Agency respectively the SEPA in Scotland) undertakes investigations as a result of an incident or complaint at a COMAH establishment. The investigation may be concerned with issues related to COMAH, or another legislative regime or many regimes (Health and Safety at Work Act or Environmental Permitting Regulations). Four major events are covered here together with a summary report from 1998 covering high-cost chemical/petrochemical accidents since Flixborough (1974).

ICHEME Safety Centre – HSE Accident Reports

(http://www.icheme.org/resources/safety_centre/products/hse_accident_reports.aspx)

The Institution of Chemical Engineers (IChemE), Safety and Loss Prevention Special Interest Group came to the realisation that over the years the HSE had released a number of reports to the public of significant major accidents and many of them were no longer available in print (or even in HSE archives). With the agreement of the HSE they set about producing electronic editions of those reports which could be obtained to make them publically available. Accidents from Flixborough (1974) to Texaco, Milford Haven (1994) are covered.

IChemE Loss Prevention Bulletin (<http://www.icheme.org/lpb>)

The website provides process safety related news articles as well as online access for subscribers to the Loss Prevention Bulletin publication. This is a bi-monthly journal exclusively dedicated to learning from accidents through sharing experience. The first issue appeared in December 1974. Articles can be published with anonymity guaranteed for both the author and the company involved. The articles are peer reviewed by an editorial panel. In addition to the journal subscribers receive access to the Toolbox Talks, which are a series of Powerpoint[®] presentations designed for communicating safety messages to the operating, maintenance and manufacturing workforce.

CSB (<http://www.csb.gov/>)

The US Chemical Safety Board (CSB) is an independent federal agency charged with investigating industrial chemical accidents. Its website provides a list of on-going and completed investigations. Of particular interest are the animations and videos which are often produced in conjunction with the final report for the completed investigations. These can be used as valuable training tools. Due to resource constraints the CSB is only able to investigate a small percentage of those serious chemical accidents which take place. Even many which are of significance cannot be investigated in full. In addition to the investigation reports the CSB provides recommendations to industry, trade associations and regulators.

Hazards Intelligence (Hint) - Ility Engineering (<http://www.saunalahti.fi/ility/>)

The Ility Engineering web site provides a catalogue of chemical accident related events which have been extracted from press and media information worldwide. The headlines can be accessed free of charge. The subscription provides a fortnightly e-journal. This service provides an overview of a large number of events which have taken place during the year. There is no long-term archive.

Tank and Petroleum Use Mishaps (republished at:

<http://www.steeltank.com/Publications/TankUseMishaps/tabid/187/Default.aspx>)

This monthly newsletter provides a documentation of incidents related to tank storage or (mis)use of petroleum. The majority of the events occur in the US, and are taken from media accounts. Many of the reports are related to accidents caused by inappropriate behaviour by people who have not understood the hazards related to the activity they are carrying out.

Lees' Loss Prevention in the Process Industries

The original two volume publication by Prof. Frank Lees is now in its 4th Edition, has expanded to three volumes and is edited by Professor Sam Mannan (Texas A&M University). This comprehensive work on process safety and loss prevention contains a number of detailed accounts about process safety accidents as case studies in the appendices.

ISBN: 978-0123971890, Butterworth-Heinemann, 2012

What Went Wrong (ISBN: 978-1856175319, 5th Ed., 2009)

Still Going Wrong (ISBN: 978-0750677097, 1st Ed., 2003)

Trevor Kletz

Both volumes contain case histories of process plant disasters and how they could have been avoided. Together they cover not only technical issues, but also procedural and managerial aspects which had they been adopted could have prevented the incident in question.

Incidents That Define Process Safety (ISBN: 9780470122044, 2008)

Atherton, J., Gil, F. and Center for Chemical Process Safety

This book describes ca. fifty incidents that have had a significant impact on the chemical and refining industries' approaches to modern process safety. Events are described in detail to allow a fundamental understanding of the root causes, the consequences, the lessons learned, and actions which can prevent a recurrence. The incidents are grouped according to themes so that each theme has around three to five incidents, often from a range of engineering fields assigned to it. This is suitable as a training resource and reference book.

Conclusions

Learning from accidents within organisations needs to be embedded into the organisational framework, so that when people move within an organisation or leave it the loss of their personal recollections and knowledge does not leave irreparable damage to the organisational memory. Senior leaders in industry and in authorities need to recognise the need to learn through sharing and to encourage cultures within their organisations which develop this.

Professional engineers and scientists, regardless of whether they work in industry, government service or as independent consultants need to share lessons learnt for the benefit of the employees, the public, the environment and their company (Bond, J. 2002).

Companies carrying out activities which have the risk of a major accident need to learn from accidents to manage their risks appropriately. Small and medium enterprises need to be aware of their potential vulnerability and work within trade organisations to share with each other.

Authorities need to recognise their own need to learn from accidents so as to be effective in their roles of permitting, inspection, safety report assessment, on- and off-site emergency planning discussions, land-use planning consultations, and accident investigation.

There are a wide range of resources available to learn from accidents. These need to be used in communication between the various parties of industry and authorities and to support training and educational measures.

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