

LEARNING LESSONS FROM ACCIDENTS: AN INDUSTRY VIEW OF THE OPPORTUNITIES AND DIFFICULTIES

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Learning from accidents and incidents is both part of every safety professional's toolkit, and a legal responsibility under EU legislation, including the Seveso directive which covers an increasing proportion of the EU's chemical industry. Most significant chemical companies have internal systems to manage the investigation of accidents and incidents, and help in sharing the learning from such events around the company. However, most companies are reluctant to talk about accidents to "outsiders", at least until any possible litigation has been dealt with. Given the time litigation can take, this may mean a delay of many years before information is released, by which time the original incident may have been misinterpreted or largely forgotten.

A number of solutions might be feasible including: use of anonymised information flowing through an independent third party; regulators disclosing more of what they learn during their investigations; and a duty on Companies to share safety information. However the question is: how would or could they work? Would they be likely to get support from industry or the regulators? And might their effects be to make industry hide incidents?

This paper views the problem from an industry perspective and is intended to complement the paper from Robin Turney which gives an IChemE/professional view. It is hope that the two papers will stimulate discussion at Hazard XXI to explore how we can ensure lessons are learned – quickly and widely – from accidents, incidents and near misses.

In a letter to Robert Hooke, Isaac Newton (referring to the science of colour rather than to industrial or alchemical progress) said: "If I have seen a little further it is by standing on the shoulders of Giants". It is said that, given their rivalry and Hooke's short stature, the remark may not have been kindly meant but in acknowledging that even the greatest of scientists can only build on the insights of those who precede us, Newton reminds us of our debt to the past and the absolute need to learn from what has gone before. (Gribbin, 2002) Indeed, when our forebears in the "Christian West" lost their knowledge of what had gone before, when in the Dark Ages they lost the knowledge that had been handed down from the Greek experimental philosophers, people in Western Europe lived shorter, less pleasant lives for the best part of a thousand years. It took the re-learning of that forgotten knowledge, from the Arabs especially in Muslim Spain, for progress to be re-ignited in the West (Lyons 2009).

But if Newton stood on the shoulders of giants, engineering has all too often stood on the wreckage – and sometimes the bodies – of our failures. Of course, we should not be afraid of this inheritance. The failure of Sir Thomas Bouch's Tay bridge (Open University, undated) and the wild gyrations of the Tacoma Narrows bridge, the one commemorated in unforgettable verse (McGonagall, 1880) and the other in unforgettable film (You Tube, undated), taught us lessons about the impact of wind on bridge and other structures. The failure of boilers in Manchester in the middle of the 19th century set in train a voluntary system of inspection of boilers – carried out by the "Manchester Association for the Prevention of Steam Boiler Explosions" which was founded in 1855 and which achieved impressive results very rapidly – and laid the first foundations of our current inspection regime for entire pressure systems.

There are many reasons for investigating and learning from accidents – for example: they are challenging intellectually, in teasing out the causes of what went wrong; they are often memorable, one good upset is always going to be much easier to remember than 10 years of smooth production; they can give us new knowledge, information we simply did not know before; they can tell us about the frailties in the systems we run, telling us where we have to improve; and there is the ghoulish fascination with death and destruction, which we all share. Any speaker knows that a picture of wrecked plant or a raging fire is guaranteed to catch the attention of an audience, even in the graveyard spot after lunch.

Sadly most of these reasons for investigation are mirrored negatively: the intellectual fascination of investigation can be an end in itself, when our aim should be to learn and move on; the fact that accidents are so memorable blinds us to their real frequency, which may be very low; they may provide new knowledge, but if we concentrate on applying the new knowledge we can forget that most accidents have simple causes and the vast majority of people are hurt in everyday, minor accidents; finding a flaw in one particular system and ensuring it is dealt with can divert attention from other flaws which have bigger effects or which are more probable. The need is to learn from all accidents and to make sure that the lessons are implemented in a proportionate way by understanding the real frequencies and probable consequences of different events. Spending large amounts of time preventing esoteric accidents inevitably diverts resources and attention from the events which hurt people every day.

The necessity is to ensure that each end of the spectrum gets appropriate resource and attention, though given the fascination of major accidents (and the challenge inherent in avoiding them) that is more easily said than done. This difficulty and the benefits of investigating accidents can be exemplified from within the UK Health & Safety Executive (HSE). In the late 1980s HSE's statisticians pointed out that more people were hurt by slips, trips and falls, usually at the same level, than any other single cause. Despite the fact that such accidents caused a great deal of real pain and suffering, they were essentially never selected for investigation by field inspectors. It took a central directive that 1 in 10 of these accidents *had* to be investigated to change this and these investigations, despite much grumbling at the time by inspectors, have produced the information which now underpins HSE's guidance and enforcement action on slips trips and falls (HSE 1995).

One of the major problems with the investigation of the biggest accidents is the increasing time it takes both to carry out the investigation and to reveal the lessons which industry and others must learn. The contrast between the speed of Tay Bridge enquiry and, for example, the rate at which information has come out following Buncefield is very marked. The Tay Bridge failure killed 75 people on Sunday 28 December 1879, just after Christmas and just before the Scottish Hogmanay holiday. Yet the enquiry team was appointed, assembled in Dundee having travelled from London, and held their first public session only 6 days later, on Saturday 3 January 1880. They produced their report and presented it to Parliament in June 1880, writing two reports and extensive appendices with further technical information, within 6 months.

The Tay Bridge report was probably done rapidly because of the inquiry team felt the necessity to understand the failure and to spread technical learning as quickly as possible. Their conclusions – that the bridge was fatally weakened by failures of the lugs holding the structural bracings in place, possibly caused by fatigue failure, with the wind loading on the bridge and train combined providing the final push into collapse – were of vital importance to bridge builders on the still rapidly expanding rail network, in Britain and around the world. The fact that the storm was not the primary cause of the collapse did not stop engineers realising that wind loading is an important design criteria and applying that knowledge without delay.

The speed of the inquiry was probably also increased by the pressure to rebuild the Tay River crossing, an important part of the Scottish rail network. Just 20 months after the collapse, the new bridge was approved with construction taking less time that for the original bridge. The lessons from the collapse were learned, with a very different style of construction being used, offering a much higher lateral stability. The new bridge is still in daily use, by much heavier trains, after 120 years. Finally it is worth noting that the Chairman's report (though not the separate report of the technical assessors) was not afraid of naming names, clearly stating the Chairman's view that Sir Thomas Bouch was principally responsible. Bouch died within 6 months of the report's publication, aged just 58.

However, as has been pointed out elsewhere (Turney 2009), it is not only comparisons with the past which show the UK up in a poor light in learning lessons from accidents. Whilst there has been a fair amount of information flow from the massive investigation into Buncefield, it still lacks openness and looks poor compared to the way information has been released in the US following the fire at Texas City. After that event both the US Chemical Safety Board (CSB 2007) and BP (BP 2007) have been generous in sharing lessons with the wider community, whereas here regulators have certainly been implying that there will be more to come out after Buncefield goes to trial. It is possible that all the important technical lessons from Buncefield are in the public domain, but it does not seem possible to be certain.

Learning may be slow because information is slow to emerge but it is very clearly a legal requirement for industry to learn from accidents. The Seveso 2 Directive (the COMAH regulations in the UK) makes learning from accidents an explicit duty in Article 12, which requires emergency plans to be reviewed periodically to include "new technical knowledge and knowledge concerning the response to major accidents". Learning is also an explicit duty in the revision of Seveso 2 safety reports, as Article 9 requires operators to "take account of new technical knowledge about safety matters, for example arising from analysis of accidents or, as far as possible, 'near misses'" (European Union, 1996). It would be interesting to know from a regulator how well they feel these requirements are complied with, both in the UK and elsewhere. I think the only way that most companies could try to show compliance with the "near miss" requirement would be internally, ie from their own accident databases. I do not know of any publically consultable databases containing near miss information.

A recent CIA initiative may begin to change this and will enable chlorine producers and users in the UK to fulfil their Seveso 2 requirement on a sector-wide basis. In early 2008 CIA, on behalf of its members producing and using chlorine, signed a "Chlorine Covenant" with HSE and the UK environmental regulators. As part of the covenant, CIA members set up a database into which the member companies can enter details of incidents and near misses involving chlorine. Data entry is voluntary but in the first 18 months I understand well over 100 entries had been made. Members can see and search the anonymised database and the aim is to identify trends and areas where improvements could be made. At present this database only covers a small number of companies and one particular topic. However it has clear potential for use, either for other particular areas/groups or perhaps on a wider basis.

Of course, companies do keep their own significant databases internally on accidents and incidents. I would guess that essentially all companies in the Chemical sector keep an electronic accident database far removed from the simple information required by the UK's "Accident

Book". Systems like Yule Catto's own Accident and Incident Management System (AIMS), generally manage accident investigation, record the principal findings of the investigation and any actions required to prevent recurrence, and track those actions to completion. Most systems will, like AIMS, include some type of assessment, based on consequence and possibly frequency, to determine the depth of the investigation which must be carried out. Some of these databases will adopt the same principle as AIMS and include near miss reports within them. Other companies will keep a separate but similar database for near misses. In either case the database or databases will be searchable, enabling companies to explore whether accidents are repeating, identify common types of event, and look for common causes.

This information is of enormous importance to companies and is often the place where a corporate memory is potentially beginning to develop, even if only for one aspect of a company's operations. Trevor Kletz has often pointed out that corporations have no memory, only individuals remember things; and that this is the reason the same events can occur on the same plant periodically, once all those involved the first time round have been promoted or moved aside. However, used properly, systems like AIMS can provide a sort of substitute memory – at least the information exists and is potentially available.

The key is to make use of the database routine and easy. "Data mining" is something many people know about in principle but far fewer use it productively to guide future actions and prevent repetition of past failures.

This is not to say that companies do not learn from accidents or from one another. No meeting of industrial safety professionals is complete without accidents being discussed and many closed industry meetings – i.e. those without regulators present – have an explicit "sharing lessons from incidents" section. Sadly this information is very rarely systematised or entered into a database of any sort, and while its value should not be underestimated, that shared value largely remains with those in the room at the time. IChemE's Loss Prevention Bulletin does provide one way this information could be captured, but only if companies are prepared to allow the information to be written down and publically released, and if someone is prepared to give time up to writing an article.

There can be little doubt that companies are less and less willing to release information which they fear might be used against them. There is debate as to whether we are really a more litigious society; certainly the fear of litigation has gone up and many (most? all?) daft decisions in the "Elf 'n safety" arena are really defensive responses to someone's fear of being sued. On the other hand, despite the activities of the "no win – no fee" ambulance chasing lawyers, the overall value of personal injury claims has been falling. However, this could have a number of very different causes: our workplaces and roads are getting safer, so there are fewer cases to pursue; the number of people in Trades Unions has fallen sharply and a TU lawyer assured of a fee may well take on a more uncertain case than a lawyer dependent on success for his payment; and we may – because of the actions of lawyers acting for companies – be better at resisting claims and releasing information about accidents.

A lawyer must, if asked for advice, always ask himself "what is in my client's interest?" and use that to guide the response. Sadly for society and the general good, this will almost never be to disclose any information which could, however remote the possibility, be of use in a case against the client. Significant battles have been fought between different defendants to obtain accident reports – very recently between the various companies involved in the operation of the Buncefield oil storage depot. This is an area where intrusion by the law will not help the spread of knowledge nor enhance the public good.

The Buncefield case is interesting and at once hopeful and depressing. It is depressing that the matter had to go to court and that one company felt it had to claim that its internal investigation into the accident should not be disclosed as it was subject to legal privilege. On the other side it is hopeful because the Judge confirmed that such a report was not subject to privilege, because the main reason for its preparation was neither to obtain legal advice nor to collect evidence on which that advice could be given. The company's internal procedures manual is reported to say that accidents should be investigated aiming for "the discovery of root causes from which remedial plans can be developed"; and the elsewhere the company says "It is of course vitally important that the accident investigation is carried out as effectively and quickly as possible in order to learn the lessons from this incident". Given these statements – and I guess similar sentiments are to be found in the preamble to most accident investigation systems – the judge confirmed that legal privilege did not apply.

If this is true, and the judgement means precedent has been set, accident reports are not privileged and are disclosable in court. If they are disclosable then surely there should be no problem in making them available and ensuring that the lessons learned and recommendations to prevent recurrence are a matter of public record? Not quite it seems; as usual the law of unintended consequences is starting to apply. The most senior managers in companies are now subject to the new Corporate Manslaughter act. This will make them more aware of safety as a corporate issue but also potentially more cautious about any document which might show that they could or should have known about a problem – which could potentially affect companies' internal auditing procedures; or that there are things which could be done to prevent it happening again and by extension means that if they had been done earlier an accident could have been avoided – which could potentially affect accident investigation procedures.

Finally there is the question – are we learning? Is all the effort we put into understanding accidents repaid in improvements in real-world performance? The view that we are still repeating the same old mistakes, that companies have the same accidents every 10–15 years clearly has some sway. The CIA's in house magazine "CIA matters" argued

last year, in an article setting out CIA's commitment to helping the UK chemical industry to improve its process Safety standards, that "... there are some eerie similarities between aspects of the Pembrokeshire incident [the fire at Texaco's Milford Haven refinery in 1994] and ... more recent high-profile major accidents". (CIA 2008). Indeed it was ever thus: it is said that the problems with the Tacoma Narrows bridge in 1940, where the deck acted as an aerofoil and was destroyed in a 40 mph wind, were similar to the problems which caused the failure of an early version of Brighton Pier, a hundred years before in 1836! However, we clearly are learning and chemical plant is very much safer today than it was only 50 years ago. It is only necessary to read the listing of major accidents in Lees "Loss Prevention in the Process industries" (Mannan 2004) to see the change which has occurred. Indeed at Hazards XX a paper from the US Chemical Safety Board (Visscher 2008) looked at the accidents they had investigated over the last 25 years. It showed out how the balance of their work had changed: initially dealing with accidents mainly in the chemical industry but now investigating accidents with downstream users.

This paper has mainly discussed the difficulties in releasing information and enabling companies to learn from accidents – what are the opportunities? The biggest opportunity is that we do still talk to each other and companies do give information – and their staff's time – to ensure lessons are learned. We should not discount the professional duty most engineers feel to teach and learn; to ensure that we do better year on year. Should we make it an explicit part of an engineer's code of ethics that they are required to share information gained from accidents? Many companies do release information despite the problems real or imagined. BP – to quote one example – have done much to publically explain what happened at Texas City, despite the litigious nature of the US, and have been generous in sharing the learning from that incident. Companies are required by Stock Exchange codes to be much more transparent about their environmental and safety performance. Should this requirement be backed up by a similar requirement to more open about learning form accidents, and not just the most serious ones? If it should, how could we go about getting such a requirement implemented?

HSE do publish data on accidents, detailed reports on major accidents and statistical data on all accidents. The first is a duty under the Health & Safety at Work act, as is their duty to carry out and publish research in the field. However there is no duty placed on HSE to continue to make information available and some of the major incident reports seem to be disappearing from HSE's publication list. IChemE is seeking to co-operate with HSE to overcome this and make the information freely available. Is this enough? Where do the relative duties of the regulators and the Institutions lie? How should we ensure that knowledge once gained remains available?

One problem in this area is that the regulators can never forget that they are just that – regulators with the power (indeed duty) to prosecute. Once they are aware of an accident there is at least a prima facie case that an offence has been committed and that the company responsible have failed either in the duty to properly assess the risks or have assessed the risks but failed to take the appropriate action to fulfil their general duties. There are those in our society who are determined that nothing bad can happen without some "wicked" person being to blame. This always puts pressure on the regulators to find fault and follow up with prosecution and thence punishment. One option is to separate investigation, lesson learning and information sharing from investigation, evidence gathering and subsequent prosecution. Putting it in that order shows how difficult it is to separate the two but, of course, the US have shown how it can be done with the Chemical Safety Board.

One answer to the problem of publication is to make it anonymous, and Loss Prevention Bulletin is happy to publish reports without a named author (in the public version) and which do not identify the company involved. However the fear remains that many people (and especially the regulators) will be able to identify the source of even an anonymous report of an accident. As the number of sites which handle any given chemical or carry out any given process becomes ever smaller, it is more and more difficult to make a report truly anonymous without mangling the story so as to make it useless. How can this problem be addressed? Is anonymity in fact useful to those who want to share the lessons of an accident?

HSE did discuss if there should be a duty to investigate accidents. In the end they decided that there was no need for more regulation on this matter, as the existing guidance together with the general legislation on the management of health & safety were sufficient. But if the Seveso directive requires learning, should it also require teaching by making information available? This would be rather one-sided regulation, applying to certain sites only, but that is an objection to the whole of the Seveso directive. Is this an area where compulsion could ever be acceptable? Do the same arguments apply as are used to justify the *requirement* to answer questions put by a Factory Inspector (unless the answer is self-incriminating) – that the greater good is served this way and it is the only practicable way to get information into the public realm?

For near misses the problems might appear to be different, after all it might appear difficult for the regulators to prosecute for something which did not happen. Even this is not as simple as it seems. To a Chief Executive or company lawyer, what makes it attractive to publicise that there have been significant failures to the company's systems? Publication potentially could draw the attention of the regulators to the company for the wrong reasons – "Look at all these near misses at MegaChem Systems, we had better have a look at them". And under health & safety law companies are always guilty, no-one's risk assessments are ever fully up to date, no-one's systems are not capable of improvement, and every near miss shows up those failings. That is why we collect the data and do the investigations – but also why they also always offer a hostage to fortune in the hands of a (fresh? ambitious? impatient?) regulator with a

mission. Zealots do exist amongst the ranks of the regulators and companies have been astonished to find themselves the subject of significant investigations having reported "Dangerous Occurrences" which caused no harm to people or the environment and which were completely controlled by secondary safety measures.

On the other hand we understand the importance of near miss reporting and spend a lot of time collecting such data. Many companies, my own included, have *minimum* targets for near miss reports, expecting employees to deliberately search them out. Companies in the CIA's Chlorine Sector network have shown that such data can be shared, even if it is a limited set of data (the companies only share incidents where chlorine is involved, not the generality of their near miss data) and only in a fairly tightly controlled group. Is this a model we could use more widely? What would be other appropriate groups? Is there a role for the regulators to facilitate such groups? Or do we need to keep control within industry, facilitated by our Trade Organisations?

In the end, of course, none of this matters if we can't solve the other problem – how do we get the information into the right people's heads at the right time? How do we make sure that the designers, builders, maintainers and operators have actually learned the lessons and will use it in their professional lives? But that is the subject of a wholly other paper.

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