IPTC 17927

Should Lessons Learned be the Blueprint for the Future?

Brian J. Gordon, SPE, Peter Wilkinson, Noetic Group

This paper was prepared for presentation at the International Petroleum Technology Conference held in Kuala Lumpur, Malaysia, 10-12 December 2014.

Abstract

Do we need a journey through the past to make our future better? Many companies say they have a Lessons Learned process as part of their management system. Whilst the intent is sincere, a review of major accident events suggests this is not working. Why is there no sense of anxiety around this failure to learn and prevent reoccurrence? From a review of various major incidents around the world, we conclude that all possible lessons have not been learned from preceding events.

In one sense, a failure to learn is understandable. Since catastrophic accidents are not common, it is easy for people to believe that similar incidents won't happen to them. Their rarity also means that the generation who were in proximity to a major incident and were deeply affected by it, will in time move on. Trevor Kletz recognised this issue many years ago in his 1993 book, "Lessons from Disaster" or "How organisations have no memory and accidents recur."(Kletz 1993)

However, is this too pessimistic a view? What can we do about building more risk aware organisations and minimising reliance on active risk mitigation systems? Much work has been done already, mainly in the field of *identifying lessons to be learnt*. This is not the same as *actually learning the lessons*, which is more difficult. We discuss the mechanisms at work which causes lessons not to be learned along with the various psychological characteristics and traits at play that can affect our ability to learn.

This paper discusses the following essential features of an effective lessons learnt process:

- A requirement to look outside the organisation and industry for sharing of lessons to learned;
- A process which goes beyond identifying the *lessons to be learnt* but has a method to *embed* or *internalise* the lessons and actually minimise the risk or eliminate the defect;
- A specific organisational capability in making changes with senior management patronage;
- Measurement to check the organisation is applying the lessons and behaviours and hardware have changed in practice.

We will argue that some lessons are learnt. These are notably to do with personal safety, the normal industrial risks we face at work. However, it is not clear that this is the case with process safety (or major accident events, MAEs which is the term we will use here). We will give some examples of incidents which have recurred and some cases keep recurring. It will offer some explanations of why this is the case including some of the human factors (psychological and organisational) reasons.

We will then give some examples from the history of the oil and gas industry of where we have failed to learn and finally offer some possible solutions for improving our lessons learnt capability including potential legislative change.

Introduction

The title to this paper suggests when designing the next facility, we should not start off with a clean sheet of paper. We strongly support inherently safer new designs, innovation and "blue sky thinking." However, we should also have on the table, within reach easily digestible lessons learnt from the past. Unfortunately we rarely do. Failure to learn the lessons from the past condemns us to repeat previous mistakes.

Why does this happen? We suggest there are a number of important reasons, including a lack of readily-available and useful data. However, there is more to it than this. The primary reason is a lack of a capability within companies to effectively implement lessons learnt and defect elimination processes, accompanied by an apparent lack of interest from regulatory authorities. It would appear that regulators do not seem to expect lessons learnt processes to be included in companies' management systems. In this paper we will explore the reasons for this situation and what could, and should be done about it.

We make an important distinction in this paper between lessons *to be* learnt (such as by the publication of a safety alert) and lessons which *have* been demonstrably learnt. When lessons are learnt, systems, processes and behaviours change and become institutionalised in an organisation. Our experience is that few organisations have a lessons learnt capability beyond sending out "safety alerts." The need for such a strong capability is the central thrust of this paper. For the purposes of this paper we include "defect elimination" under the heading of lessons learnt.

Given the complexity within the oil and gas industry, it comes as no surprise the potential for error is high and the consequences are severe. This is inherent in exploring for and producing hydrocarbons. However, the potential consequences are so severe, we must learn lessons from others if we are not to repeat the mistakes of the past. As the American comedian Sam Levenson famously once said, "You must learn from the mistakes of others. You can't possibly live long enough to make them all yourself." (Levenson 1911-1980)

We are aware that "defect elimination" refers to ensuring equipment functions as intended, particularly without failure for desired periods during its design life. This requires careful attention to design, installation, construction, operation and maintenance. Total Quality Management and more recently Six Sigma are two of the defect elimination processes in use. However, for the purposes of this paper, "defect elimination" can be viewed as a subset, albeit a very important subset, of learning lessons. Both require the lessons of the past to be learnt and institutionalised. Defect elimination warrants a separate paper of its own – but this is not that paper!

We will argue that some lessons are learnt. These notably deal with personal safety, the normal industrial risks we face at work. However, it is not clear this is the case with process safety or major accident events (MAEs). We will give some examples of incidents which have recurred and some cases keep recurring. We will offer some explanations of why this is the case, including some of the human factors (psychological and organisational) reasons. We also provide suggestions of what we can do to address these issues in our own organisations, whether you are an operator, contractor or regulator.

But first we have to ask what are we trying to prevent? We will then give some examples from the history of the oil and gas industry of where we have failed to learn and finally offer some possible solutions for improving our lessons learnt capability.

What loss are we trying to prevent and what lessons have to be learned?

We have to ask the question "what are we trying to prevent?". It is clear we need to prevent injury to the individual (personal safety) and must also prevent major accident events (MAEs), such as a loss of containment of hydrocarbons.

Recent data shows that as far as fatalities are concerned we are improving. The Australian National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA) has reported no fatalities in 2013 (NOPSEMA 2014) and Health Safety Executive (HSE) no fatalities in 2012/13 (HSE 2014). However, the HSE reported 47 major injuries in 2012/13, up compared to 2011/12 and 2010/11. They also reported that the major injury rate per 100,000 workers rose from 123.9 to 147.8 and 351 dangerous occurrences were reported (HSE 2014).

NOPSEMA reported 13 accidents, two incurring major injuries. 358 dangerous occurrences were also reported, with the rate of uncontrolled hydrocarbon releases (gas and liquid) increasing from 1.08 per million hours in 2012, to 1.48 per million hours in 2013 (NOPSEMA 2014). The evidence suggests that although personal safety may be improving, it is not so clear that the risks of MAEs are reducing.

Examples of Lessons not being learned

From a review of numerous major incidents around the world, it would appear lessons have not been learned from preceding events. Similar causal factors appear across the timeline of incidents despite many inquiries into previous incidents' which have resulted in changes to legislation. For example issues with watertight integrity are apparent from the Ocean Ranger incident in 1982 through to the P36 in 2001 (ANP 2001). Similar equipment failures such as fire pumps and management system failures abound in the various incident reports.

The offshore oil and gas industry was in its infancy when North Sea incident such as the Sea Gem sinking in 1965 occurred where some lessons were learned. The "Sea Gem" incident resulted in the introduction of new regulations. As a result of a public inquiry into the accident (Great Britain Ministry of Power 1967), several changes were made in order to improve overall safety onboard oil rigs. Amongst them the use of a stand-by boat to help rescue crews in the event of future accidents, and the requirement for an Offshore Installation Manager who is able to take command in an emergencies. However, these changes are not able to prevent an incident occurring. They are concerned about managing the incident once it has occurred. Whilst these outcomes were important and are applicable today, in hindsight these learning's were inadequate. If lessons from the Sea Quest blowout (Anderson & O'Mara 2006) in 1980 had been learned these may have mitigated the severity of issues on the Ocean Odyssey, Ensco 51 or even the Deepwater Horizon events.

Reviewing the major world accidents and incidents, clearly shows there are lessons to be learned and that some are "blue prints" for the future. Some accidents could have been prevented through better design or systems and processes, and others by improvements in operation, maintenance or construction. It is very clear there are many lessons to be learned from each and every incident, which can contribute to an inherently safer design solution.

The Importance of Design

In The Australian National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA) Annual Report December 2011, "Design issues" continue to be the top cause of uncontrolled hydrocarbon leaks, a position it has maintained since 2007 (NOPSEMA 2012). The NOPSEMA 2013 report also confirms by a considerable margin, "Design" leads the causes of hydrocarbon releases with 39% of all incidents (NOPSEMA 2014) shown in Figure 1 below.

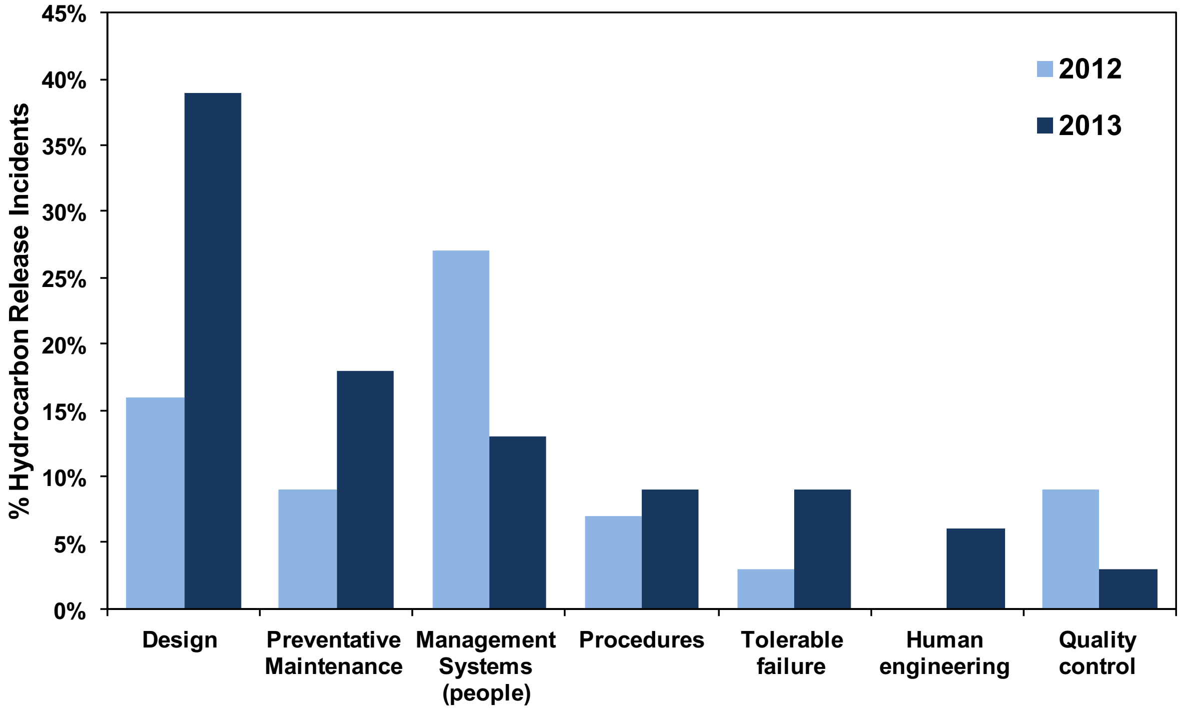

Figure 1: Causes of Hydrocarbon Releases, adapted from (NOPSEMA 2014 Fig 26)

We conclude from the information available about disasters and data referred to above, the improvement in personal safety and NOPSEMA analysis, that:

- Some lessons are learnt (the personal injury data suggest we have improved significantly)
- There have been some learnings in the field of MAEs
- But much more can be done.

Black Swans?

Before we move on, one issue to be addressed is the question of "Black Swans." as there will always be unforeseen failures. Nassim Nicholas Taleb called this phenomenon "black swans" and talks about the inability to predict the future from the past, mainly from a financial market perspective (Taleb 1960). However, the term has recently been used in connection with some MAE's. Major incidents are sometimes described as "Black Swans" or unimaginable events. The analogy had its origins in the 16th century Western world where it was assumed all swans were white, until naturalists in the seventeenth century discovered a breed of black swans in Australia. Therefore, what had previously been unimaginable was suddenly a norm.

However, the failures discussed in this paper are those which have been revealed, investigated and documented. Furthermore these failures are repeated in history. Consequently, whilst it may be attractive to label these events "Black Swans", (typically as a mechanism to avoid blame), we reject that analysis. The listing by Marsh of "*The 100 largest Losses 1974 – 2013, Large property damage losses in the hydrocarbon industry, 23rd Edition*" supports this position arguing:

"There has been discussion in recent years about the potential exposure to "black swan" events. These are events that are inconceivable and impossible to consider as a credible threat — until they occur. None of the losses listed in this document should be considered "black swan" events. Although we can identify events in the loss database that share similar root causes with all of the 100 losses described, it was the failure of prevention and mitigation measures that resulted in maximum property damage."(Marsh & McLennan Companies 2014)

Why do we fail to learn?

Our view is for the most part, we do not learn the lessons of the past and incidents that could be prevented are not. We also believe there are many reasons lessons are not learnt and there is no "magic bullet." Trevor Kletz, the great process safety pioneer, recognised this issue many years ago in his 1993 book, "Lessons from Disaster" or "How organisations have no memory and accidents recur" (Kletz 1993) . Some lessons are learnt but the extent of the learning is limited. Although it is common in the aftermath of a disaster for declarations to be made that "…..similar events must not be permitted to happen again" (and we do not doubt the sincerity of these messages), it is not clear the action necessary to actually learn the lessons, is taken. Why is this? We believe there are a number of factors at work. These include:

- The relative rarity of serious incidents inevitably means in time, the generation of engineers with first-hand knowledge of the incident move on.
- Various psychological traits and characteristics which allow individuals to perceive risk differently, including our ability to distance ourselves from incidents.
- Inadequate Data – information is available but how useful is it in practice?
- The absence of an effective lessons learnt capability in companies.
- Inadequate safety legislation and action by regulators requiring lessons learnt processes
- Reluctance of manufacturers or companies to detail the true root cause of any equipment or systemic failures

Rarity of Major Accident Events (MAEs)

Since catastrophic accidents are not common, it is easy for people to believe a similar incident will not happen to them. Furthermore their rarity also means that the generation who were in close proximity to a major incident, were deeply affected by it and learnt the lessons, will in time move on. As a result we cannot assume that succeeding generations of engineers and managers will somehow have automatically absorbed the lessons of these earlier incidents. The authors, both of whom have significant experience of the North Sea, are imbued with the lessons learnt from a variety of incidents of which the Piper Alpha disaster is but one. However, we find that it is not uncommon to meet younger engineers who have no real knowledge of these incidents and their lessons.

A convincing case can be made that *some* important lessons *were* learnt in the North Sea. These lessons extended to a considerable redesign of the regulatory network including the importance of regulating mobile offshore drilling units, (MODUs) in their own right. Previously, they had been regulated via the licence holder (typically the oil company, as was the practice in the Gulf of Mexico at the time too). It was expected that the licensee would somehow ensure the rig owner would meet the legal requirements. After Piper Alpha, the rig owners had to produce their own safety cases for their MODUs. This is of itself interesting, in the lessons learnt extended beyond the immediate issues of the Piper Alpha disaster which was a production platform incident, to looking more broadly to require drilling rigs to produce safety cases too.

However, this learning of how to more effectively regulate MODUs in the North Sea was not implemented in the Gulf of Mexico. Only after another disaster, the BP Macondo/Deepwater Horizon disaster some 20 years later was this approach adopted.

Psychological and Organisational Factors

There are various psychological characteristics and traits at play that can affect our ability to learn. These include a tendency to rationalise why disasters cannot happen to us. In particular we seem to have an ability to distance ourselves from incidents. When an incident occurs we often seem to focus on how this incident is different from our own operation, rather than on the similarities. By focussing on the differences we are giving ourselves reasons why we cannot learn from it. As Judith Hackitt (the distinguished process safety leader) has pointed out in the case of managers contemplating a disaster that has happened to somebody else:

“There is a strong tendency to try to pinpoint something which enables them to distance themselves from the catastrophe. “We don’t operate the same process, so that couldn’t happen here.” “Our procedures would not allow that mistake to be made” I heard people in the chemical industry say immediately after Texas City in 2005 – that was a refining incident, not chemicals, so not relevant to us.”(Hackitt 2013).

How we view or perceive risk plays a major part in what controls are thought necessary. There are a number of elements at play here including our natural cognitive biases. For example “design house” project teams are rarely as conversant with the current problems experienced offshore as the offshore focussed operational teams. This is not a criticism just an almost inevitable result of how many projects are organised. Almost inevitably, these two groups can perceive the operational and safety risks differently. In addition to differences in perception associated with their organisational position and focus, individuals are also subject to specific cognitive biases of which the so called “Availability Heuristic” is but one.

The Availability Heuristic

An important example of a cognitive bias which is particularly relevant to risk assessment is the so called “Availability Heuristic.”(Kahneman 2011). Research has shown that individuals when estimating what is likely, tend to recall what is available in their memory, and what is available is biased towards vivid, unusual or emotionally charged examples. This is an almost self - evident truth. This is why we value experienced personnel on our projects, because they have wide experience. However, a problem exists in relation to low probability but high consequence type incidents – such as MAEs. Most people, fortunately, do not have first-hand experience of these sorts of incidents and the lessons they spawned. Consequently, it is far from certain (in the case of low probability events) the relevant information, such as lessons learnt is immediately “available.” This can manifest itself when assessing risks including when using risk matrices. How can one effectively apply a risk matrix consistently if one is reliant on individuals’ memory given the inherent bias we are susceptible to described above?

Our experience strongly suggests the design process reflects this. Issues raised tend to be dominated by the topics individuals involved can recall and are biased towards recent information, events and issues. How can these problems of learning from past incidents described above be addressed?

A Data Driven Approach

All available Lessons Learned databases need to contain lessons which are specific and have appropriate context. Often databases are too vague to be really useful and do not identify the risk and how an incident occurred. Failure to qualify the context may lead to the risk not being understood, this occurs regularly in our industry. Quality control within databases can be found to be problematic in areas, with entries being made without an understanding of all the issues.

The hydrocarbon database (OIR12) organised by the UK regulator, the Health and Safety Executive (HSE), provides a great deal of useful data, and we believe, shines a light on key failings within the industry. It provides a great deal of the story, but because of the complexity of incidents, it maybe not the entire story. For example the quantity of hydrocarbon is recognised, its phase and the name of the facility, and the immediate causes such as “internal corrosion/erosion of the pipework” are identified. However, only partial analysis of *underlying causes* may have been conducted for various reasons and this limits the data quality. The HSE issued a cautionary notice in their report stating "*Caution should be exercised when interpreting these statistics, in view of the limited accuracy of population data, the voluntary nature of the information supplied on form OIR/12, and the small number of releases involved in some cases*" (HSE 2002). However, it is potentially one of the best tools we have. Clearly the database could be improved if there were greater clarity and detail around investigation reports submitted and improved quality of company investigation.

Unavailability of data is more widespread. Platts, the energy sector news organisation reports that a US Interior Department official wants the offshore drilling industry to develop a comprehensive public database to help improve safety and prevent spills in federal waters.

“Currently individual operators are collecting a lot of the data we need to properly assess risk, but that information isn't being shared," Brian Salerno, director of the Bureau of Safety and Environmental Enforcement, said in remarks prepared for an industry forum in Houston this week. "Everyone is working in their own silo, collecting and using information for their own operations.” (Scheid 2014)

We strongly believe there is great scope to further improve the amount and quality of data that is collated and made publicly available. In particular those who need data to implement inherently safer design options for offshore facilities must be consulted on this.

Companies do not have effective Lessons Learnt Processes

We have described some of the reasons above, why it is difficult to learn lessons. However, we believe there is one reason above all others why lessons are not actually learnt. This is the failure of organisations to develop an *organisational capability* to institutionalise the lessons. So called lessons learnt processes are in effect no more than issuing “Safety Alerts.” Design is outsourced to design houses who are not incentivised to learn the lessons and are focussed on the “fast track” of design, as time pressures result in what is thought to be potentially conservative designs but designs which are missing user feedback or continuous improvement. “What did we do last time?” and “Was it accepted by the client and the regulator?” are questions that tend to dominate our experience rather than a focus on improvement.

A Lessons Learnt Capability – What Does Good Look Like?

The first thing to understand is there are no quick fixes in learning lessons. The learning process needs to be thorough, followed through, fully understood and every step appropriately documented. When real learning has taken place, changed behaviours will be evident and therefore measurable and new approaches or skills implemented. Too many so called lessons learnt processes are simply registers of recorded issues, *ideally to be avoided next time.* In other words they are lessons *to be* learnt. We are better at informing than learning. The next section identifies the critical elements of a lessons learnt capability.

Learning the Right Lessons – Personal Safety vs. Process Safety

It is of course vital that we learn the right lessons. In the oil and gas industries we have not always recognised the differences between process safety (we use the term MAEs in this paper) and personal safety. This is now being corrected but there is still work to be done. Andrew Hopkins work on the Longford incident in Australia, BP Texas City and the Macondo blowout in the Gulf of Mexico in 2009 all provide powerful support for this thesis (Hopkins 2001, 2008, 2011). Our view is that organisations are very good at focusing on personal safety, but frequently fail to achieve the same lasting lessons associated with MAEs, (including process safety). This is a classic example of not fully understanding the problem and consequently focussing on the wrong solutions.

We are not arguing that personal safety is unimportant, just that an appropriate frame of reference is one which (so far as safety is concerned) addresses both process and personal safety. However, we would also observe that many organisations also focus too narrowly on some aspects of personal behaviour. In particular, there has been a trend encouraged by the proponents of behavioural based safety, to focus too closely on (the supposed) behavioural failings of front line workers. This can limit the scope of lessons learnt and ignores potential design solutions that can prevent personal incidents.

A *personal* safety example (but we emphasise the importance of *process* safety and MAEs because of the greater severity of potential incidents) concerns the design of a new unmanned platform. Even so called unmanned platforms require maintenance, for example the periodic replacement of light fittings. This typically involves using a ladder to gain access to the fittings with the attendant working at height risks. An unmanned platform was designed and built with the light fittings for walkways fitted inboard and maintained at waist height – effectively removing the risk of falls. How more effective is this than relying (at least in part) on a behavioural based safety system to encourage people to work safely at height?

It should be easier to learn personal safety lessons because of their relatively higher frequency and the intuitive simplicity of the issue, but the frame of reference for the design must also include MAEs including process safety. However, the issues here are much more complex, not always intuitive and often outside of individuals experience. As a result the “availability heuristic” referred to above may come into play. Consequently, a more formal and data led process is needed.

Institutionalising the Lessons

In addition to getting the frame of reference correct and being data led, for effective learning we also need an effective process for *institutionalising* the learnings. This means that in relation to design, company standards are changed. Design briefs specifically include requirements to learn the lessons of the past. The role of the manager, at all levels, is pivotal in ensuring lessons are learned. It is critical that management at all levels has a system of formal and informal checks to confirm that these changes are indeed being implemented.

However, it is far from clear that many organisations have these processes clearly articulated and nor does it seem to be a feature of guidance prepared on safety management systems by regulators (apart from brief references to the value of learning lessons). We will discuss the impact of legislation later. The absence of the requirement for a specific lessons learnt processes appears to be a significant gap.

Ensuring identified lessons are learnt requires a deliberate strategy and commitment of resources (in time, material and people). Clearly describing *how* and *why* changes will occur in key strategy documents is crucial, however, equally important are the more mechanistic approaches of assigning tangible milestones, key performance indicators, providing the resources to achieve change; and holding people to account.

Lessons Learnt Capability in Practice

Formal lessons learned process and best practices workshops offer suitable ways to facilitate active participation by operations and project team personnel to improve the design of a facility. An agreed well documented process is essential, and needs to be integrated into project thinking and decision making. Clarity around roles and responsibilities is needed and the process needs to be communicated and understood by all stakeholders. To address another well-known cognitive bias known as “group think,” independent input and reviews should be used to challenge the “company norms” and engineering process (Kahneman 2011).

The intent of the lessons learned process is to identify best and safest practices to be implemented at suitable stages in the project development cycle. These lessons should address location safety and efficiency issues, and have the potential of eliminating maintenance “bad actors” or equipment and system defects. Lessons should typically be gathered from, but not limited to, the following:-

- Corporate Lessons Learned database (if this exists)
- Previous projects Lessons Learned output
- Company accident & incident database
- Regulatory bodies such as Health Safety Executive (HSE) & The Australian National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA) Annual Health & Safety Reports
- Regulatory databases such as HSE OIR 9A & OIR 12
- Design contractors databases
- Field partner data bases
- Early operations input and feedback
- Maintainability Reviews

At the design stage we suggest a facility system-by-system approach is adopted for the lessons learned reviews. Pre-work by the facilitators running the workshops is required to ensure efficient use of the participants time. Workshops should be focussed on items with high potential gain in terms of the lesson having a significant payoff and has wide applicability. Use of a “Boston Square” (Henderson 1970) or similar tool will assist to discriminate between items. The eventual outcome should be ranked to ensure that the project workforce is working on the important items and not others of lesser value.

Case Study: Implementation of a Hydrocarbon Leak Reduction Initiative

Hydrocarbon leaks can be viewed as precursor events to MAEs. Of course preventing hydrocarbon leaks is not just a safety issue and a rigorous approach to leak reduction has beneficial outcomes for reliability, operating costs as well as safety. Although the number of hydrocarbon leaks have reduced from the early 2000’s not enough lessons are being implemented appropriately to reduce the leaks that occur each year. Hydrocarbon leaks are an area where reasonably good data is available (see for example the UK HSE’s Hydrocarbon Release Database).

We have previously identified the importance of being “data led” to reduce the impact of some well-established cognitive biases such as the “availability heuristic” and “group think.” In the case of hydrocarbon releases good data is available. However, in our experience it is rare that a project has an active initiative to target leak reduction. A Leak Reduction initiative would typically include the topics illustrated in Figure 2 below.

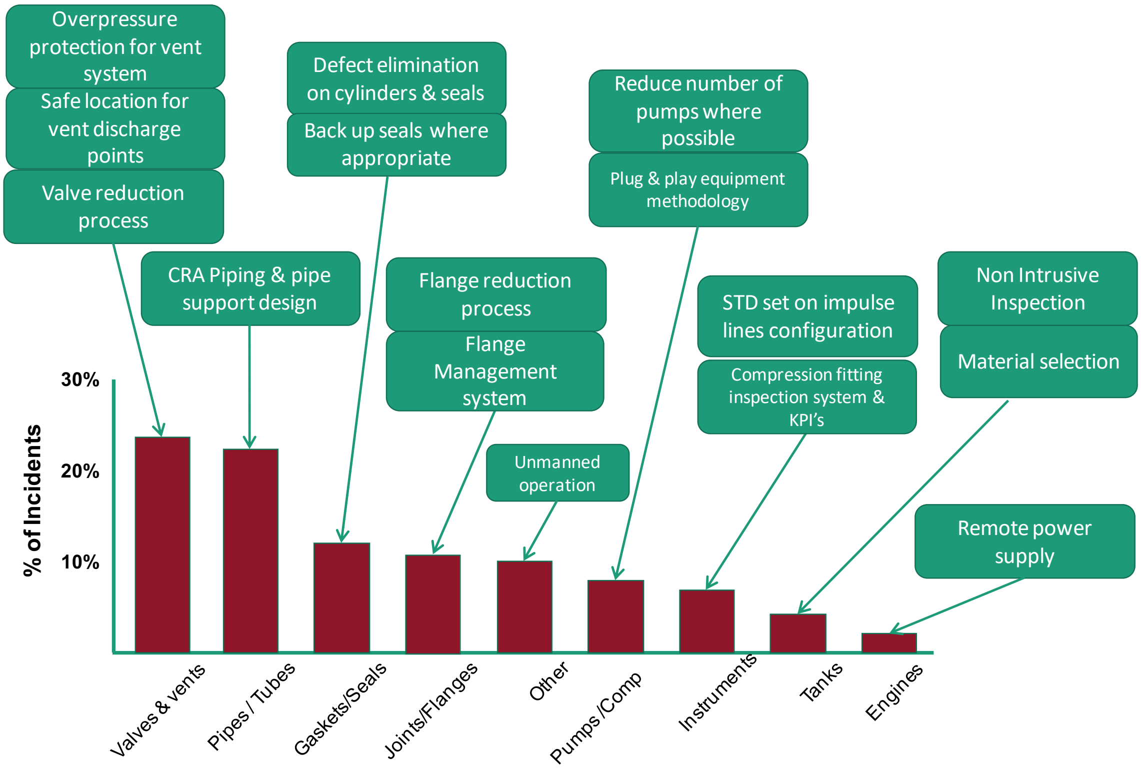

Figure 2: Typical project leak reduction initiative showing potential action which could be taken to reduce leading causes of hydrocarbon losses (Based on National Offshore Petroleum Safety Authority (NOPSA) Hydrocarbon Release Data 2005 – 2009 (NOPSA 2010))

This diagram shows the actions which can be taken to prevent or reduce hydrocarbon leaks. In this case, we have identified steps which can be applied in a project to address the top ten hydrocarbon release issues as identified in the NOPSA Report showing hydrocarbon release data 2005-2009 (NOPSA 2010).

Appropriate strategies to reduce potential hydrocarbon losses need to in place early in any project. The above categories are free pointers from the legislator to lessons that need to be learned. Each project should develop controls and KPI's (Key performance indicators) around each category. Not to address such issues increase the potential for loss and goes against the ability to be able to demonstrate "as low as reasonably practicable" (ALARP).

Measurement

Records should be kept regards where and how a lesson to be learned has been implemented. Companies with numerous assets need to understand the applicability of a particular lesson across all assets. Not applying a particular lesson may result in the identification of additional residual risk and needs to be accounted for. We suggest that a record is kept within the Lessons Learned database showing the following:-

a) Applicability of a lesson to each location
b) Whether or not the lesson was applied.
c) How the lesson was applied & reference to the change control
d) If lessons was not applicable, detail why it was not applicable and list any residual risk

Defect Elimination

Figure 3 below, shows that defect elimination is a separate entity from Lessons Learned and applied later in the process. It is not sufficient to only apply a Lessons Learned process.

In addition to eliminating design issues, other defects occur from poor fabrication, construction, commissioning, operations, maintenance or general deterioration. System defects are continually being introduced and perpetuated by lack of quality or poor management systems. How significant these failures are to the business is dependent on the internal controls in place in the organisation, and the ability to respond appropriately to prevent reoccurrence of a loss.

An appropriate defect elimination process after a Lessons Learned process is the key to achieving true ALARP. Only by striving to reduce the quantity and magnitude of defects affecting the operation, can there be low cost operation with maximal safety and production. Reducing the defects will also facilitate an optimal maintenance regime to be implemented.

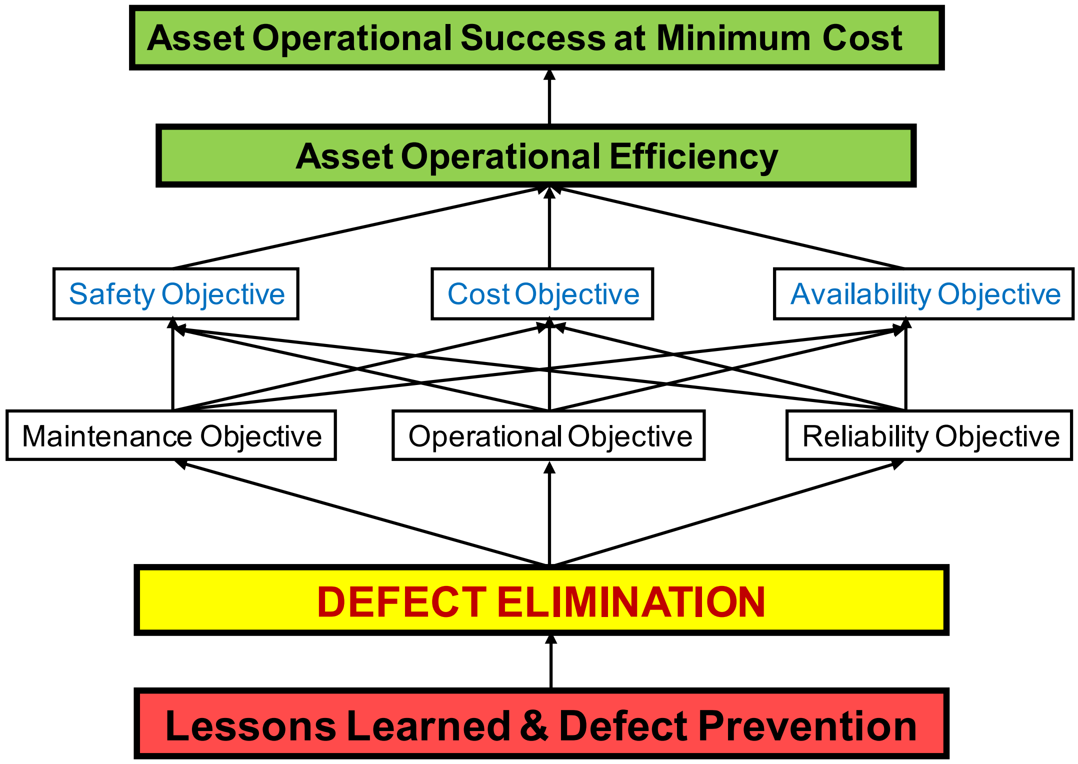

Figure 3: process for achieving Asset Operational success at minimal cost

Each defect needs to be investigated systematically and effective remedial action taken to eliminate the cause of the defects. Unless the causes are controlled and stopped the facility will be continually battling failures. An effective “Defect Elimination” Process is needed to minimise OPEX (operational expenditure) costs, maximise production and achieve ALARP. A defect eliminated in later project phases becomes a lesson to be learned for the future.

At the end of the day, a lessons learned process should be about making the installation as safe and efficient as possible in early design stages & to facilitate making the case for the design being ALARP. To minimise losses across the board and demonstrate ALARP, each project should be in a position to demonstrate a) A Lessons Learned process, b) A Leak Reduction initiative & c) A Defect Elimination process.

Implementation of all these initiatives will decrease failures, subsequently reduce attendance on any installation and therefore risk to the individual, but they will also increase facility operational efficiency. This exact process was the key to a West Australian complex offshore platform achieving unmanned status and operational efficiency.

The Role of Legislation and Regulators

We believe regulators have an important role to play in the improvement of *Lessons Learnt* processes. The implication of Trevor Kletz's lesson from the 1990s, that organisations have no memory and incidents recur does not seem to have been effectively "picked up" by regulators. The title page of a well-known book on process safety; "Incidents that Define Process Safety" by John Atherton and Frederic Gil, and published by BP and the Centre for Chemical Process Safety, (CCPS) has another famous quotation about learning lessons:

"It should not be necessary for each generation to rediscover principles of process safety which the generation before discovered. We must learn from the experience of others rather than the hard way. We must pass on to the next generation a record or what we have achieved."(Atherton & Gil 2008)

Both the authors of this paper have extensive experience of being regulated and regulating. Indeed one has experience of both working as a senior executive in an oil company and a regulator. Our experience strongly suggests effective regulation can play an important part in improving safety performance. (We note the well-known methodological difficulties of measuring low probability/high consequence events such as MAEs). Some of the more proactive regulators have produced detailed guidance on safety management systems however, it is difficult to find evidence of regulators giving this topic serious attention. The UK Health Safety Executive (HSE) refers to the topic and offers some superficial guidance in its otherwise excellent guidance on HSE Management Systems, 'Successful Health and Safety Management' HS (G) 65 (HSE 1991). The Australian regulator provides even less and although the concept is referenced, their guidance on safety management systems does not indicate what a lessons learnt capability would be expected to contain.

Undoubtedly regulators have an important part to play but at present do not seem to be effectively playing it. What could and should they be doing? In our view regulators should:

- Require "as low as is reasonably practicable" (ALARP) demonstrations in safety case type regulatory systems to include a demonstration (or explanation) as to how the company implements a lessons learnt/defect elimination process and to mandate this in prescriptive style regulatory systems

- Similarly require companies to make accessible (see below) relevant data on incidents to support lessons being learnt. At present companies are often advised by their in-house legal teams and/or insurers not to make information widely available. Ironically this makes it more likely that incidents will be repeated.

- Work with global "peak" bodies such as the International Association of Oil and Gas Producers, (OGP) and the International Association of Drilling Contractors (IADC) to develop open access databases on incidents to support lessons learnt processes.

The improvements described above are unlikely to be made overnight! So in the meantime what can we practically do now, within our own companies? The next section addresses this.

Conclusion

Very serious incidents continue to occur in the oil and gas industry. The vast majority are the result of a failure to effectively implement well known controls (or barriers) for well-known risks. Black Swans are rare or should be controllable. As the late Trevor Kletz pointed out accidents recur, at least in part because of the absence to implement the lessons of the past. The sincerity of those who, after a disaster say “this must not happen again” is not in doubt, however, without the means to ensure the right lessons are identified and implemented, the practical effect of such statements is limited.

We are reasonably good at identifying the lessons to be learnt but much less good at effectively changing our designs, equipment, attitudes and behaviours. Progress has been made – especially in the area of personnel safety, as indicated by the data, a small section of which is presented in this paper, however, it is not clear that the same progress has been made in process safety.

To make these changes we believe that significant improvements are needed to the lessons learnt processes in companies, their peak bodies and in regulators. To make these improvements will require:

- Recognition that to really learn lessons requires a specific organisational capability including relevant skills, resources and senior management support. (This is not a task that can just be added to an existing role or department without support).
- Regulators who understand the importance of really learning lessons and in the first instance can turn their attention to developing guidance (preferably in cooperation with industry bodies) on “what good looks like” in effectively learning lessons.
- Regulators to include Lessons Learnt processes in their legal requirements. In safety case regimes with competent regulators, this could be as part of the facility safety management system and/or an “as low as is reasonably practicable” (ALARP) demonstration. In more prescriptive regulatory regimes the requirements will need to be spelt out.
- Companies, their “peak” bodies (International Association of Oil and Gas Producers (OGP), International Association of Drilling Contractors (IADC), International Marine Contractors Association (IMCA) and others), regulators and their associations such as the International Regulators Forum (IRF) need to actively cooperate to develop systems and processes to improve the functionality of really learning the lessons.

As is usually the case, there are no “silver bullets.” Progress on any cross industry and trans-national initiative is always slow, time-consuming, hard work but usually very worthwhile. The authors have participated in a variety of national and international initiatives to improve safety and are under no illusions of the obstacles. However, given the global scale and significance of our industry the effort is surely worthwhile for a strategy that stands a good chance to improve process safety and associated flow on effects for environmental outcomes and efficiency?

References

Agência Nacional do Petróleo, Gás Natural e Biocombustíveis (ANP): P-36 accident considerations, 2001

Atherton, John & Gil, Frederic and American Institute of Chemical Engineers. Center for Chemical Process Safety. *Incidents That Define Process Safety*. Wiley, Hoboken, N.J 2008.

Anderson, Ian & O'Mara, Dennis: BBC's Your Place or Mine Driller's Log - Sea Quest, http://home.versatel.nl/the_sims/rig/seaquest.htm, Accessed 26 September 2014

Great Britain Ministry of Power. *Report of the Inquiry into the Causes of the Accident to the Drilling Rig Sea Gem*. London: H.M.S.O, 1967.

Hackitt, Judith. "Process Safety – Do They Mean Us?" Paper presented at the ICE (Institution of Civil Engineers) and Costain Health and Safety Lecture, London, 2013.

Health and Safety Executive (HSE). "Hydrocarbon Release System." Accessed at http://www.hse.gov.uk/offshore/hydrocarbon.htm

Health and Safety Executive (HSE). "Managing for Health and Safety HS (G) 65." (1991; Revised 3rd ed. 2013).

Health and Safety Executive (HSE). "Offshore Hydrocarbon Releases Statistics and Analysis 2002 ", In *HID Statistics Report HSR* 2002. p 8, Accessed at http://www.hse.gov.uk/offshore/statistics/hsr2002/hsr2002.pdf

Health and Safety Executive (HSE). "Offshore Injury, Ill Health and Incident Statistics 2012/2013." In *HID Statistics Report HSR 2013*, 2014.

Henderson, Bruce. "The Product Portfolio." Boston Consulting Group, 1970.

Hopkins, Andrew. *Failure to Learn: The Bp Texas City Refinery Disaster*. Sydney: CCH Australia, 2008.

Hopkins, Andrew. "Lessons from Esso's Gas Plant Explosion at Longford." *Australian National University* (2001).

Hopkins, Andrew. "Management Walk-Arounds: Lessons from the Gulf of Mexico Oil Well Blowout." *NRCOHSR Working Paper*, no. 79 (2011).

Kahneman, Daniel. *Thinking, Fast and Slow*. 1st ed. New York: Farrar, Straus and Giroux, 2011.

Kletz, Trevor. "Lessons from Disaster - How Organisations Have No Memory and Accidents Recur ". Institution of Chemical Engineers 1993.

Levenson, Sam, U.S humorist (1911-1980).

Marsh & McLennan Companies. "The 100 Largest Losses 1974 - 2013." In *Large property damage losses in the hydrocarbon industry*, 2014.

NOPSA. "Facility Integrity National Programme Final Report." 2010.

NOPSEMA. "Annual Offshore Performance Report 2013." In *Regulatory information about the Australian offshore petroleum industry to 31 December 2013*, 2014.

NOPSEMA. "Annual Report 2011/2012." 2012.

Scheid, Brian. "New Database for Us Offshore Drilling Industry Needed: Bsee Chief." (2014). http://www.platts.com/latest-news/oil/washington/new-database-for-us-offshore-drilling-industry-21069409.

Taleb, Nassim Nicholas. *The Black Swan : The Impact of the Highly Improbable*. 1st ed. New York: Random House, 1960. Reprint 2007.