Enhancing Learning from Incidents – Five Tried and Tested Approaches

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Abstract

Most organisations can improve their learning from incidents, and there are tried and tested approaches available from various industry sectors. These practical techniques go beyond simply sharing information. They seek to identify critical insights and channel improvement actions to the right part of the organisation in the most appropriate and engaging way. Based on several years of work with different organisation and industries, this paper shares five practical approaches:

1. Reporting – how to reduce the barriers to reporting and generate useable information

2. Enhancing investigations and corrective actions

3. Using multidisciplinary learning teams executing a consistent process to identify and execute higher value learning opportunities

4. Building interconnected learning teams across the organisation to channel learning to the most appropriate locations

5. Communicating and embedding learning:

   - Using defined types of communication – directives, alerts and information

   - Effective education and engagement

   - System and practice enhancements

Practical examples from a variety of industries will be used to illustrate the application of the principles and good practices identified.

Keywords: Safety, Learning, Incident Investigation, Risk

1. Introduction

Over recent years there has been an intense focus on improving risk management to reduce the potential for major accidents. Techniques such as "Bow-Tie" and Layer of Protection Analysis (LOPA) have continually evolved, alongside enhancements to the supporting tools. However, whilst the importance of learning from incidents is often stressed, there seems to be much less practical information on how to do this in the process industries. It seems that most of the focus has been on better *sharing* and *communication.* But this increase in the flow information can unwittingly lead to a secondary problem of information overload – there is simply "too much to learn" and the organisation can become overburdened. The critical question is: "how to go from information to insight and effective action?"

A comprehensive review of the learning from incidents (LFI) process has recently been published (Energy Institute, 2016). This covers the lifecycle from reporting and investigating incidents, through to implementation of effective learning and changing practices. It provides guidance for all key phases of the LFI life circle and emphasises the importance of learning in addition to investigation. It also covers the human and organisational causes of incidents through appropriate investigation approaches. The International Association of Oil and Gas Producers (IOGP) have also published a practical guide on learning from events, which is based on the experience of its members. It describes the components an organization might consider if it wants to improve how it learns from operating experience to reduce risk and prevent incidents (IOGP, 2016).

This paper build on these reviews by pulling together experience of some practical approaches to learning from incidents and other sources from several different sectors, including process and manufacturing industries, transportation and defence. The insights were gained by actually observing and participating in the activities, and by interviewing those involved. These were then distilled down into five practical themes that can be applied in any organisation and at any scale.

2. Overarching Strategy – A Learning Framework

In an ideal world incidents would be prevented by identifying all risks in advance and putting in place controls to prevent these threats from materialising (Figure 1). In practice this does not always happen and so an organisation needs to systematically identify and act on learning from investigations, trends and industry information to strengthen risk barriers and effectively embed improvements within the management system. To prevent major incidents and accelerate performance improvement the entire lifecycle of a learning opportunity needs to be considered – reporting, investigations, corrective actions and embedding of learning. Some key questions include:

1. **Reporting** – what are the barriers to receiving relevant information in the first place?

2. **Investigating** – what techniques and capabilities are most useful for identifying causes and establishing actions that prevent recurrence?

3. **Learning process** – how can we take the large amounts of information available and systematically identify relevant, risk-prioritised actions?

4. **Organisational learning** – how can we direct relevant information and actions across large organisations so that the right information reaches the right places?

5. **Communicating and embedding learning** – what techniques actually work in practice to generate effective action, build organisational competence and modify behaviours?
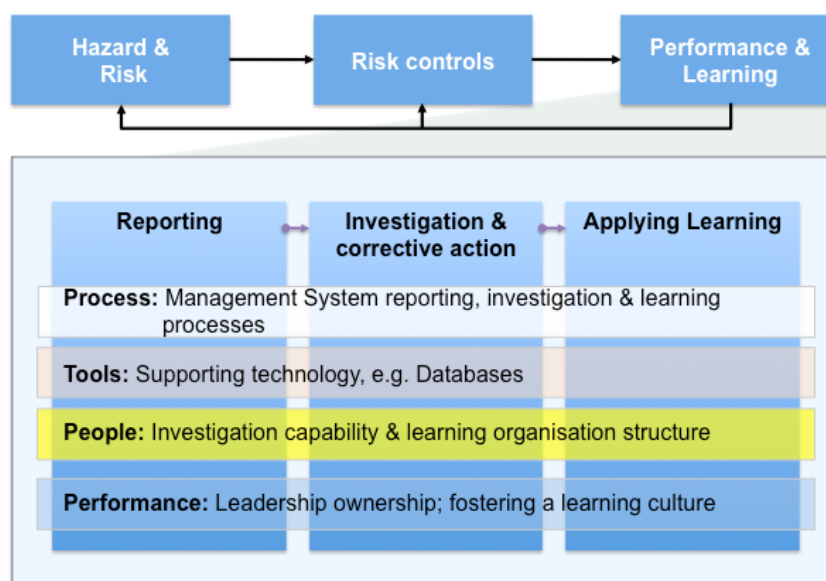

Figure 1. Framework for improving learning.

The potential enhancements across this learning lifecycle are built on four key elements (conveniently remembered as 'the four 'P's), as illustrated in Figure 1:

- **Process** – effective reporting, investigation and learning process need to be embedded in the management system, consistently applied and verified.
- **Tools (or 'Plant')** – these are the supporting tools, including supporting databases. Reporting and identification of trends needs to be encouraged, and action tracking is a vital component.
- **People** – this includes specialist investigators and trained operating managers, and organisational structures that support learning.
- **Performance** – leadership and line management engagement from top to bottom in investigation and learning from incidents is the final important component. Leaders must foster a learning culture.

3. Reporting and Tools

Of course it is vital that information comes into the system in the first place. Some key principles and effective practices have been identified in various industries.
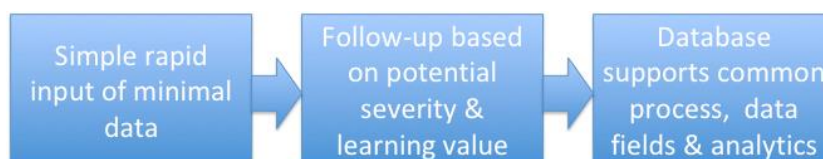

Figure 2. Key principles of data management

3.1 Initial reporting

As a general principle barriers to reporting need to be minimised. A commonly observed good practice is to have a simple front end system to capture minimal information, followed by follow up for more serious events or those of significant potential consequences or learning. It is also important to consider the users – in one situation there was a steady fall off in reporting when the paper-based system was replaced by a 'more convenient' electronic system. However, this was much more difficult for front line workers to use. Another insightful examples are the confidential reporting systems that have been applied with considerable success by airlines and railways.

3.2 Data Management

For organisations of any significant size databases are needed to manage the information. In a large enterprise this is a significant undertaking involving thousands of events each year, millions of records and tens of thousands of users. Automated systems can help to ensure that a systematic common process is used, and that appropriate authorities and acceptance

procedures are built into the system to drive quality and ownership. Experience also shows that managed data fields and labels are more critical than they might at first seem. For example, an integrated oil and gas company found out that historic data was complicated by the observation that a 'Vessel' in a refinery was referred to as a 'Tank' in upstream, where a Vessel was a ship!

3. 3 Identifying and Responding to Signals – The Data Paradox

Once a reporting culture is established, the problem is not the lack of information. In a major oil and gas company it was found that were around 150 incidents of high potential each year, thousands of investigations and millions of records. Such a large amount of information coming from multiple diverse sources raises a number of questions:

- How do you go from information to insight and generate effective action?
- How do you get the right information to the right place in the organisation?
- How do you prioritise to avoid information and initiative overload?
- How do you discern the weak signals that could prevent major accidents?

Dedicated tools and resources for trend analysis are needed and it goes without saying that the output should be useful to those that use it. However, the key insight from working with multiple organisations of varying scales is that this not just a data management issue – it is an organisational issue. Effective and efficient data management turns out to be essential, but insufficient on its own. Some practical ways in which organisations can begin to manage this dilemma will be illustrated in the sections that follow.

4. Investigations and Corrective Actions

Before discussing the organisational aspects, it should be first recognised that suitable information is needed in the first place. Quality investigations are a critical step in identifying relevant learning and establishing effective corrective actions. This paper is not intended as an in depth review of investigation methodologies, but it is worth mentioning a couple of observations in relation to process safety events.

4.1 Investigation Methodology

There are a number of investigation techniques used for identifying root causes, which can be effective in the hands of appropriately trained and experienced investigators. For example, the Energy Institute has published detailed guidance on investigating and analysing human and organisational factors aspects of incidents and accidents, including comprehensive descriptions of methodologies (Energy Institute, 2008).

The main observation in this area is that, for high hazard activities, 'logic-tree' type approaches appear to offer advantages over the traditional 'list of causes' type methods. As illustrated in Figure 3, these logic-tree methods seek to build logical fault trees and then rule potentially 'causal' or 'contributory' factors in or out based on the evidence. It is usual for this family of methods to also explicitly consider a hierarchy of causes:

- Physical – actual plant and equipment failure
- Human – analysis of the actions of people using systematic Human Factors tools
- Management system inadequacies
- Organisation, leadership and cultural factors

These methods aim to be systematic and thorough, with the findings and recommendations linked to the risk controls and management system that maintains them. The Some organisations are developing retrospective 'Bow-Ties' to systematically identify critical risk control or 'Barrier' failures and the relevant contributory factors. The aim is to identify appropriate corrective actions that will effectively prevent Barrier failure in the future.
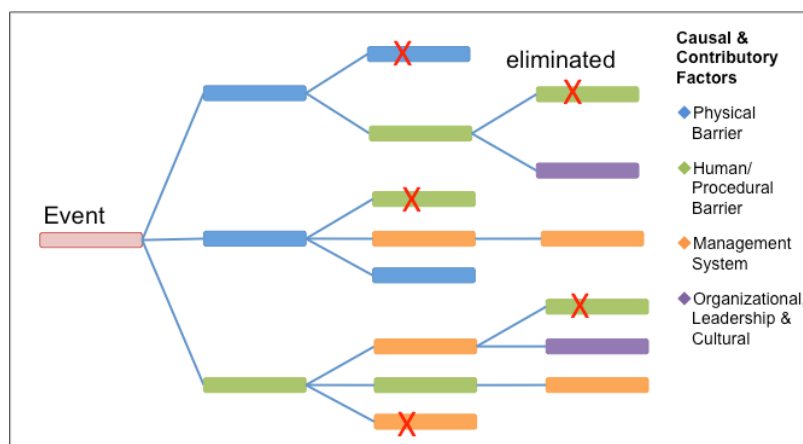

Figure 3. Logic-tree type of investigation illustration.

4.2 Investigation Capability

There is considerable discussion in organisations about the balance between having specialised investigators and involving non-specialist line management. The main observation seems to be that this depends on the cultural maturity of the organisation. Investigations should not simply be delegated to the safety specialists – the results must be owned by line management. Many organisations have found it useful to train senior management to lead more important incident investigations. This builds management expertise and gives the investigations appropriate profile. But some organisations go beyond this and have developed dedicated specialist investigation expertise to further drive quality. For example one oil company has shared the strategy illustrated in Figure 4, based on learning from NASA, US Federal Aviation Authority, the UK Police Force, and Health and Safety Regulator expertise (Flynn, 2014).

- This organisation developed a global cadre of so-called 'Master Investigators' to lead root cause investigations into more serious events and mentor the wider investigator population. Over 60 of these were trained and then certified on actual investigations.
- Several hundred 'Skilful Level' investigators were trained to lead root cause investigations into lower severity incidents and near misses that had significant learning potential.
- For the more basic investigations a standardised '5-Why/Why-Tree' method was being supported that was consistent with 'Continuous Improvement' principles.
- Core skills, such as evidence gathering, interviewing, reporting and communicating with leaders, were included in the training.
- Line managers were also being catered for so that they could interact effectively with investigation specialists and oversee corrective action programmes.

Finally, there were checks and balances in the system through independent input into the execution and review of key investigations by independent experts from an independent functional team.
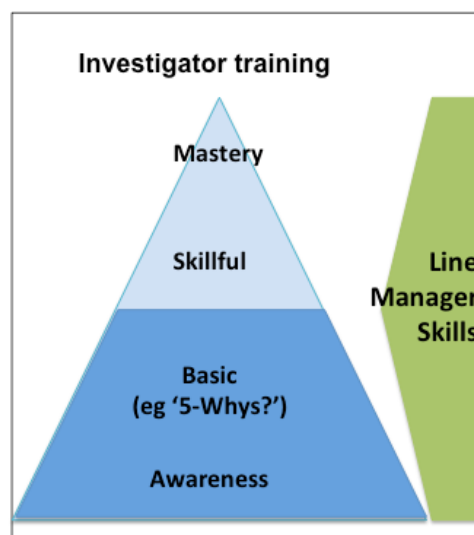

Figure 4. Example of a tiered investigation competence strategy (Flynn, 2014)

5. Systematic Learning Process

While there are varying approaches to approaches to identifying and prioritising learning opportunities, the most effective appear to have certain common elements, as illustrated in Figure 5. For example IOGP identified the following five steps in the basic process for applying learning (IOGP, 2016):

1. Collecting information
2. Evaluating information
3. Deciding the response
4. Action management
5. Effectiveness review

Experience shows that using a multi-disciplinary team to conduct this process, rather than leaving it to a single individual or department, had a number of benefits. Diverse perspectives help generate richer insights and more effective actions, as well as engaging a variety of parties in the learning process. Within each of the five elements some good practices have been identified.

Figure 5. Core elements of learning processes

5.1 Collecting Information

The most effective processes combine information from a variety of sources. For example, insights from trend analysis should be considered in addition to individual events with higher potential consequences. Information relating to external events and trends may also be channelled via this team. Experience shows that cross-referencing incident and audit analyses with other

site observations can also generate unique insights, into both the effectiveness of the processes and potential weaknesses in risk controls.

5.2 Evaluating Information

Prioritising activities to progress relies on a consideration of three factors:

- Risk – what are the potential consequences of this type of event or for this mode of risk control failure?
- Applicability – is this a local issue or does it affect multiple systems, activities or organisational units?
- Ability to influence – how does the potential risk reduction compare to the effort that will needed to be invested? Are there some other parts of the organisation better placed to evaluate or progress this?

5.3 Deciding the Response

Once the impact of the potential change on the organisation and the resource requirements have been carefully considered, there are a number of options for actions that are progressed:

- Direct Action/Communication – this includes mechanisms such as relatively concise directives, alerts and bulletins
- Education – some events are so rich in learning that a more in depth approach is justified to build organisational competence and modify behaviour
- Management system changes – this a key way to consistently incorporate learning into the practices of the organisation going forward

Further experience on effective responses is provided in Section 7 below.

5.4 Action management

Once actions have been allocated it is a line management accountability to oversee their application and to follow up on closure.

5.5 Review effectiveness

As with all management processes, it is a good practice to routinely review the effectiveness of the actions put in place to reduce risk. Did it work as envisaged? Was the anticipated improvement in risk control achieved? How could the learning process itself be enhanced?

6. Interconnected Learning Teams

In larger organisations these individual learning teams should be replicated across the entire organisation and at each level to help channel learning and insights to the most appropriate place (Figure 6). For example, learning at a particular site may be fed upwards for consideration by the wider organisation. This might be an incident or an industry alert, which is more widely applicable. Similarly, broader insights identified at a higher level by looking at multiple operating sites or externally can be channelled to relevant users. Relevant functions or networks that span across the organisation can be particularly effective at identifying solutions to particular issues in their area of expertise. This also spreads learning and builds organisational competence, and specialised teams can be formed to resolve an issue potentially affecting multiple units.

While individual teams, sites or parts of the organisation may have some sort of review and learning activity, standardising the process and tools, and formalising the connections, considerably enhances the overall effectiveness of these processes.
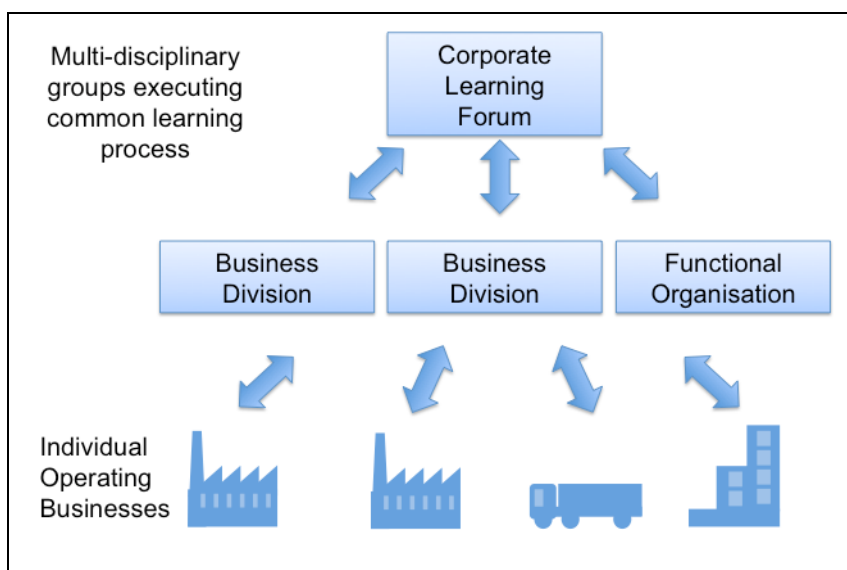

Figure 6. Interconnected learning cells to channel learning within an organisation.

7. Learning Outputs

When considering the options for responding to a particular incident or insight, it is important to consider the total burden on operating units so that interventions are appropriately prioritised. If too many requirements or alerts are issued too frequently, the situation can become analogous to 'Alarm Flooding' in a control room. In practice, major interventions are best used selectively and – 'No Additional Immediate Action' – is often the appropriate choice when considering cross cutting initiatives at higher levels in the organisation.

When action is appropriate, the options include direct action or communication to operating units, more in depth training or education, or changes to the management system. The following sections set out some observed good practices in each of these approaches.

7.1 Communications and Directives

Sharing of information is the quickest and most common action. However, it is important to make a clear distinction between the types of communication and the expectations for the receiving organisation. It is useful to distinguish three categories of communication (Figure 7):
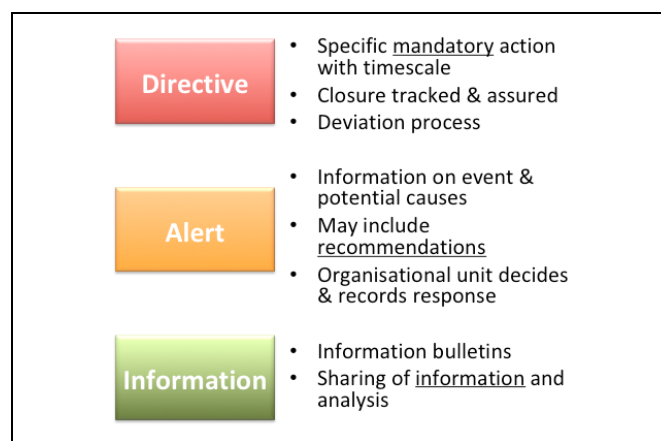

Figure 7. Categories of communication

- **Directive** – in this case specific actions are mandated by someone with appropriate authority (internal or regulatory), and have defined scope, applicability, timescale and confirmation requirements. Probably the best-established model is the 'Airworthiness Directives' issued by aviation authorities when a potential fault is identified affecting aircraft or aviation activities. It is important that this type of communication is distinct from the others so that there is no doubt in the mind of those within its scope that action is mandatory. A defined process is also required within the receiving organisational unit, which includes clear roles and accountabilities and record keeping. Checks and balances are also needed within the system, including monitoring and assurance of responses. This type of intervention takes prioritisation away from the operating unit and can cause serious disruption, so needs to be used with care. Within the process industries these may be used when defective equipment is identified, a critical procedure needs to be modified or verified, or an unusual failure mechanism needs to be communicated rapidly.
- **Alerts** – these may be used to provide timely information on events and potential causes. They should be issued with appropriate authority and may include a recommended course of action, but in this case it is for the receiving organisation to decide and record the most appropriate response. This type of communication may be suitable to give early indication of a potential issue or to draw attention to broader types of risks, and therefore allows flexibility and risk prioritisation to occur within the receiving organisation. This makes this type of communication less disruptive than the 'directive' type, but the management of alerts should still be formalised within the unit (eg. managed within the multi-disciplinary learning process) and subjected to periodic assurance checks.
- **Information sharing** – this category includes more general communications that are designed to enhance safety awareness. They are typically bulletins, reports, newsletters or videos that do not normally contain specified actions, but should provide contacts and references for further information. The information does not generally require a specific response within the receiving organisation.

There are many good examples available in various industry of each of these categories of communications. When used judiciously and applied systematically, safety directives can be highly effective in delivering quick and direct remedies. However, experience suggests that retention of learning conveyed in other types of written communication do not usually 'stick' very well. Therefore, it is sometimes useful to go beyond sharing of information and to adopt a more educational approach, which aims to change the capability of relevant individuals and habitual behaviours within the organisation.

7.2 Education & Engagement

Which incidents do we remember and impact our future actions most? It is those incidents that happen to us – those we actually experience! BP Shipping and the Keil Centre developed the chart in Figure 8 to summarise the findings from a study on the effectiveness of learning (Robertson & Lardner, 2011). They found that in a group of 30 managers involved in applying the lessons from a particular incident, most did not recognise their application to a scenario with the same generic features, but

which had different technical and geographical features. Only one participant actually identified the parallels from the earlier incident. However, when a scenario-based experience was used to convey the learning the participants were better able to retain the lessons and this resulted in modified behaviours.

Figure 8. Impact of learning methods on effectiveness (Robertson & Lardner (2011))

These insights illustrate how we can improve retention of learning and modify future behaviour. Learning methods where the participants actually engage with the content and undertake activities, rather than passively reading or watching, will be more effective. Similarly, if the audience can actually in some way 'experience' the relevant features of the event, retention is more likely to be improved and future behaviour changed. This points towards some good practices that have been employed effectively in a variety of industries and situations:

- **Scenarios** – when participants work through a scenario where they have to actually take decisions and see their consequences, learning effectiveness is improved. This can be further enhanced if the process can be made more 'experiential'. Good examples have been developed that involve video and interactive computer graphics. This approach also seems to be effective when done in group situations that allow the sharing of perspectives and team problem solving.
- **Simulation** – taking this a step further, highly realistic simulators have now been developed for a variety of learning tasks. Airlines and Formula 1 have been employing these techniques for many years. In the process industries simulators were introduced for offshore emergency management training and assessment, and more recently they have been applied for drilling, shipping and crane operations.
- **Theatre Based Engagement** – a highly engaging approach that has been used with some success is to use professional actors recreate incident events and critical situations. This literally brings the events to life and can create a visceral and emotional experience for participants. Participants can be engaged by stopping at various points and giving them questions or even engaging them directly with the actors. Interviews with front line staff indicate that this approach, although resource intensive, considerably enhances retention.

Considering all of these approaches suggests a cycle of learning and embedding that could be used to test proposed interventions (Figure 9):
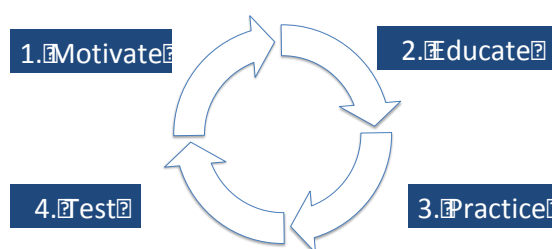

Figure 9. A learning and embedding cycle.

1. **Motivate** – does the proposed approach engage the audience to participate? Simulations do this through their realism – they can actually recreate the situation and the participants' actions generate immediate, and sometimes dramatic, feedback. Other approaches can create an emotional response by graphically recreating situations or through the skills of a trained actor. Kotter and Cohen (2002) identified the need to create a sense of urgency to initiate larger scale change and that this is stimulated by 'seeing and feeling' the need for the change. They also noted that while highly negative stimulus certainly engages people in the short term, people tend not to move towards painful experiences, and prolonged and repeated use of negative motivation tends to turn people off.
2. **Educate** – once the audience is engaged in the learning experience then they will be receptive to the more structured information, which can be delivered in a variety of ways. The more active and experiential the learning activity the more it will be retained. For example, in some areas of military training it has been found that much of the practical information can be learned through self-directed learning techniques, with contact time with education professionals reserved for practice, coaching and group activity.

3. **Practice** – new information and ways of work become deeply ingrained through repetition in a variety of situations, where the educator moves into a more supportive coaching role.
4. **Testing** – finally it is important to test what has been learned and has it been converted into the intended practical actions.

IOGP have emphasised the importance of what is termed: 'Self-Motivated Learning'. Their report catalogues good practices that help employees find learning that is relevant to them, and help them to apply what they have learned as part of their normal role (IOGP, 2016).

7.3 Management System Improvements

While people may come and go, the management system is the place where learning from experience is ultimately retained. However, the foregoing discussion should illustrate the important place that people play in its application. So when modifying the management system or local procedures to incorporate learning from incidents, it is often worth considering a couple of aspects of the change:

- Risk Control Barriers – will the proposed system change actually enable the risk controls (or barriers) to prevent a major accident? What is the vulnerability of the barrier and what monitoring is appropriate?
- People and organisational aspects – it is always people that apply the system to either affect the plant or equipment, or take certain actions. Has the system change taken into account the human aspects of the change? What are communication and educational aspects of the change?

8. The Role of Leadership

A final question worth reflecting on is: "How does leadership foster a learning culture within the organisation". As always it the words that leaders use and, more importantly, the actions that they take that will have the biggest impact. For example, it is helpful for leaders to encourage open reporting, promote in-depth enquiry and support changes in response to learning. People should also be encouraged to seek out and apply learning information in their core day-to-day tasks. Similarly, leaders can also inhibit learning by reacting in the wrong way to reports, seeking to apportion blame and adopting "zero tolerance" stances.

In this context it is instructive to consider the application of Schein's observations of how leaders shape culture to learning from incidents (Figure 10).

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*How leaders shape safety culture (**E. Schein**)*

1. What you pay attention to, measure, and control on a regular basis.

2. What you role model – your behaviour communicates 'unwritten rules' and values to others.

3. How you react to bad news, incidents and organisational crises.

4. How you are seen to allocate your time and resources.

5. How you are perceived to allocate rewards and status.

5. How you are seen to recruit, select and promote people.

6. Who you include / exclude.

Figure 10. How leaders shape safety culture (E. Schein, 2010)

Some points are obviously applicable, such as "reacting to bad news…". But there are other behavioural cues that are worth considering. For example, it was highly instructive for the author to observe military 'before and after action' briefings. The particular team operated very high hazard equipment, where an unintended action could have very serious consequences. It goes without saying that command structures are important in military situations and the unit leader was very clearly 'in charge'. However, the leader opened the briefing by reminding everyone of the criticality of the activity they were about to undertake and then proceeded to critique his own performance and opportunities to improve based on previous exercises. The leader then invited the other members of the team to give him feedback on his performance and, having created a safe space for this to happen, they each offered insights on how performance might be improved. It was then the turn for each of the team members to share their own concerns and invite feedback. It was quite possible to discern the improvements achieved during the execution of the exercise, and it was instructive to once again witness the same approach to learning and improving applied afterwards.

It would be interesting to consider how often this model from the military is evident within our own industries? How often have we heard a senior manager open an incident review by stating that: "we are here to learn and improve, and as we go through this review, I would like us to see if we can identify how my own actions may have unwittingly contributed to this situation and what I might do about it in future?"

Summary

In conclusion – what have we learned about learning from incidents and what are the practical steps we can take in our organisations to make a difference? Review of multiple sectors indicates that data and information sharing are essential, but not sufficient on their own to significantly improve learning from incidents. The challenge is often not a lack of information,

but the ability to focus, prioritise and take effective action. We need to go from 'information to insight to action' and achieve sustainable change in the organisation. By considering the application of management processes, supporting tools and people aspects to the entire learning lifecycle, five practical opportunities have been identified:

1. Barriers to initial reporting should be minimised by having a simple initial capture system that is suited to the front end users. Follow-up can then be based on potential severity and learning value. The effectiveness is enhanced by implementing a consistent, systematic process with clear accountabilities and authorities, and managed data fields.

2. Quality investigations are a pre-requisite for the opportunity to learn and prevent recurrence of similar events. One practical opportunity is to make sure the investigation capability is matched to the maturity of the organisation. The role of line management and the development of specialist investigation capability are two practical considerations. Although there are many useful cause analysis approaches, those that use logic or fault tree and barrier failure methods should be considered for process safety events. These need to incorporate Human Factors tools in addition to procedural and physical aspects.

3. In order to identify and act on learning a multidisciplinary team should be established in each relevant organisational unit to routinely review and act upon learning information. The process should encompass:
   a. Collecting relevant information from internal and external sources
   b. Evaluating that information on the basis of risk, applicability and ability to influence
   c. Deciding the response, which might include communicating, educating, system changes, or no further immediate action
   d. Managing allocated actions
   e. Reviewing the effectiveness of learning actions and the overall learning process

4. In larger organisations, interconnected learning teams applying the same common process within each organisational unit can be used to direct learning to the most appropriate locations.

5. The learning outputs should be defined and selected to achieve the required change. Some good practices include:
   a. Directives with clear actions and accountabilities should be used for urgent responses, whereas alerts and bulletins can be used to convey information where the receiving organisation has the flexibility to decide the appropriate local response.
   b. When the capability and behaviours within the broader organisation need to be influenced, then experiential learning techniques that actively engage participants can be employed. This can include scenario based learning, role-playing and simulations.
   c. Management system changes should be used to codify and embed learning for the future, however, people aspects of the change need to be considered.

All of these changes will be most effective in an organisation where the leaders foster a learning culture.

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