

Improving organisational learning: why don't we learn effectively from incidents and other sources?

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Recent research carried out by the Keil Centre for Magnox Ltd focuses on organisational learning as part of an on-going nuclear research programme. While the research itself is not published outside the industry, Magnox is willing to share the main results as part of its commitment to sharing learning. This paper describes the main results of the literature review as applicable to the non-nuclear high hazard industries and discusses the main outcomes for organisational learning theory and practice. It is already widely recognised that organisations do not readily learn from incidents, particularly where organisational factors are involved as root or contributory causes. Although there are well-publicised repeat incidents such as the space shuttle disasters and BP's Texas City and Macondo incidents, the issue is widespread e.g. as seen through IChemE's own Loss Prevention case studies. This paper builds on the main outcomes of the Magnox research to show how organisations could start to learn more reliably from their own and others' incidents, and from a range of wider sources (beyond incidents). The nuclear industry has a range of learning practices through its mature Operational Experience Feedback (OEF) system but learning from wider sources has proved difficult, and even with the OEF arrangements, reliable learning to prevent repeat incidents can still be problematic. This paper aims to show what the main barriers to conventional incident learning are and how wider learning sources and methods may be developed. The paper includes a focus on organisational factors. These are particularly hard to identify reliably and tackle. They are often part of the 'organisational wallpaper' – 'The way things are round here' as opposed to 'The way we do things round here' the accepted strapline for safety culture. Recommendations for identifying and addressing these factors are also made.

Keywords: organisational learning, learning organisation, leadership

Introduction and background

This paper is based on research carried out by The Keil Centre for Magnox Ltd's generic research and development programme for decommissioning and waste management (Magnox 2013). The final report is not publicly available but Magnox Ltd¹ has kindly agreed to disseminate key findings through events and publications such as this. The original report was 80 pages long, so this paper presents a summary and selected references.

Nuclear operators have established processes and methods to generate learning from operational experience, and from organisational and cultural root causes through a process called 'Operational Experience Feedback (OEF)'. Despite this, learning points and recommendations are not always fully understood or acted on and consequently may contribute to further – or repeat – events. This research therefore considered how to identify and understand the barriers to organisational learning at a fundamental organisation level focusing particularly on leadership, management style, and systems and management processes (ONR 2012 p2-8 – this gives the Office for Nuclear Regulation (ONR's) direction for nuclear research in this area). The scope was all high hazard industries.

Method

The main methods used were: a literature review, including a review of existing organisational learning theories. The research outputs also included guidance for senior leaders to help identify barriers and enablers to such learning and to help overcome the barriers and develop an effective approach to organisational learning. The main recommendations for leaders are included here. Two supporting tables were also developed to provide initial support for leaders and relevant others to make a start in taking up the recommendations. Table 2 (Appendix 2) lists some example organisational factors from the literature and Table 3 (Appendix 3) summarises some potential activities to support wider organisational learning.

Literature review

[Note: The results of both reviews – literature and theory – are summarised below in the Conclusions' section]

The business organisational literature is huge but has little that is directly applicable to the high hazard sector. The research has proliferated over the last 2-3 decades. However, new concepts appear to emerge to drive new areas for research without good evidence of a convincing starting point on existing concepts. Even a recently revised standard text struggles to make sense of the research picture in a way that is convincing (Easterby-Smith & Lyles 2011: Introduction). This has implications for the theoretical basis of the relatively few applications to the high hazard sector.

¹ Magnox is the management and operations contractor responsible for 10 nuclear power electricity generating sites and one hydroelectric plant in the UK, of which 8 are defueling or decommissioning. .

That said there is a reasonable consensus that the attributes of a typically commercially successful organisation – decentralised with independent business units, and characterised by a trial and error approach to learning – are not those suited to high hazard businesses or high reliability organisations (HROs). HROs are said to be able to do both, particularly when responding to events (HSE 2011). For the high hazard industries generally, a more traditional structure is considered essential for managing major hazards. The challenge therefore is to allow sufficient flexibility in structure and arrangements without losing the underpinning hierarchy necessary for safety. However, this needs to be qualified by recent HSL research (ibid e.g. pvii, p20) which questions the limited research available to support the HRO concept, particularly the lack of a coherent underpinning theoretical framework.

The strongest basis for application to the health and safety domain found was an extended meta-study and other work by Burke et al (e.g. Burke et al 2006 and 2011). This provides a reasonably sound basis for this application, and is certainly the best available to date (and see Lardner and Robertson 2011). Key points from this work are that: more active and engaging health and safety learning and training methods are more effective for higher hazard/consequence work; and ‘uncertainty-avoiding’ organisations like the nuclear industry tend to use more passive and less engaging training methods (see table 1 below).

Table 1: Effect of types of experience and learning method on learning (Table 2 in Lardner and Robertson 2011: adapted from Burke et al 2011)

		Type of learning method	
		Passive Less mindful	Active More mindful
Type of experience	Direct Own experience	More effective	Most effective
	Indirect Others experience	Least effective	More effective

The Burke et al work is further developed and applied to the high hazard side through Andrew Hopkins’ work (for example Hopkins 2012), which steers a clear route from organisational theory to high hazard application. Hopkins’ work is based on direct involvement in the investigation of seminal incidents in the sector, and allied research and analysis.

He makes a number of key points for high hazard industries wanting to improve their organisational learning. These include the importance of leadership driving activity on and implementation of organisational learning from the top in an informed, active and engaged way; the embedding of learning and lessons in organisational practices, structures and processes so that change is effective and to avoid corporate memory loss. He argues that the HRO concept - currently under some challenge anyway (HSE 2011) - while helpful, creates a tension between the traditional (and necessary) hierarchical structure of high hazard organisations and the need for flexibility in response e.g. in an emergency, and in structures e.g. for innovation and change, for a high hazard or commercial organisation. Further issues identified include: the reception and implementation end of the learning cycle is often under-resourced; leadership and learning structures need to be able to tune into ‘weak signals’ to pick up softer emerging (organisational) issues which may not have a firm evidence base at that stage; high hazard industries naturally tend towards their engineering and technical ‘comfort zone’ in identifying, prioritising and implementing learning; methods of sharing lessons and learning are often passive and so less effective; the use of summaries and digests both upwards to leadership, and downwards from leadership may skew leadership understanding (and ability to tune into weak signals), and also tacitly signal that time for learning is limited.

Work in developing a scenario approach in the oil and gas sector (Lardner and Robertson 2011) is a more practical and potentially more applicable method though. Based on two case studies so far, it offers a structured means of reliably introducing learning for individuals, potentially in a proactive way rather than just after incidents. This method can also tap into some specific organisational barriers by creating the opportunity for these to be articulated and captured in a safe group environment. As an example of what can be done to make learning and training more active and engaging, this could be applied to other learning, training and dissemination methods.

The nuclear literature is relatively sparse, particularly on the guidance and methods side (both for the industry and the regulator), and also in the research literature. The papers identified are either more widely aimed at identifying common organisational factors (including organisational learning) based on major incident analysis (for example van Wijk et al 2008) as is some similar HSE work (HSE 2007 or present limited case studies (for example, Hayes 2009) which, while rich in qualitative detail and with very helpful insights into cultural and organisational issues preventing learning, provide limited specific practical help at this stage. Some examples that were found in the nuclear literature are in Table 3 (Appendix 3) - possible activities to support wider organisational learning identified primarily from nuclear sources – is offered as a starting point for those wishing to take this further.

One attempt to anchor regulator and other demands for nuclear organisational learning to a more practical basis for the industry to implement was found (Wahlström 2011) but despite some sensible and helpful observations the paper becomes bogged down in further modelling considerations. One very helpful insight in this paper though is that organisations need to be clear about what they want to learn about and especially which part of the 'life cycle' the site or operation is in e.g. design, operations, decommissioning. They also need to be able to combine existing research, knowledge and methods into a single framework for organisational learning.

The nuclear industry's OEF process while well ahead of most other industrial major hazard sectors, still has acknowledged difficulties in the reliable identification – and subsequent addressing – of organisational factors (e.g. Hayes 2009). This includes difficulties in reliably identifying repeat events where organisational factors will likely be key, and the relative lack of organisational factors scope in agreed OEF reporting arrangements (see e.g. ONR 2012).

Very limited examples of good practice from other high hazard sectors were found. Those that were found do however provide some promising support for how existing learning structures and arrangements could be developed to ensure softer issues such as organisational factors are identified, shared and analysed in advance of possible incidents. This is a necessary corrective to the more traditional engineering and technical focus identified in the high hazard industries which, although a proper focus, needs widening to allow better and earlier consideration of the 'softer' organisational factors. The limited but fast-developing healthcare literature found supports this view (for example Carroll & Edmundson 2011).

Other comparable high hazard sectors produced relatively little of immediate help despite the background of for example, the space shuttle disasters for the space travel sector; and in aviation and air traffic control (ATC) where a more OEF and culture-focused approach appears dominant.

Review of theories of learning

The theory background in the mainstream organisational learning literature presents a confused picture with multiple sub-literatures and lack of clear agreement on some basic concepts. 'Ockham's razor'² is best applied to the theory side i.e. try to simplify it. In practical terms this means looking for evidence of real application in high hazard industry areas.

Even finding agreed definitions of basic building blocks like 'learning organisation' is a challenge. However the most useful definitions stress the importance of active responses and change. Hopkins provides the most useful of these: "An organisation can be said to have learnt from an incident if it changes its structure, procedures, resourcing priorities, performance indicators, or makes some other organisational change in response to the incident." (Hopkins 2012, p111) This means more than just sharing lessons. And while the types of change resulting from organisational learning (the way the organisation and individual think, their knowledge, routines and performance) are important, in industry (and especially the high hazard industries) some learning becomes embedded through technological change for example, redesign, re-engineering and so on (Lardner & Robertson 2011). The theory side does not really address this aspect. The educational literature is also very theory-driven but does provide reasonable support for more applied theory to the high hazard sector (Burke et al 2007).

In both cases the emphasis on reflection and action, and on deeper learning methods including self-articulation and self and group discovery of meaning, support some specific applications developed from the theory to the broad health and safety domain, represented in the work of Burke et al. This work has been further applied in a practical and useful way to the high hazard sector, specifically to the oil and gas sector (Hopkins 2012; Lardner & Robertson 2011). It also usefully brings in the essential 'story' element - one of the main ways that people remember is through stories i.e. narrative structure helps memory and recall. It also allows the essential integration of meanings and facts to take place to support deeper (and therefore longer-lasting) learning. A final useful supporting point is that the way we remember tends to be in concrete form and it is this concreteness that makes generalisation more difficult and so requires a deeper learning approach. In principle the more concrete examples from different domains that we have, the more readily the learning can be transferred.

On the business organisational theory side, it is difficult to disentangle organisational learning/learning organisation and organisational culture. Learning appears as a key element of culture (but not always) and culture appears as key element of learning (always). A suggested way of resolving this apparent circularity for practical purposes is that a learning organisation develops a capacity to learn and what it learns is knowledge which it then needs to implement, retain and manage. If a learning culture develops or exists in the organisation then this will happen better and more effectively. A further circularity concerns incidents: having a major incident is cited as evidence of a failure to learn, and failure to learn is cited as a contributory cause of (or vulnerability to) a major accident. At best this describes something but does not explain it. This can in any event only be helpful further if the incidents are well investigated and the organisational and other factors clearly identified.

A further lesson from looking at the learning theories is that they need to be applied with care and in practical way rather than to allow theory to drive innovation directly. So while examples can be found in the wider literature which may be helpful for the high hazard sector, starting from already-applied examples is likely to be more productive and practical.

² Attributed to the mediaeval philosopher William of Ockham as a principle of parsimony and economy in scientific hypotheses and explanation: 'Entities must not be multiplied beyond necessity'. See e.g. <http://www.britannica.com/EBchecked/topic/424706/Ockhams-razor>

While Hopkins' examination of learning theory is very useful (Hopkins 2008; 2012), his examples of direct application are more limited. The scenario approach (Lardner & Robertson 2011 – discussed above - is more promising as an example already developed for a high hazard industry and incorporating more of the practical aspects of underlying theory. Of course other methods would need to be developed alongside this provided they follow the active and engaging approach.

Another important strand that emerges from theory and is strongly supported in the main literature review is the impact of cultural and organisational factors in organisational learning. Learning is limited both by what individuals can identify and have the knowledge/experience base to learn from, and by the culture around them which can facilitate or hinder the valuing and subsequent embedding of that learning. For this to reliably take place the structures and arrangements for learning need to take account not just of engineering and technical factors (with associated 'hard' evidence - the comfort zone of organisations with such a focus) but also of the softer organisational issues. While the initial hard evidence may be lacking, if the softer issues are taken collectively (and taken seriously and studied further) they can help organisations to identify in advance just those factors which are known to be the most significant contributors to major accident prevention. As a simple example, the scenario method discussed above includes an element of group discussion on barriers to learning from the selected scenarios, and so helps make these explicit. In other words the method helps to surface what 'everyone knows' but tacitly accepts, so that the organisation is alerted to a developing issue.

In getting an organisation's structures and arrangements right for learning, a second issue is that of gaining maximum benefit from existing incident learning arrangements. Current arrangements are generally capable of significant improvement and could capture some key aspects of the softer evidence side. Ideally this should be done without creating new/parallel structures or arrangements which, although well-intentioned, could easily work against improvement in practice.

Loop theories (single, double and triple) are popular in the high hazard industries but are poorly supported in the literature (Tosey et al 2012). 'Triple loop learning' ('learning about learning') is seen widely as a key part of a learning organisation so the lack of real support in the literature creates a serious problem for the theorists and possibly for application. That said the concept can be usefully applied to existing structures and arrangements rather than in seeking innovation or change for the sake of it. What can be said is that any such 'learning about learning' requires a culture that looks outwards as well as inwards and is prepared to learn from a wide range of sources, and question its own learning limits and methods. The same application could be brought to the high hazard industries and this aligns with making existing incident learning arrangements more effective.

For application of theory to health and safety and specifically to the high hazard industries, little was found but the work of Burke et al (for example, Burke et al 2011 – discussed above). Learning theories are also reasonably well summarised by Burke et al. (Ibid) who, while naturally championing their own 'dialogical' perspective, are convincing about the appropriateness of this for the health and safety domain and make a similar point to that of Wahlström (Wahlström 2011) – that in the high hazard industries, uncertainty avoidance and other factors tend to engender more passive training and learning methods. While 'dialogical' is not an easy descriptor to use, it disguises the rather simpler idea that the articulation and sharing of thoughts and observations promotes reflective thinking and so improves learning. These are inherently more active and engaged individual ways of learning which can then contribute in turn to more active and engaged ways of group and organisational learning.

Conclusions from literature review

The literature review overall shows that there is limited directly applicable research available for the high hazard sector in general and nuclear in particular. However, there is some limited but robust applied research to the health and safety domain, and very limited but potentially very useful application and practical examples for the high hazard domain itself. There is also some limited but promising nuclear work.

The business organisational literature is huge and increasingly diverse but has little that is directly applicable to the high hazard sector. There is however a reasonable consensus that the attributes of a typically commercially successful organisation – decentralised with independent business units, and characterised by a trial and error approach to learning – are not those suited to high hazard businesses or high reliability organisations (HROs). There is therefore an on-going tension between the high hazard and commercial drivers for learning. The challenge therefore is to allow sufficient flexibility in structure and arrangements for learning without losing the underpinning hierarchy necessary for safety. There is also tension with other requirements such as conservative decision-making, learning across teams, and the traditional engineering/technical focus of the industry.

The HRO concept which on the face of it should be useful and applicable, is less readily transferable in practice from the military and other limited HRO exemplar (and primarily non-commercial) research areas to the high hazard industries, and lacks the underpinning theoretical framework for this (HSE 2011). For the high hazard industries generally, a more traditional structure is considered essential for managing major hazards. 'Mindful Leadership' (HSE 2011) as a key category for HROs gets no real purchase if leaders don't know what they are looking for or if this is not made explicit. For organisational factors, this is the core of the problem.

The limited application found for the health and safety domain (Burke et al 2006 and 2011) is nevertheless robust but is not directly applied (in the Burke et al research model) to the high hazard sector. However there are some very limited but promising practical applications of Burke et al's work to this sector by others (for example, Lardner & Robertson 2011: use of scenarios). The key findings from both are that: more direct, active and engaging health and safety learning and training

methods are more effective for health and safety, especially higher hazard/consequence work; and that ‘uncertainty-avoiding’ organisations like the nuclear industry tend to use more passive and less engaging training methods

The Burke et al work is further developed and applied to the high hazard side through [Andrew Hopkins](#)’ work (e.g. Hopkins 2012). He recognises the importance of leadership driving activity on and implementation of organisational learning from the top in an informed, active and engaged way; and the embedding of learning and lessons in organisational practices, structures and processes so that change is effective and to avoid corporate memory loss. He also identifies; the importance of adequately resourcing the reception and implementation end of the learning cycle.

Leadership and learning structures need to be able to tune into ‘[weak signals](#)’ including softer emerging (organisational) issues which may not have a firm evidence base at that stage. This is more difficult for high hazard industries which naturally tend towards their engineering and technical ‘comfort zone’ in identifying, prioritising and implementing learning. Methods of sharing lessons and learning are often passive and so less effective. So the use of summaries and digests both upwards to leadership, and downwards from leadership may skew leadership understanding (and ability to tune into weak signals), and also tacitly signal that time for learning is limited.

The [nuclear literature](#) is relatively sparse, particularly on the guidance and methods side (both for the industry and the regulator), and also in the research literature. The work available is primarily focused on identifying common organisational factors or some limited but rich case studies. The organisational factors’ studies offer a promising framework for identifying these but are not yet applied (van Wijk 2008; Wahlström 2011; and see HSE 2007). A key finding from one nuclear study (Wahlström 2011) is that the nuclear industry has put most effort into learning as applied to the early phases of the design life cycle and not to later phases such as decommissioning. In other words, there needs to be a clearer (though not exclusive) initial focus on what learning is required for the specific phase concerned.

The inherent complexity of nuclear management systems is also a barrier, along with an allied lack of time to learn and to position itself strategically for learning. One small case study offers useful insights into learning in a more balanced way from successful or positive events (Lackman and Söderland 2013). This can contribute significantly to a more balanced and richer picture to support organisational learning.

The tendency to use incidents and other potential learning aids as [checklists to screen out their application](#) rather than as starting points for thorough questioning and checking of organisation’s barriers and arrangements for safety is identified (WANO 2005). The fact that multiple barriers have been breached is what is most interesting (and so worth generalising from), and not the barriers themselves or the direct apparent (in)applicability to plant, equipment, process or operation.

The important role of the [regulator](#) is identified in the literature but the ONR definition of organisational learning is skewed more towards the OEF side and requires more development. However, it may well be that the industry has to develop some better practice first (if the regulator already knew in detail what was missing, it would likely not be missing in the first place). The current industry OEF process is not fully effective in identifying or acting on organisational factors (Hayes 2009). This will influence how well wider organisational learning is done.

Very limited examples of [good practice](#) from other high hazard sectors were found. Those that were do however provide some promising support for how existing learning structures and arrangements could be developed to ensure softer issues such as organisational factors are identified, shared and analysed in advance of possible incidents (see Table 3, Appendix 2). This links strongly to the HRO concept of ‘sensitivity to operations’ and Hopkins’ variant of ‘*amplifying [or tuning into] weak signals*’, both of which are challenges to more technically and engineering-focused organisations such as the nuclear industry. This is therefore another area of inherent tension.

Other possible [comparable sectors](#) did not provide immediately useful material beyond more OEF-focused work, or were more concerned with culture as a learning lens rather than organisational learning per se. But [waiting for more research](#) is not likely to produce the required action: future potentially useful research will have to rely now on activity at organisational level to inform it.

Conclusions from theories of learning review

The theory background in the mainstream [organisational learning literature](#) presents a confused picture with multiple sub-literatures, proliferation of concepts, and lack of clear agreement on basic concepts. Although even finding agreed definitions of basic building blocks like ‘learning organisation’ is a challenge, the most useful definitions (e.g. from Hopkins 2012) stress the importance of active responses and change, so that learning impacts on the wider organisation and is embedded in organisational structures, rather than just on the engineering, technical or narrower safety management system areas. Learning is more than just sharing lessons.

Theory recognises some key types of change resulting from organisational learning - the way the organisation and individual think, their knowledge, routines and performance. However, in industry (and especially the high hazard industries) some learning becomes embedded through technological change for example, redesign, re-engineering and so on. The theory side does not really address this aspect.

On the [business organisational theory](#) side, it is difficult to disentangle ‘organisational learning’ from ‘learning organisation’ and ‘organisational culture’. Learning appears as a key element of culture (but not always) and culture appears as key element of learning (always). A suggested way of resolving this apparent circularity for practical purposes is that a learning organisation develops a capacity to learn and what it learns is knowledge which it then needs to embed – to implement,

retain and manage. If a learning culture develops or exists in the organisation then this will happen more effectively and be sustained.

The educational and psychological theories provide support for an emphasis on reflection and action in learning, and on deeper learning methods including self-articulation and self and group discovery of meaning. This in turn supports some specific health and safety and high hazard applications (Burke et al 2006; 2011; Hopkins 2012; Lardner & Robertson 2011) and the need for more direct, active and engaged learning approaches. The importance of stories in effective learning also supports these applications, both in the form of multiplying concrete – and rich – examples to aid generalisation and transferability and in developing stories such as generalised scenarios to help embed deeper learning.

Having a major incident is invariably cited as evidence of a failure to learn, and failure to learn is cited as a contributory cause of a major accident (or vulnerability to one). This is circular and at best descriptive rather than explanatory. In practice this can only be helpful further if the incidents are well investigated and the organisational and other factors reliably identified. Such well investigated incidents are relatively rare in practice.

Theory should be treated with caution. For example, learning loop theory (single, double and triple loop learning) is not in fact securely supported by theory or research (Tosey et al 2012). The proliferation and churning of concepts in the theory area is reminiscent of mediaeval cosmological efforts to ‘save the phenomena’ (trying to reconcile increasingly better observed planetary movements with the idea of a stationary Earth at the centre of the universe). This suggests a lack of evidence and application to support more structured theory development. So examples of actual application of wider learning theory, particularly to the health and safety and specifically the high hazard area are a better starting point. Such examples can then be used to develop organisational capacity and processes for more active and engaged learning.

Another important strand that emerges from theory and is strongly supported in the main literature review is the impact of cultural and organisational factors in organisational learning. Learning is limited by what individuals can identify, what they have the knowledge and experience base to learn from, and by the culture around them which can facilitate or hinder the valuing and subsequent embedding of that learning. To address the impact of cultural and organisational factors successfully requires an organisation to be able to tune into emerging softer issues – for which initial hard evidence may be lacking - and these are typically the organisational factors. If culture is ‘The way we do things round here’ then organisational factors (see Table 2 in Appendix 2 for some examples) may be said to be the organisational wallpaper ‘The way things are round here’. So eliciting and identifying these factors is inherently much harder and requires a different approach to that typically taken for engineering and technical issues – and also goes outside the industry’s traditional comfort zone. All of this is particular challenge for leadership in balancing control and routine against some loosening up of both of these to encourage more improvisatory learning and challenge of assumptions - deep learning.

Recommendations

The following recommendations are made, primarily – but not exclusively – for senior leadership in the high hazard industries:

Develop a leadership approach to learning which is in itself more active and engaged. This will include moving beyond receipt of – or generation of – summaries and less direct sharing methods; and the identification of a wider range of learning opportunities and mechanisms, including learning from positive as well as negative experience.

Develop an organisational learning framework based on a wider range of learning sources (beyond just learning from incidents and near misses) for example monitoring, peer review, audit and review experience, and also industry/organisational successes and good practice (Table 2 – Appendix 2). This framework is best implemented by building on existing learning from incidents’ expertise and arrangements rather than by setting up another process. This is to avoid further organisational complexity and overlap, and provides a good involvement and empowerment opportunity.

Develop incident learning and investigation arrangements and guidelines to support the more reliable identification of organisational factors, and subsequent actions and implementation (a list of example organisational factors is given in Table 2 – Appendix 1).

Develop and strengthen existing learning structures and arrangements (such as monitoring, audit and review) to facilitate improved and more reliable capture, analysis and lessons’ implementation of organisational issues, including ‘weak signals’. The challenge is to find ways of encouraging the eliciting and articulating of the softer knowledge and experience that are held in the organisation but which are often filtered out (or not articulated); and analysing and using this effectively. A useful analogy for organisational factors in this context is between culture as ‘the way we do things round here’ and organisational factors as ‘the way things are round here’, the organisational wallpaper in effect.

Consider how a scenario approach (Lardner & Robertson 2011) can assist in improving individual and group/team learning combined with improved identification and feedback of organisational barriers to such learning. This approach can be applied both retrospectively and prospectively. Develop a range of methods for improved active and engaged training and learning to complement this.

Focus on organisational learning in the current life cycle phase e.g. design, commissioning, operation, decommissioning, the needs of each part of the life cycle are different.

Learn from already identified potential tools and methods (e.g. van Wijk et al 2008; Wahlström 2011). Although these are nuclear industry initiatives, a similar approach was taken by HSE for the high hazard industries under COMAH (HSE 2007). The active principle here is to learn by doing and to validate these approaches further through iteration and experience. Waiting for further research or other confirmation before using them is unlikely to generate much improvement. Learning comes as much from the process of use as from the mechanism used.

Table 2 (Appendix 2) lists some example organisational factors from the literature and Table 3 (Appendix 3) summarises some potential activities to support wider organisational learning. These are offered as initial support for leaders and relevant others to make a start in taking up the recommendations.

Overall conclusion

The literature and theory reviews found surprisingly little of practical help for the high hazard industries in developing a wider organisational learning process. Useful research will likely need to wait for the industries themselves to develop some practical approaches first so that there is something solid for researchers to work on and to help inform theory development. That said, the key role of leadership was underlined in improving this situation (and the recommendations above show how they can start doing this) and there were a number of useful learning points, tools and methods identified from the reviews to allow the industries to get started. Equally the reviews show the importance of making sure that existing incident/near-miss learning arrangements are really effective, particularly in identifying and remedying the background and underlying organisational factors.

Appendix 1: Organisational factors

Organisational factors are often talked about but specifics are harder to come by. Table 2 sets out a list of organisational factors identified from a range of sources most likely to be relevant to high hazard industries. However it is equally likely that each organisation will have to identify its own relevant set of these - relevant to its current life cycle phase, activities, business/economic position and so on.

Table 2: Typical organisational factors

Organisational factors	Source/comment
<ul style="list-style-type: none"> • Poor work planning e.g. leading to high work pressure • Lack of safety systems and barriers • Inadequate responses to previous incidents • Management based on one-way communication • Deficient co-ordination and responsibilities • Poor management of health and safety • Poor health and safety culture 	Applicable to all aspects of health and safety, not just high hazard. <i>Source: HSE1999 p11) Listed as 'Organisation & management factors...often cited causes of human failures in accidents'.</i>
<ul style="list-style-type: none"> • Organisational culture and management goals and priorities • Health and safety culture of an organisation 	<i>HSE 1999 p18 and p35)</i>
<ul style="list-style-type: none"> • Communication • Learning organisation • Health and safety focus • External pressures • Committed rewards • Participation • Management visibility • Balance of productivity and safety • High quality training • A clean and comfortable working environment • Job satisfaction • Workforce composition 	These are listed as organisational factors "found to be associated with good safety performance." <i>HSE 1999 p44</i>
<ul style="list-style-type: none"> • Senior management commitment • Management style • Visible management • Good communications between all levels of employee • A balance of health and safety and production goals 	Listed as "Organisational factors associated with a health and safety culture." <i>HSE 1999 p46</i>
<ul style="list-style-type: none"> • An effective health and safety management system • A positive safety climate and culture • Adequate supervision • Effective incident reporting and analysis • Clearly visible health and safety leadership • Suitable team structures 	Listed as part of "A checklist for human factors in the workplace." <i>HSE 1999 p55</i>

<ul style="list-style-type: none"> • Efficient communication systems and practices • Adequate staffing levels • Suitable work patterns 	
<p>ONR does not define organisational factors at any level of detail e.g. in the Safety Assessment Principles (SAPs) for nuclear safety cases assessment or in other guidance. (see eg. <i>ONR T/AST/058 Human Factors Integration - Issue 1: 4.7</i>)</p>	<p>This suggests that the industry has not succeeded in defining these factors at a more specific level except by factors already identified as being organisational from investigated incidents. By implication the general HSE definitions are the default.</p>
<p>A: Objectives, priorities and resources. B: Formal systems and practices. C: People's attitudes and orientation. D: Corporate culture and traditions. E: Communication, guidance and appraisals. F: Maintaining touch and focus. G: Openness and trust. H: Work community.</p> <p>Two key themes are identified as emerging from these 8 clusters: "...the lack of time that prevents a strategic outlook and acts as a hindrance to organisational learning." And the second "...is connected to the complexity of the plants and their management systems that make communication and planning difficult."</p>	<p>These are eight 'clusters', the outcome of nuclear industry research. As such they are very general but may be useful a starting point for developing more specific tools e.g. a checklist is suggested. The two key themes of time and complexity affecting strategic outlook and communication and planning are more useful but still vague. <i>Wahlström 2011 p68</i></p>
<p>The eight main areas identified by this nuclear study based on exhaustive analysis of a sample of industrial major incidents were:</p> <ul style="list-style-type: none"> • Leadership issues; • Operational attitudes and behaviours (operational 'culture'); • The impact of the business environment (often commercial and budgetary pressures); • Oversight and scrutiny; • Competence and training (at all levels); • Risk assessment and risk management; • Organisational learning; • Communication issues. 	<p>These general areas require development and support e.g. by a set of organisational objectives and allied question sets though these would require some further application and iteration to develop fully. <i>van Wijk et al 2008</i></p>
<p>"Dominant organisational factors affecting performance of people [also identified from incident analysis] were:</p> <ul style="list-style-type: none"> • Organisational learning, memory and knowledge failures in relation to major accident prevention. • Failures in selection (or job allocation) and/or provision of training for personnel in job positions with key authorities and roles in major accident prevention. • Social norms and pressures within the organisation which conflict with implementing major accident prevention measures. <p>The following were further contributory factors:</p> <ul style="list-style-type: none"> • Inadequate resourcing of major accident prevention activities. • Inadequacies in communication and coordination. • Organisational complexity (interactions) in control of the technical process. <p><u>...Especially highlighted are criteria and resources for providing sufficient know-how and prioritising with respect to major hazards."</u></p>	<p>This is based on exhaustive analysis of a sample of major industrial incidents and is focused on major accident prevention. It recognises the organisational learning contribution, focuses on individual selection and training arrangements, and reflects organisational drift issues. It also highlights resourcing (and prioritisation), communication, co-ordination of work, and organisational complexity. <i>HSE research HSE 2007: 4.4.2 (p18)</i></p>

Appendix 2

Table 3: Initial list of possible activities to support wider organisational learning identified primarily from nuclear sources. This shows that current practical ideas are limited even on the nuclear side where this debate is active.

Activities	Notes
<p>"Self-evaluation activities include but are not limited to self-evaluation team reviews, management monitoring observations, event investigations, root-cause analyses, benchmarking, self-checking, peer-checking, and problem-reporting systems." (WANO 2005 p29; <i>one of the WANO cross-functional performance objectives for peer review as 'self-evaluation (learning organisation)'</i> (Ibid pii).</p>	<p>This is limited though helpful. For example, implementing recommendations from e.g. peer reviews, is known to be more difficult for the receiving organisation. This is in itself an organisational factor.</p>
<p>"Whilst historically the focus has tended to be on operational experience</p>	<p>This is a fuller list and less focused on OEF-type</p>

<p>feedback (OEF), there is increasing recognition that organisational learning is much wider and uses or draws on many different mechanisms for example, workshops, secondments, peer group exchange forums, peer review and assist missions. These provide the opportunity to learn from both routine operational experience, as well as from events.” (ONR 2012 p23).</p> <p><i>“Nuclear operators have established processes and methods to generate learning from operational experience, organisational and cultural root causes and learning points, but these are not always fully understood or implemented most effectively. Consequently they may only be of limited value in eliminating deficiencies.” (ONR 2012 p23)</i></p>	<p>activities. It is limited by the knowledge, experience and ‘unconscious incompetence’ (what they don’t know they don’t know) of the industry general pool though. Effective learning through this range of approaches presupposes that those involved can go beyond (or are encouraged to do so) ‘single loop’ comparison with routines, standards, procedures and so on, to question less obvious assumptions and surface softer concerns and underlying organisational factors. <i>It is also vital to make sure that established incident/near-miss learning processes are actually working effectively already.</i></p>
<p>“An organisation should have effective processes for seeking out, analysing and acting upon lessons from a wide range of sources.” (ONR 2010 MS-4: 66)</p>	<p>This is a challenge in terms of e.g. timing, basis for such reviews, purpose and structure, the way in which learning is sought. In principle any external incident is a potential learning source, if only in considering the underpinning organisational factors as an exercise in identifying these regularly.</p>
<p>“Learning should occur throughout the organisation and information should be collected from inside the organisation from a number of sources including:</p> <p>a) workers (eg about strengths, weaknesses, deviations and errors in safety procedures and processes);</p> <p>b) monitoring, review and audit of the implementation and effectiveness of safety strategies, policies, plans, goals, standards, processes and procedures; c) monitoring of plant, systems and processes; d) testing and validation of safety procedures under normal and emergency situations; e) the inspection of sites, facilities, plant and equipment and other operational feedback systems; f) the investigation of accidents and incidents specifically to ascertain immediate and underlying causes, including organisational, safety management and cultural factors; g) self assessments; and h) external assessments.” (ONR 2010 MS-4:67)</p>	<p>This is more the existing OEF territory. Although it refers to ‘organisational factors’ in OEF (f) this is an area of known weakness.</p>
<p>“Learning opportunities from external sources and beyond the nuclear industry should be actively sought and used in learning processes...The information should be analysed to identify trends and issues, such as common cause failures (CCFs) or human factors, as a foundation for improvement. Sources outside the organisation should include: a) reviews against international standards and practices; b) lessons from the investigation of incidents in other organisations both within and outside the nuclear industry; and c) benchmarking safety performance and safety management methods and processes with other organisations from both within and outside the nuclear industry.</p> <p>The lessons derived from learning should be embedded through a structured system for implementing corrective actions that is rigorously applied and actively followed up to completion. Effectiveness reviews should be undertaken to confirm that the changes have delivered the desired improvements.” (ONR 2010 MS-4: 67-69)</p>	<p>This is more outward-looking but limits itself to ‘trends and issues’, and to the ‘lessons’ from external incidents. Such an approach is likely to miss underlying organisational factors if not adequately identified in the associated investigation reports. In practice this is relatively rare e.g. for Columbia; and still not fully done for e.g. Macondo). A more active and questioning approach might flush some of these out.</p>

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