KEY FACTORS IN EFFECTIVE APPROACHES TO LEARNING FROM SAFETY INCIDENTS IN THE WORKPLACE

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Learning from health and safety incidents (hereafter called LFI) in the workplace is critical for organisations. To ensure effectiveness of LFI and to contribute to the development of a holistic safety and learning culture in an organisation, it is important that a learning approach appropriate for the safety context is adopted. However, there are a variety of approaches to and interpretations of LFI, therefore the selection and application of a learning approach most appropriate to the problem at hand is not a straightforward task. It is, therefore, necessary for organisations to understand which approaches are useful in different contexts and under different time and cost constraints. This issue is of particular importance in an era when industry is mandated to maintain and improve increasingly high safety standards. This paper outlines the application of a range of safety-related learning approaches within the energy sector, focusing on a refinery and a gas processing plant in two distinct, multinational organisations. This study forms part of a larger project, 'Learning from incidents: a social approach to learning from health and safety incidents at the workplace'. The paper presents the results of a qualitative study including in-depth, on-site interviews with 16 employees. The study revealed five factors relevant to the selection of appropriate and effective approaches to LFI: formality of learning, learning participants, learning processes, relationship between the type of incident and learning, and type of knowledge. The paper concludes by proposing a framework for analysing and selecting effective and appropriate approaches to learning from incidents.

INTRODUCTION

Learning from health and safety incidents (LFI) has been high on the agenda in the energy sector. Both practitioners and researches agree that LFI demands serious attention. Although organisations use a variety of LFI initiatives, the question is what learning approach is most appropriate and most effective for what context. The increased attention to learning from incidents does not necessarily mean that all the initiatives are equally effective (and efficient) or that there is a 'one-size-fit all' solution. The complex nature of incidents in the process industry poses a challenge when deciding on a learning approach that would both be efficient in preventing the same types of incidents from re-occurring and pre-empting new types of incidents.

Most literature interprets LFI merely as a step (usually a final one) in the lifecycle of an incident (Lukic, Margaryan, and Littlejohn, 2010). However, if learning from incidents is supposed to bring about deep change in the safety level it should be integrated throughout the lifecycle of an incident or a near miss. Even if learning is more integrated into the safety processes, not every type of learning approach automatically increases safety levels. The question is: what factors influence the effectiveness of learning approaches in a particular industrial setting? To address this question, this paper brings together findings of a literature review of approaches to LFI and a qualitative study conducted at two different multinational organisations, in order to identify key factors in effectiveness of LFI approaches.

The qualitative study is part of a pilot baseline phase of a larger project 'Learning from incidents: A social approach to learning from health and safety incidents'.[1] Data was collected in 2010, through semi-structured interviews with 16 employees at two distinct organisations (a refinery, hereafter referred to as Site 1, and a gas processing plant, Site 2). The interviews were conducted with people from various positions in the companies to ensure that both managers' and employees' viewpoints are taken into account. The qualitative study focused on incidents that took place in the near history at the sites where the interviewees were familiar with the process arising after the incident in question. Moreover, the study did not focus on process safety incidents specifically but included discussions of any learning from instances that the interviewees deemed as safety incidents.

The following five key categories of factors emerged from the data: formality of learning, learning participants, learning processes, relationship between the type of incident and learning, and type of knowledge. Our findings suggest that these factors should be considered when selecting the most appropriate LFI initiative. These factors are further discussed in the following sections.

FORMALITY OF LEARNING

The first distinction in the learning process from safety incidents is between formal and informal initiatives (Beckett & Hager, 2002). The majority of initiatives in companies are formalised actions and procedures. Formal

[1] http://www.academy.gcal.ac.uk/lfi/index.html

learning would here represent structured systematic initiatives deployed by the company with learning as one of specific objectives. These initiatives usually form part of the official safety procedures and processes of a company. Informal learning would be learning taking place through natural course of work and not necessarily having learning as an explicit objective. A great deal of actions that could be linked with informal learning would be informal discussions and conversations, such as when an incident or a near miss is discussed informally with a colleague. There are also intermediate types, such as shift handovers, the learning aspects of which can be either structured and formal or informal. The line between formal and formal safety learning initiatives is not so strict, as many formal and systematic initiatives can be followed by informal sharing and learning. Table 1 gives an overview of the LFI initiatives identified at the two sites, in which the study was conducted.

Both formal and informal forms of learning have strengths and limitations. Our interviews indicated that the benefits of formal learning initiatives include structure and the number of people they can impact. Moreover, formal learning was perceived to have higher validity, due to being verified or verifiable by experts (safety engineers, shift superintendant, and so on). Knowledge acquired through formal learning is usually not tied to an individual and, if stored in accessible formats such as easy to use computer databases, can be valuable not just for various shifts and different units, but also for broader groups of workers and the organisation.

Informal learning, in contrast, occurs in a more spontaneous, less structured way. Potential safety issues are communicated through unofficial individual emails and private discussions. Interviewees highlighted the benefits of such communication as it occurs naturally and they could often speak more freely about an incident or a near miss than in the formal safety processes. On the other hand, such informal discussions and communication does not get captured in the formal documents and initiatives and the respondents highlighted that sharing of information in this way is individual-specific and can be lost if a person changes position or leaves. The interviewees mentioned information being discussed with immediate colleagues or the next shift, but that most of it will be lost in further dissemination of the information. These viewpoints suggest that both formal and informal ways of LFI have their benefits and shortcomings. It can be concluded that it is important to take the degree of formality of initiatives into consideration in developing approaches that would benefit from both the broad accessibility and verified nature of formal learning, as well as building on spontaneous and open inquiry typical of informal learning.

Table 1. Formal and informal LFI initiatives at the two sites

Safety initiative	Description	Type of learning	Site 1	Site 2
Database reporting system	An online system through which incidents can be reported and stored, with actions arising from each incident	Formal	Yes	Yes
HSE sheets	Individual booklets containing sheets through which hazards and safety issues are reported	Formal	No	Yes
Investigation	A thorough investigation process comprising a range of methods, e.g. after-action reviews (AAR) or root cause analysis (RCA)	Formal	Yes	Yes
Toolbox talks	Discussion sessions where safety issues are discussed	Formal and informal	Toolbox talks are a key means of rolling out LFI	Toolbox talks are a part of the work-permit meeting prior to start of the shift
Shift takeover	Transfer between shifts, recorded in logs or carried out verbally	Formal and informal	Yes	Yes
Safety meetings	Meetings at various levels of an organisation dedicated to safety issues	Formal	Yes	Yes
Email dissemination	Safety alerts and safety bulletins raising awareness of incidents and learning outcomes arising both from on-site incidents and the external ones	Formal	Yes	Yes
Personal communication	Communication between employees, office talk, private discussions	Informal	Yes	Yes

LEARNING PARTICIPANTS

Depending on the breadth of LFI processes, a variety of stakeholders can be involved. Existing approaches to learning assume a range of different perspectives: while some focus on individual learning, others emphasise teams and groups, and others involve the whole organisation or the sector. Two concepts are important when considering the participants of LFI: *inclusion* and *individual agency*. In terms of *inclusion*, the question is: do the LFI initiatives involve individuals, teams or the whole organisation? Learning literature involves the discussion of the notion of inclusion in both directions (towards the bottom and the top of the organisation), emphasising that, although the grass-root level is important, executive involvement in learning should not be overlooked (Dyreborg & Mikkelsen, 2003; Cooke & Rohleder, 2006). Moreover, it is important that LFI approaches also take into account the level of *individual agency* (Billett & Pavolva, 2005). Individual agency in the workplace learning implies the level of actual engagement of the employees with the learning initiatives. Key considerations include the extent to which all stakeholders have a say throughout the learning process and have opportunity to question organisational and systemic issues. A study by Burke et al. (2006) suggests that participatory approaches are effective for learning from incidents, although these approaches tend to be the most time consuming and expensive.

Our study showed that the level of inclusion in learning approaches appeared to be fairly high at both sites, especially when learning initiatives are based on dissemination of information through board posts and email, such as alerts and safety bulletins. However, the extent of inclusion (and involvement) appears to vary when it comes to other initiatives. Although initiatives such as safety meetings and investigations usually involve dissemination of key learning points, interviewees emphasised how they appreciated actually taking part in these meetings and investigations. An issue in inclusion is the relevance a particular initiative has for the actual job role of a particular individual. Many safety alerts, especially ones coming from other sites, are filtered and forwarded only to those employees for whom they are considered to be relevant. Although the majority of our respondents indicated that safety incidents unrelated to their work could yield important learning points, there was a concern expressed by a few that there is limited time and that it is difficult to pay attention to all initiatives that are not directly related to one's work. Therefore, deciding who to include in learning initiatives is an important factor.

However, it is not mere involvement and access to learning initiatives that is important. Even though a learning approach may be very inclusive in its scope, employees may not have an active role in the learning process. Interviewees ascribed high importance to the opportunity to participate fully in an LFI initiative and a have a say. They also expressed strong motivation to engage with safety learning. Therefore, employee *individual agency* is an essential component of learning from incidents and is important in ensuring employees take ownership of the safety processes (Cooke & Rohleder, 2006; McElhinney & Heffernan, 2003). Moreover, input from those actually dealing on day-to-day basis with complex issues that safety experts are trying to solve, is very valuable.

LEARNING PROCESSES

There is a wide variety of conceptualisations of learning processes underpinning LFI. Argyris and Schön's (1996) outline two modes of learning, double-loop and single-loop learning, which could provide a particularly useful conceptual framework. According to Argyris and Schön, single-loop learning includes solutions to errors and mishaps in the organisation by correcting the superficial elements of the problem. Examples of single-loop approaches include skills training, punitive decisions and technical changes. These are 'quick-fix' approaches that companies use to analyse and learn from incidents. This is also evident in the education of safety engineers which focuses on human and technical factors rather than organisational culture or systemic dysfunctions (Ferjencik, 2007). However, the nature of incidents is more complex and there is usually a complex system of causes that lead to a negative event, which is compared to an 'onion' with many layers of factors. The process of investigation and learning from incidents is supposed to unravel all of the layers of the 'onion' and prevent future recurrence (Kletz, 2001). This requires a deeper learning process. Double-loop learning, in contrast to single-loop learning, is based on open inquiry into deep-rooted causes, system failures and values. This mode of learning questions the underlying assumptions of organisational work (Argyris & Schön, 1996) and aims to change organisational factors and culture that often cause incidents (Spear, 2002). In this approach, there are two models that guide our action and they are expressed as either *theories-in-use* that can be inferred from observable actions or as *espoused-theories* that people claim are guiding their actions. Argyris and Schön highlight the contradiction between these two models: they argue that often espoused-theories contradict theories-in-use, suggesting that what people claim or even believe are their guiding values and principles are often very different from the values and principles manifested through their actions at the workplace. For example, this contradiction is sometimes reflected in 'blame-game' attitudes related to learning from safety incidents. Rose (2004) suggested that if 'a culture of perceived risk minimisation and blame avoidance becomes established in an organization, the desire to learn from incidents is greatly diminished' (p. 468). Moreover, the process of LFI is supposed to bring about a thorough change in the safety culture of the organisation. There are already attempts in the industry to look into the human factors through, for example, the Hearts and Minds programme which is trying to promote a deeper change in the safety culture towards a 'generative organisation'.[2]

[2]http://www.eimicrosites.org/heartsandminds/roadmap.php

Interviewees at both sites emphasised a notable improvement in the way blame-free organisational attitude is promoted and enacted in their organisation. However, the blame-game still appears to take place: respondents noted some discrepancies and contradictions, especially in incidents investigations and reports. Although management may claim that the main aim of investigation is learning, respondents considered the possibility of disciplinary actions to be a limiting factor in ensuring openness and transparency of learning from incidents. Furthermore, the consistency of actions following an investigation was highlighted as particularly important by the respondents. Sveen, Rich and Jager (2007) state that the 'blame-game' attitudes can persevere longer than a safety incentive can last; they assume that it takes an average of three months for the effects of an incentive to disappear while negative experiences, such as recriminations, linger for on average two years.

Interviewees also highlighted the impact of *ego-protection* routines, and, consequently, pointed out lack of incentive to openly share information about small-scale events, which do not cause big disruption, but are considered an embarrassing mistake by those involved. However, since small-scale near-misses could potentially cause more serious events in the future (Heinrich, 1931), it would be undesirable if these small-scale events stayed under the radar. Moreover, inquiry into the deeper causes and questioning systemic and underlying issues does not seem to figure in most learning initiatives. Full-fledged root-cause analysis investigations do allow for surfacing deeper causes. However, our study shows that they are not conducted in every instance and do not always question the organisational and management factors. Moreover, initiatives other than investigation are prevalently not questioned and discussed by the employees, which is characteristic of single-loop learning. However, the data does also provide some examples of individuals exhibiting a level of inquiry by reflecting on the learning shared through alerts and toolbox talks and also taking their concerns to those responsible for safety learning in their organisation. As Naot, Lipshitz and Popper, (2004) propose, genuine transparency, integrity, inquiry, issue-orientation and accountability are all important in the implementation of double-loop learning.

RELATIONSHIP BETWEEN THE TYPE OF INCIDENT AND LEARNING

Learning from incidents is sometimes oversimplified such that incidents are not understood in their full complexity. Naot, Lipshitz & Popper (2004) argue that one of the reasons for the low-level learning from an incident could be a relatively brief process of analysis and an overemphasis on implementation of lessons learned. Cooke & Rohleder (2006) noted a prevalent desire to find a single-root cause, sometimes termed 'root-cause seduction'. Loud (2004), while accepting the importance of general best practices, points out that employees' own, more specific solutions and ideas are more appropriate for learning from particular incidents. The type and complexity of an incident should be considered when adopting an LFI approach (Deloitte, 2009). The Cynefin framework (Snowden, 2002) has been used successfully to address areas such as organisational complexity and policy, knowledge management as well as safety at work, in particular the relationship between the incident type and the learning process. The Cynefyn framework (Figure 1) consists of four domains: *simple*, and *complicated* (orderly domains), as well as *complex* and *chaotic* (un-orderly domains).

In the *Simple* domain, cause and effect relationships are clear and solutions tend to be straightforward, often in the form of 'best practices' that can be captured and shared. In the simple domain, one needs to determine the facts, categorise them and use the best-established practice when dealing with a particular problem. In the *Complicated* domain, causal relationships are not readily evident. An in-depth analysis is required to surface the issues. While causes may not be evident at an individual level, an efficient solution usually exists and can be identified by someone else through such in-depth analysis. Solutions in the form of 'good practices' (as opposed to 'best practices') are likely to be most effective. The *Complex* domain deals with situations where urgent action is required and in which there are intertwining causes and influences. These causes are difficult to determine in action, but could be surfaced in hindsight. In the *Complex* domain, identifying solutions requires a shift from 'fail-safe' towards a 'safe-fail' attitude, whereby solutions can be tested. In the *Chaotic* domain, incidents are usually unforeseen, with little time for an in-depth analysis, since rapid, decisive action is required to mitigate the crisis, aiming to shift the situation from chaotic to complex (Snowden, 2002).

It is important to apply appropriate solutions within the appropriate domain. Problems may arise when solutions appropriate for simple cases are applied uncritically to complex incidents (Snowden, 2002). Trying to apply simple solutions to a complex problem (as many organisational issues are) can be counterproductive.

Most of the learning initiatives outlined in Table 1 are focused on dissemination of good/best practices. Although these approaches are very useful as a means of sharing

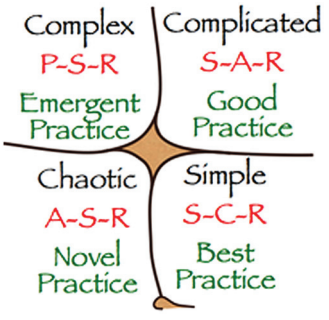

Figure 1. Cynefin complexity framework (taken from http://en.wikipedia.org/wiki/File:Cynefin.png)

information and 'lessons learned' (Bond, 2002; Gordon, 2008) they may not be the most effective approach in all situations. Most safety incidents are complex, with greatly differing underlying causes. Full root-cause analysis investigations have the highest potential for taking into consideration the relation of the type of the problem and the learning approach. In the case of such investigations, respondents suggested that the complexity of incidents is considered and proper learning actions are devised. However, they reported a tendency to condense the learning points into simplistic, 'bullet' points or one sentence long key learning points, suggesting a 'route cause seduction'. Such oversimplification may result in the loss of deep contextual meaning and a limited relevance of dissemination of learning points arising from an incident investigation. Besides investigations, most other initiatives do not consider the complexity and type of the problem causing the incident as a factor when deciding on the format of the learning initiative. Overall, the data indicates that at both sites insufficient attention is paid to choosing learning approaches appropriate to the level of complexity of the problem, favouring solutions more appropriate for simple problems.

TYPE OF KNOWLEDGE

Within LFI, the *form* of the learning approaches is often paid more attention than the *content* of such learning. It is important to take into account the type of knowledge required to address a problem and to prevent future incidents. Four forms of knowledge are central to learning: **conceptual, procedural, dispositional** and **locative** (Lukic, Margaryan, Littlejohn, 2010).

Conceptual knowledge ("knowing why" and "knowing what") comprises facts, concepts and propositions (Anderson, 1982). It refers to declarative understanding of safety issues and incidents. Deep conceptual knowledge is important because it allows complex problem solving through enabling an individual to understand the possible nature of the problem, and its relationship with other, associated problems.

Procedural knowledge ('knowing how') comprises techniques and skills that enable one to enact conceptual knowledge (Anderson, 1982). Procedural knowledge is classified into three levels (Stevenson, 1991). First-order or specific procedures are activated to achieve specific goals or tasks that are usually automatically enacted, without conscious thought (e.g., how to manage high pressure notice). In unfamiliar situations, second-order procedural knowledge becomes important – the ability of individuals to monitor and evaluate selection of strategy. Third-level procedural knowledge is required to monitor and organise activities, particularly when individuals are faced with novel tasks/problems.

Dispositional knowledge underpins conceptual and procedural knowledge and consists of attitudes, values, emotions, interests and personal motivations (Perkins et al., 1993). Dispositions are instrumental in putting conceptual and propositional knowledge into action. Dispositions such safety values or attitudes to wearing protective equipment can have strong implications for health and safety.

These three types of knowledge have received significant attention in cognitive psychology and learning literature. However, there is a fourth type of knowledge – "knowing where" – which is less well understood (Nicholls-Nixon, 1997). We call this ***'locative knowledge'*** and it represents the meta-knowledge about the location and sources of relevant knowledge (people, tools, resources, practices) in the organisation and beyond. This type of knowledge is usually acquired through networking and interactions with others, as well as training. Employees should know where to find the knowledge they need to deal efficiently with safety incidents (IBM Institute for Business Value studies, 2009).

Our data indicates that the majority of the safety learning initiatives address primarily conceptual and procedural knowledge. Many respondents expressed a need for more conceptual knowledge and understanding of how the whole process at the site works, while one respondent emphasised that it was not necessary to know the underlying concepts as long as the procedures were followed. Locative knowledge was mainly reflected in informal communications, such as information or advice about a particular safety issue from more experienced colleagues. Some respondents indicated that they would also check online databases, web networks and previous incidents reports. With regards to dispositional knowledge, data from both sites suggests that this type of knowledge is not considered by organisations when selecting a learning approach. LFI at both sites appears to focus primarily on rather decontextualised procedural and conceptual knowledge.

A FRAMEWORK FOR LEARNING FROM SAFETY INCIDENTS

Integrating a review of the relevant literature with our empirical findings, we propose a framework for analysing and making informed choices about selection of an appropriate LFI approach (Figure 2).

As we have shown in our detailed discussion above, firstly, the formality of learning approaches should be considered and to what degree it should be a part of formalise procedures, having in mind the characteristics of formal and informal learning. Secondly, it is necessary to understand who is to be included in the process of identifying solutions and to what extent they should participate in the learning process. Both individual and organisational aspects should be taken into account. Thirdly, the depth of learning (single- or double-loop) is critical. Research shows that incidents usually are caused by a mixture of technical, human, and organisational factors, therefore both single- and double-loop learning play an important role. Fourthly, understanding the nature of the problems causing incidents is important for ensuring that appropriate solutions are devised and implemented. And lastly, the type of knowledge must be considered, paying attention to the balance of conceptual, procedural, dispositional, and locative knowledge.

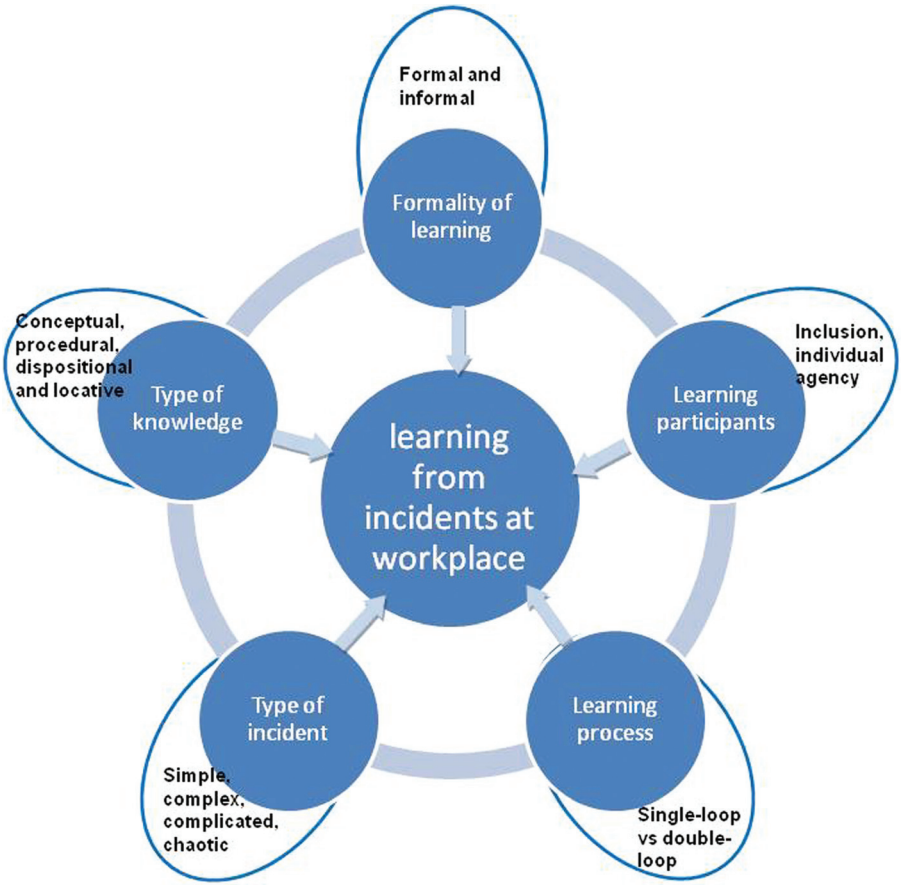

Figure 2. Framework for learning from safety incidents

These five factors and related concepts are envisaged as part of a cyclical rather than a step-by-step process. The five factors influence each other. They also overlap to a certain degree. This overlap could be desirable as different layers of safety or as a form of what Weick calls 'requisite variety' (Weick cited in Naevestad, 2008). This framework encourages a holistic view of learning from incidents, in the context of the whole cycle of an incident, rather than as a final step.

In conclusions the study showed that there are few examples of learning initiatives addressing all relevant factors identified by the literature review and the baseline qualitative study. The proposed learning from incidents framework (Figure 2) could be useful in systematically analysing and identifying effective approaches to LFI. This framework could be useful for safety planners, safety managers, human resource managers and researchers in the area of organisational learning and safety. The framework is unlikely to be exhaustive. However, it serves as a useful tool to analyse LFI. The scope and effectiveness of the framework will be validated in the next phase of research with the two sites where both another phase of qualitative study will be employed as well as series of interventions trying to bring about change in the companies and address factors of effective LFI.

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REFERENCES

Anderson, J. R., 1982, Acquisition of cognitive skill, *Psychological Review*, *89*(4), Jul 1982, 369–406.

Argyris, C., & Schön, D. A., 1996, *Organizational learning II. Theory method and practice*, Reading: Addison-Weslay Publishing Company.

Beckett, D. & Hager, P., 2002, *Life, work and learning: Practice in postmodernity*, London: Routledge.

Billett, S. & Pavolva, M., 2005, Learning through working life: self and individuals' agentic action, *International Journal of Lifelong Education*, *24*(3).

Bond, J., 2002, A janus approach to safety, *Process Safety and Environmental Protection*, *80*(1), 9–15.

Burke, M. J., Sarpy, S. A., Smith-Crowe, K., Chan-Serafin, S. & et al., 2006, Relative Effectiveness of worker safety and health training methods, *American Journal of Public Health*, *96*(2), 315.

Cooke, D. L., & Rohleder, T. R., 2006. Learning from incidents: From normal accidents to high reliability, *System Dynamics Review, 22*(3), 213–239.

Delloitte, 2009, Mining safety, A business imperative. *Thoughts Leadership*, Studio at Deloitte, Johannesburg.

Dyreborg, J., & Mikkelsen, K. L., 2003, Evaluation of an accident investigation tool using a safety perception maturity scale, *Safety Science Monitor, 7*(1).

Ferjencik, M., 2007, Best starting point to comprehensive process safety education. Process *Safety Progress*, *26*(3), 195–202.

Gordon, H., 2008, Integrating learning into safety: Developing a robust lessons-learned program, *Professional Safety, 53*(9), 30.

Heinrich, H. W., 1931, *Industrial Accident Prevention: A Scientific Approach*. New York: McGraw Hill.

IBM Institute for Business Value, 2009, The Enterprise of the Future: IBM Global CEO Study – Telecom Industry Edition. Available from http://www-935.ibm.com/services/us/index.wss/ibvstudy/gbs/a1031155?cntxt=a1000065 (accessed 20/01/2010)

Kletz, T. A., 2001, *Learning from Accidents*. Gulf Professional Publishing.

Lukic, D., Margaryan, A. & Littlejohn, A., 2010, How organisations learn from safety incidents: a multifaceted problem, *Journal of Workplace Learning*, *22*(7), 428–450.

Loud, J. J., 2004, Corrective action programs. *Professional Safety*, *49*(12), 32.

McElhinney, J., & Heffernan, O., 2003, Using clinical risk management as a means of enhancing patient safety: The Irish experience, *International Journal of Health Care Quality Assurance, 16*(2/3), 90.

Naevestad, T., 2008, Safety cultural preconditions for organizational learning in high-risk organizations, *Journal of Contingencies and Crisis Management*, *16*(3), 154–163.

Naot, Y. B., Lipshitz, R. & Popper, M., 2004, Discerning the quality of organizational learning, *Management Learning*, *35*(4), 451–472.

Nicholls-Nixon, C. L., 1997, Commentary: the importance of know-where and know-when, in Walsh, J. P., Huff, A. S. (Eds), *Advances in Strategic Management*, Vol. 14 pp. 103–9, JAI.

Perkins, D. N., Jay, E. & Tishman, S., 1993, Beyond abilities: A dispositional theory of thinking, *The Merrill-Palmer Quarterly*, *39*, 1–21.

Rose, A., 2004, 'Free lessons' in aviation safety, *Aircraft Engineering and Aerospace Technology, 76*(5), 467–471.

Snowden, D., 2002, Complex acts of knowing: Paradox and descriptive self-awareness, *Journal of Knowledge Management, 6*(2), 100–111.

Spear, J. E., 2002, Incident investigation: A problem-solving process, *Professional Safety, 47*(4), 25.

Stevenson, J. C., 1991, Cognitive structures for the teaching of adaptability in vocational education, in Evans, G. (Ed), *Learning and Teaching Cognitive Skills*, Acer.

Sveen, F., Rich, E. & Jager, M., 2007, Overcoming organizational challenges to secure knowledge management, *Information Systems Frontiers, 9*(5), 481.