Title: More effective incident learning: practical steps

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ABSTRACT

All organisations in the process industries seek the holy grail of truly learning and embedding lessons from incidents. However few, if any, achieve this. Methods of learning lessons tend to be dominated by passive and indirect methods such as presentations, bulletins and posters.

This paper describes a project that arose from a serious incident. The incident was thoroughly investigated, and the immediate and system root causes, lessons-learned and preventative actions were identified. These were communicated via in-depth briefings to the engineers and managers responsible for applying the safety management systems which had failed. In such circumstances there is always a difficulty in learning the generic lessons (which could apply to many operations and types of equipment) and not being distracted by the specifics of the incident (specific type of operation or equipment).

Once the immediate aftermath of the incident had passed, senior managers posed the question “could something like that happen again?”. This is a sensible and responsible question to ask, but a harder one to answer. The approach taken was to simulate “something like that” – namely an incident with similar generic characteristics. A realistic written scenario was devised, containing all of the management decision-making elements of the incident. However, the scenario was carefully disguised by reference to different equipment, operations and geographical location. The scenario was validated and tested with subject-matter experts.

Engineers and managers then completed the written scenario during a facilitated workshop. Many participants had previously attended the in-depth briefings, therefore might have been expected to have “learned the lessons”. Only one person recognised the parallels between the scenario and the incident. Scoring of the scenario revealed many continuing “holes” in organisational barriers, due to either lack of understanding or application of these barriers. Key learning from the recent incident was not consistently applied to the analogous scenario. Discussion of the scenario helped to explain why this was so, and what could be done to remedy the situation. Following the workshops individual participants were interviewed.

Differences in the individual learning impact of the scenario-based workshop and in-depth briefing are fully described in this paper. Since then, other active & direct methods of strengthening and verifying learning from incidents have been used elsewhere in the process industries. This experience and the underlying principles are described. There is believed to significant potential for wider application, and the paper should therefore be of interest to the Hazards Australasia audience.

INTRODUCTION

This paper describes a project that arose from a serious maritime incident. In such circumstances there is always a difficulty in ensuring that generic lessons are learned

(which could apply to many operations and types of equipment) and not being distracted by the specifics of the incident (the specific type of operation or equipment). For example, van Wijk, Taylor and May (2009) reviewed ten major incidents from many industrial sectors, and identified eight common organisational and cultural failings, which were independent of the specific technology or sector.

Once the immediate aftermath of this specific maritime incident had passed, business leaders posed the question "could something ***like*** that happen again?". The approach taken was to simulate "something like that" – namely an incident with similar generic characteristics. It is common to simulate incidents for people directly controlling technical systems (e.g. putting pilots or control room operators in high-fidelity simulators), and to develop incident commanders' emergency response competence (e.g. Flin, 1996).

Research indicates that managerial judgement is not typically learned via formal education. Such learning takes place via direct training and experience "on-the-job". Managerial judgement can be successfully measured via scenarios, and used to select and develop managers and leaders (SHL, 2004). It is arguably uncommon to simulate non-emergency management tasks to aid post-incident learning. It is thought that using a scenario method to verify and strengthen and management judgement and learning from incidents is very unusual, if not unique. It is believed to have more general application.

Since then, other active & direct methods of strengthening and verifying learning from incidents have been used elsewhere in the process industries. This experience and the underlying principles are described.

THE INCIDENT

In 2009 a serious maritime incident occurred, which had significant commercial impact, and had the potential to cause reputational damage to the operating company (see Lardner and Roberston, 2011). Had events unfolded slightly differently, the incident could also have had serious environmental and safety consequences. The exact nature of the incident is confidential, however the specifics are not important for the purposes of this paper.

In the aftermath of the incident, attention was initially focused on the immediate causes of the incident at sea. The incident was thoroughly investigated by the ship operator's full-time Marine Incident Investigation Team. The ship's bridge voice recorder aided identification of technical and "human factors" causes, alongside recordings from navigational data recorders, and witness testimony. Actions of ship personnel were analysed using BP's "Human Factors Analysis Tools", developed by author (Lardner and Scaife, 2006).

In parallel with the offshore phase of the investigation, attention was also directed towards the onshore managerial and organisational pre-cursors of the incident, which concerned (amongst other things) judgements and decisions about the management of modifications to ship's equipment.

Once the incident investigation was completed, the immediate and system root causes, lessons-learned and preventative actions were identified. These were communicated via in-depth post-incident briefings to the engineers and managers responsible for applying

the safety management systems that had failed. Work also began to revise and improve various aspects of the safety management systems.

THE PROJECT REQUIREMENTS

Once the immediate aftermath of the incident had passed, senior managers had asked themselves whether something similar could happen again. This is a sensible and responsible question to ask, but a harder one to answer. It was unlikely that the exact circumstances of the incident would be repeated. The author of this paper was tasked with addressing the question posed by senior managers.

ORGANISATIONAL LEARNING

The safety science literature contains many examples illustrating how different organisations have failed to learn the lessons of previous incidents in their own organisation e.g. Texas City, Longford – see Hopkins, (2008).

Organisational learning can be defined as "a change in the organisation which occurs as a function of experience" (Argote and Todrova, 2007). In their more detailed definition of what organisational learning actually means, the following distinctions are recognised, as summarised in Tables 1 and 2 below.

Change can involve (a) how the organisation and its members think about their world, (b) their knowledge (c) their routines and (d) their performance. Such change can occur at several levels – the individual, group / team, and organisation.

This definition does not adequately capture changes to hardware and software systems and technology which occur as a result of organisational learning from an incident. Such technological changes have the potential to embed learning, and are less reliant on people changing their style of thinking, remembering, or changing their routine behaviour.

Table 1: Types of learning

	Types of change resulting from learning			
Levels of learning	Thinking	Knowledge	Routines	Performance
Individual				
Team				
Organisational				

The type of experience upon which learning is based can be direct (such as personal involvement in an incident), or indirect (such as hearing about an incident which happened to someone else). Direct learning is typically more powerful. However, the way in which indirect learning is managed can improve its impact – see Table 2 below. Passive, indirect learning methods, such as listening to a briefing about an incident that happened to someone else, will have limited impact. If indirect learning is managed to include actively *interpreting* others' experience, and *understanding cause and effect* relationships, this deeper level of mental processing is likely to lead to greater indirect learning.

Table 2: Effect of types of experience and learning method on learning

		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 relevance of types of learning method to improving health and safety outcomes was demonstrated by a long-term programme of research by Burke et al (2011), who examined the effectiveness of different styles and methods of health and safety training. Effectiveness was defined as having three components (1) acquisition of knowledge (2) application on-the-job and (3) effect on negative health and safety outcomes - incident rates. This research concluded that as the method of training becomes more engaging, the effect of the training is greater for knowledge acquisition, safety performance improvements, and the reduction of negative outcomes. The most engaging methods were, on average, approximately two times more effective than the moderately engaging methods, and three times more effective than the least engaging methods, for knowledge acquisition.

PROJECT DESIGN

The project was designed to answer the question “could something similar to the previous maritime incident happen again?”. The focus was on events onshore, which are managed by a group of approx 30 managers and engineers. Specifically, the project was designed to establish

- Had individual learning occurred, leading to changes in individual knowledge, routines and performance?
- Had team and organisational learning occurred, leading to changes in team and organisational knowledge, routines and performance?

As most of these engineers and managers had already received some indirect learning about the incident via a post-incident briefing, it could be argued that they possessed the knowledge to prevent a similar incident occurring. However, this indirect learning was largely passive in nature, so could have had limited impact.

It was decided to simulate an incident with similar generic characteristics to the earlier maritime one. A realistic written scenario was devised, containing all of the key onshore management decision-making elements of the incident. However, the scenario was carefully disguised via reference to different equipment, operations and geographical location.

The scenario consisted of six pages of text. At the top of the first page was a description of a situation, with a number of questions below. The questions prompted the reader to

consider and record what they would do, whom they would consult, and what they would expect to happen. Subsequent pages explained how the situation developed, with more questions and prompts. Embedded within the scenario were twelve key decisions and actions, which were considered critical in the causation of the original maritime incident. Most of these decisions and actions were mandated by compliance with a key risk management procedure. The scenario was constructed so it could be objectively "scored", yielding the number of correct responses. If all responses were correct, this represented successful resolution of the management decisions that contributed to the maritime incident. The scenario was validated and tested with subject-matter experts before use.

PROJECT IMPLEMENTATION

As the project aim was to establish the extent to which individual, team and organisational learning had taken place, considerable care had to be taken to (a) prevent the scenario appearing to be an individual assessment or test, and (b) address any concerns that the results might be used against those who did not perform well. This was achieved by emphasising that the focus was on "organisational capability", not individual competence, and by including an opportunity for participants to comment on whether the organisation was providing the right conditions to support their performance. The individual scenario results were confidential and anonymous, with the results being only available to the first author, and not the employer.

The scenario was deployed via a series of 3-hour "Organisational Capability" workshops, facilitated by the two authors. This combination of facilitators allowed sufficient attention to be paid to technical maritime issues, organisational terminology, group processes, and the recording of responses.

The workshop process included, in the following order:-

- Explanation of reasons for project
- Assurances regarding confidentiality of individual scenario results
- Individual completion of scenario
- Group discussion of scenario
- Explanation of link between scenario, and earlier serious incident
- Self-marking of individual scenarios, which were later independently verified
- Structured consideration of whether participants believed the organisation was providing the right conditions to support their performance
- Effects of recent organisational change.

A total of five workshops were delivered over a five-week period. At the conclusion of each workshop, participants were asked not to disclose the scenario to their colleagues, and it is believed secrecy was successfully maintained.

TEAM & ORGANISATIONAL LEARNINGS

Table 3 below shows on the vertical axis the 23 managers and engineers who participated in the workshops. The horizontal axis refers to the 12 key questions, each of which had a correct answer. A shaded cell indicates a wrong answer – and therefore a potential "hole" in the organisation's safety defences.

Table 3: Grouped scenario responses

	Critical decision												
Person	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total correct**
1													**9**
2													**5**
3													**10**
4													**5**
5													**5**
6													**7**
7													**6**
8													**6**
9													**8**
10													**6**
11													**9**
12													**4**
13													**5**
14													**7**
15													**9**
16													**8**
17													**6**
18													**6**
19													**8**
20													**8**
21													**5**
22													**6**
23													**5**
Total correct	**18**	**22**	**5**	**0**	**18**	**15**	**7**	**13**	**18**	**10**	**9**	**18**	

It can be seen that there are many such holes, and some interesting patterns. Overall, the results do not provide confidence that a similar incident could not happen again. The results also highlight certain areas (e.g. columns 3, 4 and 7) which need particular attention to improve knowledge and application of the existing safety management system.

Group discussion of the scenario revealed many of the underlying reasons why the "holes" remained. Interestingly, only one of the workshop participants recognised the parallels between the scenario and the original incident.

Looking at the rows, each of which represents an individual, it is evident there is a wide range of correct answers, ranging from 4 to 10 out of a possible 12. It would be interesting to know what the impact of participating in an active yet indirect method of learning about an incident was, and whether this added value to the previous largely passive, indirect post-incident briefing.

INDIVIDUAL LEARNINGS

Whilst the results in Table 3 are helpful in answering the original question "could something like that happen again?" they do not explain whether more active and direct learning via the scenario method added any value to the more traditional, passive post-incident briefing which had taken place. It might be expected that the active nature of scenario completion, coupled with realisation that it contained generic features of the

previous incident, and individual self-scored feedback on performance would lead to increased learning.

Approximately four weeks after the completion of the workshops, each workshop delegate was invited to complete an online survey to evaluate the impact of the scenario, and view the grouped results (Table 3). During the online survey, Table 3 was displayed, which had not been seen before. Survey questions and responses are shown below.

Table 4: Results of online evaluation survey

Survey Question	Responses and comments
Please tell me what you thought about the scenario method, as a way of gauging how well individuals and the BP Shipping organisation have learned from a serious incident? For example, what did you like or dislike, and how might the method be improved?	**95% positive, liked** **5% negative, disliked** Positive comments included “invokes thought processes”; “realistic”; “good way to gauge reactions”; “good team discussion and reminder”; “useful way to gauge thoughts and decisions”; “novel and effective”; “better way to discuss incident”; “explore ideas”; “new approach”; “drove the right thinking”.
Please briefly describe anything new that you learned or realised as a result of completing and discussing the scenario?	**93%** described new learning, the nature of which varied greatly. The most common learning was re-emphasising the importance of ensuring compliance with critical procedures, and the value of team decision-making & peer review.
Has completing the scenario, and discussing it with your peers, affected how you would approach a similar situation in the future?	**61% yes** **39% no** Those who had changed their approach described a more cautious, conservative style of decision-making, with greater consultation with peers and managers, and greater rigour in using existing management processes. It is possible that those who have not changed their approach are those who scored better on the scenario, and therefore have less need to modify their approach. This is not possible to determine due to the anonymity of responses.
The grouped results (Table 3) were shown, which had not been seen before by survey respondents. They were each asked for their reaction to the pattern of results.	Reactions included discomfort, concern and disappointment. A few were not surprised. Common trends were very evident. Inconsistency was noted. The need for improvement was obvious.

Do these grouped results supplement what you learned from participating in the workshop?	**85% Yes** **15% No**
BP, like many other companies, is keen to truly "learn from incidents" - but this is often difficult to achieve in practice. Do you think the use of similar scenarios offer any additional benefits to more traditional ways of learning from incidents, such as "post-incident briefings"?	**78% Yes** **12% No** Comments mentioned the value of group discussion, the interactive nature of the scenario exercise, which helped to see patterns of error. It was suggested scenarios could be used annually to see if key learning had been embedded. It was thought important to carefully select suitable incidents with a clear cause.

These results indicate that the scenario was very well received, and led to new learning for the majority of participants. Nearly two-thirds reported having changed the way they would approach such a situation in the future. For the majority, getting additional feedback about the collated pattern of team results (Table 3) supplemented other information learned during the workshop. The majority recognised the added benefits of the active and direct scenario method of learning.

DISCUSSION & IMPLICATIONS FOR CURRENT PRACTICE

This project demonstrated the feasibility of constructing a simulated incident scenario, with the same generic features as real incident. The scenario was successfully used to determine the extent to which individual and team /organisational learning had occurred via post-incident briefings, a relatively indirect and passive type of learning. Using the more active scenario method, coupled with group discussion and individual and group feedback on performance, led to new knowledge and a changed approach towards situations with similar features.

It is thought that this method of strengthening and verifying learning from incidents is very unusual, and has the potential for more general application. For example, scenarios could be used for

- Communicating the results of incidents in a more active and direct fashion, leading to greater learning and behaviour change
- Strengthening learning from incidents when hardware or software fixes are not possible, and changes in thinking style, knowledge and routine behaviour must be relied upon.
- Testing whether generic lessons have been successfully generalised to other situations
- Assessing and developing the knowledge and judgement necessary to successfully manage safety.

More generally, a move towards the use of more active and direct methods of learning is likely to lead to better knowledge acquisition, application on-the-job, and improved health and safety outcomes.

PRACTICAL APPLICATION – FOUR EXAMPLES

EXAMPLE 1 – Designing an isolations HSE campaign

In an Australian oil and gas company, there was a desire to design a more effective HSE communication campaign about the importance of energy isolation during a forthcoming commissioning project. The intent was to apply the effective learning principles described, resulting in a more active and direct learning experience, which would be more effective than the traditional passive slide pack presentation. Eight of the organisation's previous isolation incidents were reviewed. The key lessons were identified, including the errors made during design of the isolation, implementing the isolation and removing the isolation as well as factors that shaped people's performance and contributed to the errors. Some of the common performance shaping factors included ambiguity in communications, time pressure, and lack of independent checks. A realistic written scenario was developed based on the common characteristics of those previous incidents. The scenario involved the repair a high pressure pump, which included executing the required isolations to complete the repair.

The scenario had six pages of written text. The first page introduced the scenario and key players. Subsequent pages provided further information, where the situation progressively developed. Each page was written such that participants would adopt the role of one of the key players in the scenario. At the bottom of each page, questions were posed for participants and probed what they would think and do at each stage of the situation. The final page of the scenario also asked what behaviours would have prevented the potential loss of containment event described.

The scenario was validated and tested with subject-matter experts. This validation was conducted in two stages. First, subject matter experts were consulted to review the draft materials. Changes were made based on their feedback, namely amendments to match terminology used in the permit to work system. Second, the scenario was conducted with another group of subject matter experts. Based on feedback from this session minor changes were incorporated into the final scenario.

Given the intent to design an interactive and engaging learning experience, a workshop was also developed. The workshop was one and a half hours long and included the following elements.

- Explanation of reasons for the workshop and for focus on isolations.
- Completion of the scenario in pairs.
- Group discussion of answers to the scenario, illustrating potential "holes" in organisational barriers if understanding or application of these barriers was lacking.
- Quiz on human error to reinforce key lessons emerging from the scenario about how and why isolation errors occur.
- Discussion on implications of the workshop.
- Evaluation of the workshop and scenario as a method of learning from incidents.

The full facilitated workshop was then trialed with a range of personnel from different business areas and minor updates made based on feedback. Finally, detailed notes

were developed for facilitators on how to conduct the workshop. A facilitator version of the scenario was developed which included answers to each page of the scenario.

The workshop, known as the “Isolations Campaign” was first facilitated for the health and safety management team by the author of this paper. This enabled the managers to experience the workshop first hand, understand the materials, and determine the target audience in their respective areas. The expected target audience for the campaign was production technicians, managers and supervisors, and anyone else involved in the design, implementation, and removal of isolations.

The health and safety managers subsequently conducted workshops for teams in their areas. In larger areas, facilitators were selected to conduct the workshops and training provided to them by the organisation’s human factors advisers. The workshops were run with 6-12 participants and included a mix of managers, supervisors and people who were not in leadership roles. This mix helped people at all levels see how errors can be made and how leaders can contribute to conditions that influence the likelihood of errors.

Once the Isolations Campaign was completed for people involved in upcoming commissioning projects, information about the scenario and workshop was uploaded onto the health and safety intranet for use by other groups as appropriate.

On conclusion of the workshop, facilitators asked groups three questions to help evaluate the method. Answers to these questions and additional comments were sent back to the company’s senior human factors adviser for collation.

1. Does this method of learning from incidents offer any additional benefits to more traditional methods (e.g. events bulletin, slide presentation)?
2. Did you learn or realise anything new, which you can use to play your part in improving the reliability of isolations?
3. Do you support using this approach in your part of the business?

The response to the first evaluation question was unanimous. Participants indicated this approach to learning was a far more interesting and engaging method of learning from incidents than more passive methods of emails, bulletins, and presentations. Comments mentioned the interactive nature of the scenario exercise, sharing examples and experience helps learning, the value of group discussion, better than the noise of emailed notices, you have to engage and think about the issues involved.

In terms of the second evaluation question, for some participants the materials reinforced existing knowledge while for others new information was learned. The most common learning was re-emphasising the increased likelihood of error under certain circumstances such as time pressure, and the importance of independent checks and peer review

All participants supported using this approach in their part of the business. The Isolations Campaign was used more widely than the target group. For example, teams in the company’s development division used the workshops to educate people on human error and performance shaping factors.

EXAMPLE 2 – Designing a working at heights HSE campaign

In the same Australian oil and gas company, a series of working at heights incidents and near-misses were analysed, to extract learnings. The learnings were then presented to a group of operating company and contractor working at height specialists, who were tasked with designing an educational campaign using active and direct learning principles. This took the form of a series of DVD re-enactments, where the audience had to anticipate what happened next, and interviews with the people involved in the incidents. Again the audience much preferred the active and direct learning methods.

EXAMPLE 3 – Teaching operational personnel about human error

The author was asked to develop and present a 1-day course about human factors in process safety. The course venue was adjacent to a simulated process plant used for training purposes. To make the 1-day human factors course more active and direct, several exercises were held on the process plant. One exercise was designed to demonstrate how, under the wrong conditions, even the most competent and experienced person can make an error. Two course delegates volunteered to help with a seemingly innocuous task on the process plant. Both were acknowledged experts in control of work systems. Using a combination of ambiguous instructions, misleading cues and time pressure, they both were induced to start work on the wrong (live) piece of equipment. This provided a much more powerful learning experience than simply asserting that competent people make mistakes.

EXAMPLE 4 – Encouraging the use of active and direct learning methods

The author has used Table 2 to (a) explain the different types of learning methods (b) ask the audience which combination is the predominant method used to “learn lessons” in their company – the answer is typically passive / indirect, then (c) challenge the audience to think how this learning could be made more effective by using a more active / direct approach.

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