Open Research Online

SPE-190527-MS

How do you know if you're learning from incidents?

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Abstract

Objectives/Scope: Despite the importance of learning from incidents, little is known about the indicators that signal whether people have actually learnt. Previous research has shown that learning is dependent on context; a software engineer and an operator at a petrochemical plant display learning in different ways, so the indicators of whether or not they have learnt will differ. Therefore it is important that energy organisations are able to recognise indicators of learning following an incident that are relevant to their context. The objective of this study is to explore ways of understanding whether individuals are learning from incidents, and provide a general model that companies can use as a starting point in evaluating learning.

Methods, procedure, process: The Open University, in collaboration with the Energy Institute, undertook interviews with 18 workers at a European site of a multinational energy company. The participants came from a variety of positions in both operations and maintenance, ranging from front-end operators to managers. A model of professional learning was used to guide a thematic analysis of what participants viewed as effective learning from incidents.

Results, observations, conclusions: The interviews provided many examples of ways that individual practice and site processes had changed as a result of learning from incidents. Indicators of learning ranged from individual traits, such as accurate perception of risks, to changes in leadership priorities. While the number of incidents has been used in both research and practice as an indicator of learning, the interviews demonstrated that there are many ways in which learning can be evidenced. Understanding what changes are important for individuals, teams, leadership, and the company as a whole is a first step to being able to assess if effective learning is taking place. Our preliminary findings indicate that there is no single measure that can be used to assess how well people learn. However, once a company has defined what changes it expects to see, a combination of measures could be created to give insight into how effectively learning is happening.

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[1] The views and opinions expressed in this document are those of the individual authors and do not necessarily reflect the policies or positions of their employer.

Novel/ additive information: This paper aims to provide some examples of indicators of learning after an incident. Both in research and in practice a single metric is often used to assess whether learning is occurring. This study proposes a model that would allow companies to select appropriate metrics for various aspects of learning from incidents.

Introduction

In professional learning settings, like the energy sector, it is often difficult to determine whether and how employees learn from incidents. Skills and knowledge are more often acquired through performance of every-day tasks than via formal training in professional settings (Tynjälä, 2008), making holistic evaluation of an individual's learning difficult. Understanding when learning is happening, nonetheless, is vital for both individuals, teams and organisations, particularly following a large scale accident. Learning from incidents, i.e., near-misses and accidents, is essential for energy companies to prevent future accidents, and usually achieved through a process of investigation and distribution of insights (Littlejohn, Margaryan, Vojt, & Lukic, 2017). However, understanding whether this process is prompting effective learning is not as simple as observing a reduction in the number of incidents experienced by a company.

Edmondson (2004) discovered in research in the healthcare sector that groups that had good teamwork often reported more incidents than those less able to work together effectively. She theorised that this was due to employees feeling more comfortable reporting incidents, a proposition that was later empirically tested and supported (Leroy et al., 2012). For this reason it is often difficult to judge whether learning is happening from the number of reports that are submitted alone. Reason (1998) discussed the difficulties in equating a lack of events to a safe organisation, instead promoting an 'informed culture', i.e., one where an organisation regularly analyses data on incidents, but also regularly checks factors related to workers, the work environment, and technical requirements. This resonates well with the 3-P model of workplace learning proposed by Tynjälä (2013), which suggests that there are three main elements of learning in workplaces: presage (i.e., learner factors and learning context), process (i.e., learning activities), and products (i.e., learning outcomes). For example, in the context of learning from incidents in an energy company this could be worker perception of risk (a learner presage), meetings that effectively evaluate the likelihood of an incident occurring (a learning process), or a change in official procedure (a learning product).

While Tynjälä's (2013) model fits well with Reason's (1998) notions of 'informed culture' it remains a very general conceptual tool. With regards to safety, context is key (Perin, 1995), and what presage, process, and product entails in an energy company when learning from incidents has not yet been explored by research. If energy companies are going to be empowered to evaluate learning from incidents as more than just an absence of incident reports, it must first be established what that concretely means in a particular organisation's context.

This paper describes a study to explore what workers perceived as effective learning from incidents. Tynjälä's (2013) 3-P model of workplace learning was used to organise the responses and thoughts of participants on the subject.

The 3-P model of workplace learning

Tynjälä's (2013) 3-P model of workplace learning is a modification of the 3-P model proposed by Biggs (1993). Biggs' (1994) model was designed to conceptualise learning in a classroom environment, by considering the learner context, the learner factors, the learning process, the learning products, and how they interact with each other. Biggs' (1993) model was created for a classroom, a different environment to most workplaces, but included a holistic view of interacting parts that Tynjälä (2013) modified to represent the complexity of workplace learning.

The first P of the model is presage. In Tynjälä (2013)'s modified model this consisted of two parts: learner factors and learning context. Learner factors is concerned with elements such as motivation and prior knowledge. In terms of learning from incidents in an energy company this would include aspects such as the knowledge needed for an operator to perform their job, a worker's attitudes towards safety, or skills possessed by workers. In short, learner factors are attributes and characteristics of a worker that they possess before receiving information on an incident. Learning context, on the other hand, concerns the type of environment in which a worker learns. This would, for example, include the organisational

structure, interactions with management, the safety culture of an organisation, technology used for work, or connections to other groups such as professional bodies. The learning context, therefore, deals with the situation in which learning is taking place.

The second P in the model is process. In Biggs' (1993) original model, this was the specific activities that teachers undertook to guide learning, for example, lecturing or assigning a group project. In the workplace Tynjälä (2013) suggests that there are many different activities that guide learning, including learning by doing a particular task. The process of learning from incidents in general has been mapped out by previous research (Drupsteen, Groeneweg, & Zwetsloot, 2013; Littlejohn, Margaryan, & King, 2014), and includes some combination of seven stages: reporting, investigating, creating incident alerts, communicating, reflecting, implementing actions, and evaluating changes. Each of these stages in real work places will involve a variety of both formal and informal learning activities. For example, reporting could involve filling in a formal report, where completing the different boxes can be considered a way of reflecting on what happened, or informal conversations with co-workers.

The final P in the 3-P model of workplace learning is product. In this case product means tangible results from learning. In a school environment this could be a student acquiring new knowledge, a product that is also appropriate in a workplace. Learning from incidents in an energy company could also have other concrete changes, such as updates to hardware or procedures. Importantly learning products do not have to be limited to changes in individuals. The day-to-day tasks of front-line workers may not have changed, but if a company has introduced a new piece of hardware, for example, that will prevent future accidents, then this is also a learning product.

The interaction between the three Ps is also a key part of Tynjälä's (2013) model. The learning activities, such as safety meetings or formal trainings, will of course be influenced by elements of the learning context, such as management. The personal experiences and attitudes of a worker, i.e., learner factors, will influence how they interpret company procedures and the purpose of the learning from incidents process. While each P has a distinct definition, there is in reality an overlap between them.

Method

The study took place at a European site of a multinational energy company. The site employed around 200 workers. We purposefully sampled workers based on their position within the company. In order to obtain a broad variety of views participants were invited from two production operations teams (n = 6), the production management team (n = 6), maintenance engineers (n = 2), and the maintenance management team (n = 4). The final selection of interview participants depended on the availability of workers during the visit of the researcher to the site, with thirteen of the interviews taking place in person. Seven additional workers were invited to online interviews due to the key role their position played in the learning from incidents process, for example a team supervisor. Of the seven invited five additional participants accepted invitations and were interviewed online. All participants were male.

Each interview lasted between 26 and 56 minutes. The interviews were conducted as semi-structured interviews, i.e., a predefined question was asked, and then followed by prompts to get more details depending on the answer of the participant. Participants were asked to describe specific examples of times that they had learnt from information about an incident. Participants were asked to detail specific changes that had resulted from reading or interacting with incident information. Other questions explored what participants perceived as the purpose of the learning from incidents process, and how their organisation could tell if either an individual or the organisation as a whole had learnt.

Interviews were recorded using an audio recorder and later digitally transcribed using Express Scribe. Interview transcripts were anonymised and then imported into Nvivo version 10 for analysis. Thematic analysis was conducted in-line with the procedure outlined by Braun and Clarke (2006). One of the researchers initially familiarised herself with the data through transcription and re-reading all the interview transcripts. An initial set of codes was then created, which were then grouped into themes. The themes produced focused on any indicator of learning mentioned that could be considered either presage,

process, or product. Themes were then defined and compared to relevant sections of the text. An iterative cycle was then undertaken comparing the themes to the data, and then updating the themes until they were clearly defined.

Ethical approval was obtained for the study from The Open University's Human Research Ethics Committee prior to data collection. The aims of the study were explained to participants before conducting the interview. Consent was collected from each participant prior to answering interview questions.

Findings

Tynjälä's (2013) 3-P model of workplace learning was used to analyse the interview data. The following sections detail general themes that emerged from the interviews for each section of the model.

Presage

Presage can be described in a workplace setting as consisting of two components: learner factors and learning context. Participants described several learner factors they expected to develop through the company's learning from incidents process. Worker knowledge, for example, was flagged as important by several participants. One participant even described a situation where formal job roles had needed to change. In his example, an incident that had resulted in a flash fire due to its oxygen system at a different company was used to identify a need for more in-company knowledge on oxygen systems. The participant was subsequently trained to ensure that he could act as an expert on oxygen systems. This change ensured that a worker possessed the right knowledge to carry out a specific procedure securely. In this case, incident information prompted the company to identify knowledge that was not already available in-house. The need for this knowledge altered the responsibilities of some job roles. Another common example of knowledge development was an assessment of the relevance of potential risks identified in an incident alert to your own teams' work. One manager mentioned that when he received information on incidents he looked a direct link to potential risks and his team's work, as this was a good opportunity to learn.

Closely connected to knowledge development, several operators also mentioned that incident information reminded them of the need to manage significant risks in certain elements of their work. One participant described, when asked why information on incidents was useful, the way that risks can fade into the background after a while. Even with sufficient barriers and training workers are exposed to controlled risks every day, and the participant appreciated receiving incident alerts to remind him not to become complacent.

This was described by some participants as 'a consistent chronic unease'. As this chronic unease is manifested internally, it could be difficult for companies to assess as a measure of learning. However, some concrete behaviours were described by participants that would come as a result of this attitude, such as voicing concerns about unsafe situations, changing not only the ways that work is conducted but the way information is shared. One manager described this attitude as being displayed in the way that a worker conducts his tasks. For example, ensuring that their work area was well organised.

A number of the learner factors described by participants were not factors that would necessarily change day-to-day work practices. Nevertheless, knowledge, awareness, and attitude are qualities that individuals need to have if learning from incidents is to be successful, and should be shaped by the learning from incidents process.

The second aspect of presage is learning context. This factor is concerned with elements such as the organisation of the company, how teams work together, leadership support, and so on (Tynjälä, 2013). One specific example raised by participants was the willingness of an operator to go to their supervisor when he or she had some concerns. One manager said that he wanted his team to feel comfortable reporting even minor observations. Discussion about incidents appeared to be an important part of the incident reporting process, as operators frequently discussed with each other or their supervisor whether a potential issue needed to be reported. The importance of good communication was not just in the initial reporting within the team, however. One operator described how a weekly report was compiled and read to the team

by the team leader. This report became the start of a discussion about what incidents applied to the team and what their learning opportunities were.

Being able to communicate effectively was also important for learning in the management team. Participants with a management role reinforced the operators' views that the willingness of operators to raise an incident was critical for learning from incidents. Management also signalled that good communication was vital for gathering information and spreading awareness of incidents. One manager described a mutual process where he often talked to industrial working groups he was involved in about incidents. They would exchange information about incidents in the industry that they had heard about, and might be relevant to each other. Two aspects of communication were flagged as particularly important: being able to freely discuss issues, and knowing where to find information.

Besides communication, the learning context element that was most frequently articulated was the role of leadership. Two specific points on leadership were raised by participants with managerial roles: deciding priorities and obtaining buy-in from others. In large companies a lot of information is shared about incidents of all sizes, including incidents from other companies. Nonetheless, time is often limited and leaders need to be able to effectively identify what incidents are most relevant to their teams. One manager described the benefits of a group approach, where opinions could be exchanged and the relevance of an incident to a particular job could be debated.

Linked closely to this is the need for leaders to obtain buy-in from the workers in their organisation. If the management team make decisions that are not sufficiently communicated to and informed by the front-line staff then there is the risk of, as a manager, described, that workers don't understand the need for a rule and see it as a burden. This idea was again echoed by a front-line worker when he described how procedural changes sometimes needed to be modified to become more practical. One manager emphasised that continual communication between front-line operators and management was necessary to avoid unintended consequences from new rules, stating that risk minimisation was achieved through open discussion on feedback collected from front-line workers. Communication between and within different groups is key to creating a conducive learning context. It is also an essential part of the learning process.

Process

The LFI process has been well-defined through previous research (Drupsteen et al., 2013). Littlejohn et al.'s (2017) LFI process model indicates six discreet phases: reporting an incident, investigating, creating incident alerts, disseminating incident information, considering how the information relates to different work practices, and implementing changes. Drupsteen et al. (2013) also identify a potential seventh step of evaluating the changes implemented. This seventh step was identified as important by participants. One manager described that in his experience evaluation and readjustments were often necessary after implementing changes following an incident, to understand if they achieved what they were designed to do.

Data on LFI can be aggregated and analysed to identify trends, however few organisation have implemented this approach to incident analysis into the LFI process (Jacobsson, Ek, & Akselsson, 2011, 2012). The purpose of this trend analysis was highlighted by two participants. One manager described how aggregated data of incidents had potential to discover patterns, but also discussed how constant measuring of process measures could highlight deviations away from the norm, which had been associated with incidents.

Previous studies have shown limited use of aggregated data, and inconsistencies in implementing recommended actions (Lundberg, Rollenhagen, & Hollnagel, 2010; Lundberg, Rollenhagen, Hollnagel, & Rankin, 2012; Stackhouse & Stewart, 2016). Key to ensuring that these steps are actually carried out are detailing these phases of the LFI process in documentation, including clear indication of responsibility (Drupsteen et al., 2013; Lundberg, Rollenhagen, & Hollnagel, 2009).

Product

The most common product as a result of learning from incidents mentioned by participants was the number of incidents experienced by the company. When asked what the purpose of learning from incidents was all respondents gave answered to prevent accidents from happening again. While a reduction in the overall number of incidents was seen as an indicator of learning, participants were more concerned about not having incidents repeated. One manager also noted that the severity of consequences from incidents should be reduced. As mentioned in the introduction to this article, the number of accidents taken on its own is difficult to use as a standalone measure of learning, due to its interdependence on cultural factors (Edmondson, 2004). However, analysis of incidents can provide important feedback on how well lessons are being embedded into an organisation. Rather than focusing on the absolute number of incidents, more emphasis should be placed on whether the incident had been caused by a known issue, and whether the severity of incident consequences has been reduced.

Besides the number and type of incidents, interview participants also gave many examples of changes in procedures and processes that can be considered concrete outcomes of learning from incidents. For example, one operator described an update to the procedure for managing change, where increased documentation when making changes in design lead to a more thorough review process. Other changes mentioned included increased documentation and record keeping. Record keeping in particular was described as having two purposes: better understanding sequences of events when something goes wrong, and enhancing knowledge transfer between shifts or teams. However, one participant commented that the documentation can become very time consuming, and cause people to focus on small details rather than seeing the bigger picture.

While the increased documentation was generally seen by participants as a good product that comes from learning from incidents, there also runs a danger that the increased administration becomes time consuming. While it is important to change procedures, it is equally important to ensure that the changes are evaluated against what they were supposed to achieve and their costs.

Conclusion

The interviews presented here help to demonstrate how learning from incidents can be evaluated against several criteria besides the number of incidents recorded. Tynjälä's (2013) 3-P model of workplace learning forms a useful starting point for companies to begin thinking about what might be considered indicators of either the presage, process, or products of learning from incidents.

In terms of presage the participants gave many examples of developing worker knowledge, skills, and awareness that would fit into the learner factors aspect of the 3-P model. For the learning context most examples revolved around communication and leadership. Practically developing measures of presage can be difficult, as many of the indicators discussed in the interviews were not necessarily observable in daily work practices. However, a combination of proxies for these qualities could be helpful for companies to gain a feel for how well their workers are doing in this regard. For example, the amount of time workers spend in formal training and drills, the amount of experience workers have with a variety of risks, the number of workers without adequate protective equipment in the field, or even occasional short tests in safety meetings on the most important aspects of workplace hazards.

Process is one of the best researched areas of learning from incidents, with at least one research backed questionnaire available to assess areas of weakness (Littlejohn et al., 2017). However, one of the most important areas that is often overlooked is the implementation of actions (Stackhouse & Stewart, 2016). Lundberg et al. (2010) documented in his interviews with accident investigators that the actions recommended for implementation are often influenced by many factors, such as what is technically possible. Ensuring that the recommendations that come from incidents address the underlying causes, as opposed to technical issues that can be resolved relatively easily, is difficult. Aggregating incident data to search for common causes is on tool that can aid this.

Products of learning from incidents lend themselves to assessments of how well a company is learning as they are usually practically easy to measure. However, any concrete change that is used to demonstrate a learning product must be placed in context. The number of incidents needs to be accompanied by the number of incidents caused by known issues, and the severity of consequences before it can become meaningful. Procedure or hardware changes again must be evaluated before they can justifiably be called evidence of learning. Products in context can give meaningful insight into how well a company is learning from incidents, but can easily be misrepresented if the context is missing.

To understand if learning is occurring after an incident companies must select several indicators from the presage, process, and products that can be used as evidence. It is not possible for a single metric to represent every aspect that must be present for individuals, teams, and organisations to be learning effectively.

Limitations
The interviews conducted here took place on one site of a large company. Future research would preferably conduct more interviews across multiple companies in a larger variety of positions, for example including upper management. The work presented here demonstrates that learning from incidents fits well with Tynjälä's (2013) 3-P model of workplace learning. However, for a usable guide for companies more research must be conducted in a wider variety of environments to understand how universal the findings are in the energy sector.

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