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Method for evaluating learning from incidents using the idea of "level of learning"

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ABSTRACT

Learning from incidents is considered a very important source for learning and improving safety in the process industries. However, the effectiveness of learning from reported incidents can often be questioned. Therefore, there is a need to be able to evaluate the effectiveness of learning from incidents, and for that purpose we need methods and tools. In this paper, a method is described for evaluating the effectiveness of learning, based on the idea of "level of learning" of the lessons learned. The level of learning is expressed in terms of how broadly the lesson learned is applied geographically, how much organizational learning is involved and how long-lasting the effect of learning is. In the 6-step method, the incidents reported in a typical incident learning system are evaluated both for the actual and the potential level of learning in a semi-quantitative way with different tools. The method was applied in six process industries on a large number of incidents. The method was found to be very useful and to give insights of aspects that influence the learning from incidents.

1. Introduction

1.1. Background

Incidents are defined in this paper as "deviating events which differ from normal conditions and which could have adverse effects on safety, health or environment" (OECD, 2008).

With learning from incidents we here mean the capability of an organization to extract experiences from incidents that happen in the organization and convert them into measures and activities which will help in avoiding future incidents and in improving safety overall. There is currently a great deal of interest in using incidents for learning in many sectors, such as the aviation industry, medical care and the process industry. One would obviously like the process of learning from incidents to be as effective as possible and to yield end products which are effective in preventing further incidents. However, the effectiveness of learning from incidents can often be questioned. In many cases the learning process stops at the reporting step. The analysis of the incident reports and the following implementation of appropriate measures and improvements are often ineffective and the full lessons are therefore seldom learned. Accident investigations often stop at the events close to the accident, which usually concern only the behavior of the hardware and of the operators/workforce directly concerned with carrying out the activity (Hale, 2008). The goal should be to achieve organizational learning, both single-loop and double-loop learning (Argyris & Schön, 1996). Incident analyses need to be so deep that latent conditions (Reason, 1997) and situational factors that triggered the incident are revealed.

Major accidents sometimes occur in high-risk process industries. They are normally dealt within thorough accident investigations including real root cause analysis, resulting in far-reaching actions to avoid a recurrence of the event. However, such major events are very rare, which means there is only seldom an opportunity to learn. However, often there are numerous events with minor consequences or no consequences at all, which, if analyzed properly, could reveal weaknesses in the organization or the equipment and processes, the same weaknesses that, under other circumstances, could lead to a serious accident. These are the events that the process industry must use and learn from to avoid both minor incidents and major accidents. There is also a high potential in the process industry for traditional occupational health accidents/incidents that could have serious consequences for individual employees.

The reporting and further handling of deviations from normal operation has been a standard procedure in the process industries for many decades. Numerous administrative systems are in use for reporting and dealing with incidents, many of them on a commercial basis. Nowadays, most of these systems are computer-based, and can be used to track incidents from reporting to final closure of the case, and for various analyses, including statistical analyses on aggregated events.

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Related to the efforts of reporting and learning from incidents, is the issue of evaluating the effectiveness of such efforts. In an ongoing research project 'Learning from incidents for improving safety within dangerous operations', funded by the Swedish Civil Contingencies Agency, the aim is to develop tools for evaluating the effectiveness of learning from incident learning systems. In these evaluations the term incident learning system includes all activities, from reporting an incident, to implementation and follow-up of measures designed to prevent such incidents in the future. In the research project several ways to approach the issue of the effectiveness of learning from incidents are used. One approach is to focus on the measures that are taken as a result of the incident – the lessons learned, asking e.g.

- What are the measures actually implemented?
- What measures could be taken if the organization would use the full potential for learning?
- How does the actual learning compare with the potential learning?

In this paper we will focus on the above bullets, i.e. the product of the learning – the lesson learned. The paper presents the development of a method for evaluation of the lessons learned expressed in "level of learning". If such levels of learning can be evaluated and possible weaknesses can be identified, the organization can direct its efforts to those areas in need of improvement. Furthermore, it would be valuable to obtain measures of the learning that could be used in work directed at finding possible correlations between the learning from incidents and other safety issues, such as for instance results from safety audits and safety climate evaluations.

1.2. The aim of this paper

Good organizational learning is not always easy to achieve, and it is therefore vital to know how effective the learning from incidents is in an organization. The aim of this paper is to present a method for the evaluation of the effectiveness of learning from incidents in an organization, based on the idea of level of learning.

1.2.1. Study objectives

The objectives of the work presented in this paper were:

- To develop a method for the evaluation of the effectiveness of learning from incidents in the process industry, based on an evaluation of the level of learning.
- To test the method by applying it in six organizations in the Swedish process industry for the evaluation of actual learning compared with potential learning.

The intention is that the method should be used primarily by companies in a self-assessment to find opportunities for improvement in the learning from incidents. It is also the intention that the method could be used in research work aimed at finding correlations between learning from incidents and other safety parameters.

The collection of data in the six process industry companies could also be a first step in establishing reference data concerning levels of learning in the Swedish process industry.

1.3. Theoretical foundations

The theoretical foundations of the method developed and used in this study are described below.

1.3.1. Organizational learning

Most learning starts as *individual learning* before it can become *organizational learning*. In the development of the method the primary interest is in organizational learning. Learning from incidents means gathering information from the individual(s) involved in an incident and from the incident itself, and converting it into general knowledge for the whole organization, or at least for those people for whom the knowledge is important. Argyris and Schön (1996) talk about learning as both a *product* and a *process*. Here, the focus is on treating learning from incidents mainly as a product.

Organizational learning regarding safety normally takes place via many activities and instruments. Besides incident learning, these include safety audits, training, safety rounds, safety committees, risk analysis, inspections, and behavior-based-safety activities.

Organizational learning can be any type of learning where the organization increases its ability to perform its activities better, which in this context means performing them safely or at least safer. The organizational learning can include technical matters (e.g. exchanging a piece of equipment to another of better material), procedural matters (e.g. modifying an operating instruction), and personnel matters (e.g. increase the competence of operators through more training).

Classical terms used to describe the actual learning process are *single-loop* and *double-loop learning* (Argyris & Schön, 1996). In the definition of double-loop learning there is a requirement that the organization changes its guiding principles and/or values regarding how an industrial activity should be performed, e.g. as a result of an incident. Our interpretation of this definition is that this means change of fundamental and profound guiding principles and values. From this follows that the vast majority of incidents reported in the normal broad range incident learning systems of process industries will only have a potential for single-loop learning and that only very few will lend themselves to true double-loop learning.

1.3.2. Accident model

For the purpose of this work, the view of the traditional sequential accident model was chosen. Although regarded in the scientific community as somewhat old-fashioned, this accident model appeared to be the most practical, considering the material obtained from the field objects of this study. The sequential model talks about *causes* and *effects* (*consequences*) and *barriers*. Normally, there are a number of barriers that should stop an initiating event from developing into a serious accident. However, there are sometimes defects in these barriers, and if all the barriers have defects or weaknesses at the same time, the initiating event can propagate through the barriers and result in a major accident – as illustrated in the Swiss Cheese model by Reason (1997). We consider that in the current context accident models could also be used as incident models. Koornneef (2000) also found that the adoption of a causal model was the most feasible in settings similar to those in this study.

Apart from the *direct cause(s)*, there are normally additional aspects in every incident that influence the probability of the event happening and the course it takes. The term causes thus embraces both the *direct* causes, which trigger the event, and *underlying causes*. Typical examples of direct causes are an error by an operator or failure of a piece of equipment, while underlying causes may be inadequate training, which leads to mistakes, or inadequate maintenance, which leads to equipment failure. The *root cause* is defined by Hollnagel (2004) as "the combinations of conditions and factors that underlie accidents or incidents, or even as the absolute beginning of the causal chain", and by Kjellén (2000) as "most basic cause of an accident/incident, i.e. a lack of adequate management control resulting in deviations and contributing factors", which are both similar to underlying causes or the most deeply lying underlying cause.