



## The roles of incident investigations in learning processes at a Scandinavian refinery



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### ARTICLE INFO

#### Article history:

Received 11 June 2014

Received in revised form

26 September 2014

Accepted 26 September 2014

Available online 28 September 2014

#### Keywords:

Learning

Accident

Incident

Investigations

Refinery

### ABSTRACT

This paper examines how investigations played a part in ongoing learning processes at a Scandinavian refinery. Data regarding the roles of investigations was collected during six months of observations at the refinery and interviews with 70 employees. We focus on two investigated incidents, the rupture of a blowdown pipe from a steam drum and an incident that could have led to the injury of mooring operators during the mooring of an oil tanker. We found that investigations were used as part of efforts to learn from incidents at the refinery, but by far from all the interviewed employees. Investigations were described as having several roles. They generated new knowledge about the causes of incidents and confirmed existing knowledge regarding the dangers of corrosion for plant integrity and the importance of following mooring procedures. However, they also suggested measures that were not considered economically feasible or well suited for the refinery. In addition, investigations contributed to learning regarding issues that were not addressed directly in suggested measures, because findings were also applicable to other safety issues at the refinery. In light of these roles, we suggest that investigation groups should ensure closer cooperation with investigated units when developing measures, and work to ensure that investigation reports are used systematically as a learning tool among employees. This may increase the integration of investigation findings in important safety improvement initiatives and thereby the potential for learning from incidents.

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### 1. Introduction

Investigations are a commonly used tool in the petroleum processing industry following incidents such as accidents and near misses. The aim is to reveal causal factors, identify measures that can prevent reoccurrence, and improve safety performance (Kjellén, 2000; Ramanujam and Goodman, 2011). When investigations are completed and facts are known, there is an expectation that organizations will take action to remedy identified weaknesses. The desired end result is often described as organizational learning (Lindberg et al., 2010). This is natural because investigations are formalized, structured and lengthy processes that delve deeply into incidents and their context. Though investigations are carried out in relative isolation, they do not occur

in vacuums. Instead, they are part of a web of activities in the safety management system. Hence, rather than focusing on the totality of activities to which incidents contribute, investigations often become the main source from which learning is expected to occur. This assumption, however, should not be readily accepted. Lindberg et al. (2010) and Rollenhagen (2011) note the need for further research regarding the follow-up of investigations.

In this paper we examine how investigations played a part in ongoing learning processes at a Scandinavian refinery. Our approach was motivated by observations and field conversations with refinery employees. When we discussed investigations, employees often compared them to other parts of the safety management system, emphasized the interconnected nature of tools for examining incidents, and focused on how learning from incidents was not an activity that was separate from their daily work. Our goal in this paper is therefore to develop an understanding of the role played by investigations in relation to learning from incidents both during and after the completion of investigations at the refinery.

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## 2. Learning and examining investigations

In the field of organizational studies the issue of whether organizational learning from crises is attainable has long been the subject of discussion (see e.g. Smith and Elliott, 2007; Turner, 1976). It is assumed that crises or severe events have a particular impact on organizations and individuals and can create opportunities for wide-ranging changes, for example because the causes of events may be more visible (Smith, 1995). However, factors such as power and defense mechanisms to avoid blame are found to create barriers that can be detrimental to efforts to learn from incidents (Pauchant and Mitroff, 1992; Turner, 1978). In light of these discussions regarding crises, it is also worth considering whether investigations, even if they concern near misses where lives could have been lost, represent a particular type of stimulus for learning that it may be difficult to exploit fully.

Definitions of learning often focus on a final result, for example in the form of relatively permanent changes in behavior (Argote and Ophir, 2002; Wilson et al., 2007). The emphasis is on actions, rather than on how a process has affected the state of knowledge. Notions of learning as an end result also beg the question of the sustainability of learning within organizations, i.e. how do organizations retain knowledge and practices that the knowledge influences? (Argote et al., 2003). Measuring the longevity of learning is a much debated topic. Some use indicators related to the implementation of measures (Jacobsson et al., 2012). Others find that tracing the effect of safety interventions, such as training, or measures that address organizational causes of incidents is difficult because many learning processes are not clearly demarcated and are combined with other improvement processes (Størseth and Tinmannsvik, 2012).

We argue that learning should be understood as constituting the development of new knowledge, confirming existing knowledge or gaining access to existing knowledge that can affect work practices, procedures, equipment and organizations.

Our examination of the roles of investigations in learning from incidents was based on the frameworks for learning posited by Illeris (2009) and Braut and Njå (2013). Illeris (2011) finds that theories of learning emphasize three important elements: learning mechanisms, the content that is developed and the context in which learning occurs. Braut and Njå (2013) build on this model and propose that it is also important to consider what creates a commitment to participation in learning processes.

The roles of investigations as a generator of learning mechanisms were examined by focusing on what the use of investigations led to at the refinery. Learning mechanisms are the processes that occur when knowledge is developed. Different learning mechanisms are considered to be important for different actor groups. Reflection on and interpretation of inputs is considered to be important for individual learning (Illeris, 2009). Theories of organizational learning emphasize the importance of mechanisms, whereby individual learning becomes part of groups, and eventually also that knowledge is institutionalized in artifacts such as tools, objects and systems (Crossan et al., 1999; Easterby-Smith et al., 2000; Rosness et al., 2013). The roles of the investigations in creating a commitment to learning were examined by focusing on how investigations motivated and triggered learning among actors at the refinery. The content dimension of learning was examined by focusing on how the investigations contributed to knowledge about the incidents, their causes, and about how similar incidents can be avoided. Finally, we also consider the context in which learning from investigations takes place, and how it is far from the only input to learning processes following incidents.

## 3. Examining learning from investigations at the refinery

A Scandinavian refining facility consisting of a natural gas liquids fractionation plant, a crude oil terminal, a combined heat and power plant and refinery was the site of our study. The site was chosen because it was the largest land-based facility operated by the refinery owner and because full access to activities and documents was granted. We carried out observations at the refinery for five months over a period of two years. During this period, two incidents at the refinery resulted in major investigations.

For both investigations we observed activities in the investigation groups and follow-up activities at the refinery. In addition to observations, 70 employees at the refinery, leaders, engineers and field operators, were interviewed about their experiences regarding learning from incidents and the follow-up of the two investigations. Table 1 shows the role and departments of the respondents. Among those interviewed were operators who had been involved in the two incidents. All the operators that were interviewed either worked in the process area of the refinery where incident A took place, or in the terminal and harbor area where incident B took place. Our presentation of the two investigations below is based on the final investigation reports, observations, case details from the safety management database and interviews.

**Table 1**  
The interview respondents.

Employee type:	Department	Number of respondents
Operators	Maintenance	4
	Oil terminal and harbor	10
	Refinery	7
Engineers	Maintenance	9
	Refinery	4
	Oil terminal and harbor	1
	HSE department	5
	Modifications/Technical safety and integrity	8
Leaders	Maintenance	6
	Oil terminal and harbor	6
	Refinery	5
	Modifications/Technical safety and integrity	5

### 3.1. Investigation A – pipe rupture and leakage of steam and hot water

Investigation A examined an incident that occurred in the fluid catalytic cracker unit in the refinery. A 2" blowdown pipe from a steam drum ruptured and a 2-m-long piece of the pipe rotated approximately 180°. When in use the pipe contained steam at a temperature of 245 °C and internal pressure of 35.6 bar. The rupture led to the release of water and steam of approximately 16.9 kg/s. Before the rupture, a leak from the metal jacketing surrounding the pipe had been detected. Employees at the refinery assumed, however, that this stemmed from the 20 mm steam-tracing pipe that ran underneath the metal jacketing and insulation surrounding the main pipe. The day before the pipe ruptured, personnel had been building scaffolding so that the metal jacketing could be removed and the pipe repaired. Repairs of this type of leak were carried out often and were considered to be a routine job. No personnel were seriously injured when the pipe ruptured, but, had the incident occurred a few hours later, personnel would have been working on the pipe.

The cause of the pipe wear was found to be external corrosion (corrosion under insulation – CUI). The actual rupture of the pipe

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