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What you find is not always what you fix—How other aspects than causes of accidents decide recommendations for remedial actions

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ABSTRACT

In accident investigation, the ideal is often to follow the principle "what-you-find-is-what-you-fix", an ideal reflecting that the investigation should be a rational process of first identifying causes, and then implement remedial actions to fix them. Previous research has however identified cognitive and political biases leading away from this ideal. Somewhat surprisingly, however, the same factors that often are highlighted in modern accident models are not perceived in a recursive manner to reflect how they influence the process of accident investigation in itself. Those factors are more extensive than the cognitive and political biases that are often highlighted in theory. Our purpose in this study was to reveal constraints affecting accident investigation practices that lead the investigation towards or away from the ideal of "what-you-find-is-what-you-fix". We conducted a qualitative interview study with 22 accident investigators from different domains in Sweden. We found a wide range of factors that led investigations away from the ideal, most which more resembled factors involved in organizational accidents, rather than reflecting flawed thinking. One particular limitation of investigation was that many investigations stop the analysis at the level of "preventable causes", the level where remedies that were currently practical to implement could be found. This could potentially limit the usefulness of using investigations to get a view on the "big picture" of causes of accidents as a basis for further remedial actions.

1. Introduction

To learn from events is often celebrated as one of the key principles of effective safety management. Experience feedback from events take many forms such as collecting statistics and performing in-depth analysis of event (Kjellén, 2000). A basic assumption underlying accident investigation is that analysis of specific events will reveal patterns of underlying causes and conditions that if addressed by the right remedial actions can prevent further events. The distinction often drawn between retrospective (analysis of events) and prospective (risk analytical) methods is intuitively understandable but incomplete: risk analysis requires the experience from analysis of previous events and event analysis implies that the weaknesses found are the ones that impose risk. Consequently, in accident investigation, an ideal is often to follow the principle "what-you-find-is-what-you-fix", which is clearly a guiding principle for instance in Swedish accident investigation manuals and guidelines (Lundberg et al., 2009). (It is obviously impossible to fix something that has not been 'found,' i.e., which has not basis in reality. Even so, it happens every now and then, cf., below.) Another way to state this principle is: if an accident happens determine the causes and implement suitable arrangement to eliminate the causes and/or their effects. This is also a goal that guides research: there are numerous articles and books describing methods for finding the right causes, as well as articles describing "accident models", that is generic models of factors and their relations that can provide support for finding cause–effect relationships behind accidents (e.g. Heinrich, 1931, 1934; Gordon, 1949; Lehto and Salvendy, 1991; Svenson, 1991; Kjellén, 2000; Hollnagel, 2004; Leveson, 2004; Sklet, 2004; Factor et al., 2007; Santos-Reyes and Beard, 2009). Fewer studies (e.g. Elvik, 2010) focus on difficulties of fixing what has been found. Modern accident models focus on factors and relations other than those focusing on humans closest to the events. Such approaches are based on the idea that numerous factors and conditions in a complex socio-technical system may have influence on accidents: including political and organizational factors, cultural factors, and issues of power relations, technological development and so forth (Hollnagel, 2004; Leveson,

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Table 1
Informants.

N	Domain
3	Rail
3	Maritime
4	Road
3	Work, general
3	Nuclear
6	Patient safety

2004; Santos-Reyes and Beard, 2009). This extension of the scope of issues relevant for understanding accident propagation has lead to a deeper understanding of safety. Accident models of today often include nuanced ideas about "factors" behind accidents as well as elaborated ideas about cause–effect relations. Somewhat surprisingly, however, the same factors that often are highlighted in modern accident models are not perceived in a recursive manner to reflect how they influence the process of accident investigation in itself. Another way to rephrase this issue is the following: how does the same organizational context that is responsible for accidents impose constrain on the methods and understanding of accident investigation and associated methods. In this article we have set out to approach some of these issues by means of interviews with accident investigators from various branches. Our goal has been to reveal patterns of influence affecting accident investigation practices that presumably represent the same roots as those often claimed to be "root causes" to accidents.

2. Purpose

Our purpose is to reveal constraints affecting accident investigation practices that lead the investigation towards or away from the ideal of "what-you-find-is-what-you-fix".

3. Method

We used the interview guide in Appendix to guide the interviews. During the interviews, the informants could also initiate topics of their own (Question 4.4. was not used in the interviews with the health care sector, interviews 17–22, Table 1). Interviews 1–10, Table 1, and the same interview guide, was used as data in a previously published study (Korolija and Lundberg, 2010).

The interview guide (see Appendix) covered five areas: background information about the informant, the phases of an investigation, their support in the form of accident investigation manuals, accident models, and safety culture. The first section covered the experience of different areas of accident investigation of investigators and their professional networks for exchange of experiences. The second section regarded investigation activities. It focused on previously neglected activities (Lundberg et al., 2009) in particular the design or selection of measures and the transition from analysis to measures. However, there were also questions about the investigation at large, about what activities were focused in the investigation practices. The third section focused on their view on accident investigation manuals and other supporting documentation, focusing on whether they found that it reflected current practices, were lagging behind, or described practices that had not yet been implemented. In the fourth section, the interviews focused on accident models. The questions were designed to guide the discussion both to what extent simple linear accident models were used (Heinrich, 1934) vs. more complex linear models that take underlying factors into account (Reason, 1997). Moreover, they covered more recent factors and models such as resilience (Lundberg and Johansson, 2006), and safety culture (Rollenhagen, 2005) which was in focus in Section 5.

Twenty-two semi-structured interviews were conducted during 2007 (see Table 1). The informants in the transportation domain (1–10) were all male, whereas seven of the remaining 12 in the other domains were female. 10 of them had between 1 and 5 years of experience with investigation, the others had longer experience, and most of the 10 had about 4 years of investigator experience. The remaining 12 had long experience of investigation. Most of them had gone through few courses in accident investigation. Two of them (with the longest experience) had not gone through any courses. The first author conducted interviews 1–16, interviews 17–22 were conducted by a masters student. The interviews lasted between 45 and 108 min, depending on the style of talk by the informant. Some presented longer comments and examples, whereas others gave shorter responses.

The interviews were recorded (audio only) and transcribed. A print of the questions was available to the informants during the sessions. During the interview, the analyst departed from the interview guide either to ask follow-up questions, to skip questions already covered by answers to a previous question, or to elaborate or explain a question further.

The analysis was conducted by reading through the data and noting factors to be considered when analyzing or designing remedial actions. The notes and the data was entered into a database, with a total of 207 excerpts (some lines of transcription) regarding constraints, and sorted into four general tables, concerning constraints during investigation (58 excerpts), during design and selection of remedial actions (111 excerpts), the stop-rule for going from analysis to design (15 excerpts), and quality criteria for investigations. (28 excerpts) Excerpts could appear in more than one category since people sometimes talked about several subjects in the same excerpts. The excerpts were then sorted into more narrow categories, as presented in the results section below. References to the particular excerpts were finally removed, and replaced with a general reference to the domain, to avoid the identification of informants. In some particularly sensitive cases, the reference to the domain was also removed. Excerpts in the text below have been translated from Swedish, and corrected to become easier to read (false starts, and language flaws common in speech, have been corrected).

4. Bias in accident investigation

Previously, a need for research on real-world accident analysis has been requested, to find sources of bias that actually occur (Woodcock, 1995). However, some sources of bias in accident investigation are well known. Johnson (2003) lists several biases that can affect investigation, for instance the following: *Author bias*, a reluctance to accept findings from other people's investigations. *Confirmation bias*, a tendency to confirm preconceived causes. *Frequency bias*, a tendency to classify causes in common categories. *Political bias*, where the status of an individual gives him or her undue influence on the attribution of causes. *Sponsor bias*, where the attribution of causes are influenced by the risk of damaging the reputation of the investigator's own organization. *Professional bias*, where causes that are the most acceptable to colleagues of the investigator are chosen. Svenson et al. (1999) moreover demonstrated bias based on engineering vs. psychology background of investigators, regarding analysis of causes. The engineers tended to attribute more causes to human factors than to technical errors. Their study also found that the purpose of the investigation had a major impact. Legal analyses attributed blame to an individual whereas an analysis based on the accident evolution and barrier function method instead pointed at other factors. It should however be noted that different methods have historically had different foci—for instance, Heinrich (1931) promoted a focus on the most