



Review

The need to establish consistent international safety investigation guidelines for the chemical industries



Alpo Vuorio ^{a,*}, John Stoop ^b, Christopher Johnson ^c

^a Health Centre Mehiläinen Airport, Vantaa, Finland

^b University of Applied Science Amsterdam, Aviation Academy, Delft University of Technology, The Netherlands

^c School of Computing Science, University of Glasgow, Scotland, UK

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ABSTRACT

The Bhopal pesticide accident triggered a number of responses from the companies involved from the Indian government as well as reforms in the United States. These initiatives reached a range of different conclusions that arguably failed to provide a coherent framework for action around the globe. In other domains, organisations such as the International Civil Aviation Organisation (ICAO), provide a common point of reference for the many different investigations that may be conducted in the aftermath of an accident. The early origin of the international aircraft safety investigation process can be traced back more than 70 years and has developed in the course of time to be useful in improving aviation safety. Despite these practices can't applied directly to other industry they may help to develop good practices. Even today, the international chemical industry lacks international guidelines for safety investigations. There are, however, initiatives to support investigations within individual nations. Without greater consistency, we argue that there is little prospect of ensuring international cooperation in mitigating the consequences or reducing the likelihood of future accidents across increasingly globalized chemical industries. This contribution elaborates on the engines for change, taking into account system inherent properties and safety management concepts that serve as barriers for implementation. Such barriers are of a methodological nature, originating from differences in goals and perspectives between accident investigation in aviation and risk management strategies in nuclear and chemical industries. We also identify opportunities to overcome these barriers through the exchange of good practice across these industries.

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* Corresponding author.

E-mail address: alpo.vuorio@gmail.com (A. Vuorio).

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1. Introduction

Traditionally in the chemical industry, safety engineering has been based on the fact that risks can be predicted in most production processes. But this becomes increasingly difficult when systems become more complex in a dynamic network. In most cases complexity is increased because chemical plants form part of open socio-environmental-technical systems and because toxic products may cause harm for humans and the environment. In these circumstances, accidents can be caused by new, unforeseen mechanisms. At the same time, the global reach of complex supply chains creates new interdependencies between manufacturing units. The safety of chemical processes should be supported by the harmonization of incident and accident investigation across national borders. If accident investigation practices are better aligned the knowledge related to rare, unanticipated interactions could be shared and possible prevention measures created. The concepts, models and methods that are in use across the chemical industry are very different from those within the aviation industries. However, the chemical industry is in a strong position to learn from the practices already available in other industries, in particular in civil aviation and nuclear power generation. Although these practices can't be accepted without modifications they are applicable in developing safety investigation processes and practices.

2. Accident investigation practices in aviation industry

The early origin of the international aircraft safety investigation process can be traced back more than 70 years (Johnson and Holloway, 2007; Stoop and Kahan, 2005). In 1944 the International Civil Aviation Organisation (ICAO) approved Annex 13 of the Chicago convention. This established the basis for international co-operation in safety investigation in major accidents. Since then this Annex has been updated several times (ICAO, 2010). The most important principle is to prevent similar types of accidents from occurring again. As a result of investigation, there are always some safety recommendations for the local company or national authorities or occasionally for the international airline industry or international aviation authorities. These safety recommendations may go beyond current regulations and legislation. Usually the recommendations will be given within 12 months after the accident, but if needed it is possible to give urgent recommendations even when the safety investigation process is still going on. If criminal investigation proves necessary, it is carried out separately in most

countries. Such separation is mandatory by ICAO Annex 13 regulations so that all parties in an accident are encouraged to contribute in identifying safety recommendations.

2.1. The state level of investigation

ICAO Annex 13 defines the stakeholders who can take part in the safety investigation process. In summary, the country in which an accident occurs will usually assume responsibility for coordinating an investigation. Annex 13 also provides for the participation of representatives/investigators from the country in which an aircraft or its major components were manufactured. Additional representation is provided for the country in which the aircraft was registered as well as from those countries, which represent the nationality of deceased passengers. This increases the number of participating countries, the number of investigators and may also complicate the investigation process. The extensive participation of different stakeholders serves the objective outcome of the accident report and assists in implementing the final safety recommendations; it reduces the likelihood of subsequent disagreement. The first objective is to achieve consensus on the description of the course of the event and to better understand the failure mechanisms that caused the event, building on available evidence. The second objective is to share information and to achieve recommendations that can be of value for the aviation community by supporting common learning processes. It increases confidence in an investigation by increasing the transparency of investigatory processes. During the early stages of an investigation the aim is to collect as much relevant evidence as possible. It is important to avoid hindsight bias and to look beyond the sharp-end; beyond individual actions to consider the systemic aspects of an accident. Hindsight bias uses evidence that was not available at the time of an accident to make unwarranted judgements about the behaviour of individuals and groups involved in an accident. It is often coupled with a 'perfective bias' where the focus is on blaming the operators and engineers directly involved in the final events before an accident. In major aviation accident investigations, the classic 'pilot error' has been balanced with an increasing focus on the organisational factors that create the context in which an error is more likely to occur. The 'sharp end level' is more common in occupational accident investigations (Vuorio et al., 2014) and arguably also in the offshore and process industries. 'Blame free', or more correctly 'proportionate blame', investigations have

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