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Review

Managerial and non-technical factors in the development of human-created disasters: A review and research agenda

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ABSTRACT

A number of common underlying factors in the development of human-created disasters, as cited in numerous official inquiry reports, encompass in particular, safety management system defects and weaknesses in an organization's safety culture. Human factors such as faulty risk cognition, bounded rationality, groupthink, failure of foresight and organizational learning, suspect motivations, reactive attitudes, and inappropriate risk decision-making, are commonly associated characteristics of such shortcomings. This article summarizes and discusses underlying managerial and non-technical factors in human-created major hazard accidents in the light of theories of accident causation, findings from disaster inquiries and published research, and the systemic holism-versus-reductionism debate. Ideally, all site operators would know and understand disaster aetiology and preventive requirements and be motivated to enact them. However, there is sufficient empirical evidence from inquiry reports into major hazard incidents and disasters that idealized enactment rarely occurs and in many cases safety policy and strategy as enacted is distant from espoused safety policy and strategy. Research questions relating to board level thinking and actions on major hazard risks are posited and a proposal for a more holistic and potentially more effective major hazard safety research framework is put forward.

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1. Introduction

This article seeks to provide a summary review of, and discussion regarding, underlying managerial and other non-technical factors in the development of disasters involving human-created major hazards. For experienced academics and practitioners in safety science, the summary of accident theories, relevant factors and issues provided in this article is likely to be well known. Nevertheless, it is beneficial from time to time to collate, review and reflect upon them to ensure that possible new insights and implications for potential new research agendas and practice are not overlooked.

This review and discussion consider how the identified factors may be addressed in a more integrated and systemic way than is frequently the case at present, with the objective of benefitting both research and practice in safety science. The article also considers a number of puzzling questions, and provides some possible answers and their implications for research and practice. For example: Why is there such an apparently large gap between the ideal and reality vis-à-vis major hazard accident prevention? Why do boards and individual directors and executives so frequently apparently defy rational commonsense requirements (and indeed statutory requirements and professional good practice) for safety risk management intended ultimately for the protection of shareholder/stakeholder interests? The article comments on intellectual debates on the sources of accidents and disasters and the implications for safety science, including research needs and methodology, identifying themes from Hopkins (2014) and Le Coze et al. (2014). A further objective is to clarify some relevant research problems and offer some potential solutions, for example in the under-researched area of board-level motivations for and influences on decisions that can affect major hazard safety in particular. Current problems with the whole approach to major hazard safety research are also examined.

There are continuing academic debates about what constitutes a disaster and how the latter, and indeed related concepts such as catastrophe and crisis, should be defined and scoped (see, for example, Perry and Quarantelli, 2005; Quarantelli, 1998). As such topics are already debated widely elsewhere, for the purpose of this review the author characterizes such disasters by the scale of adverse outcomes from what otherwise might be described simply as accidents. Unless interacting with human-created hazards, such as occurred following the Great East Japan Earthquake and the subsequent tsunami which struck the Fukushima Daiichi nuclear power plant in March 2011, this article also excludes natural disasters from its scope. However, many and perhaps all of the human, organizational and managerial factors and issues discussed in this article will also be relevant both to development of an awareness of the need for response systems for natural disasters and the design, planning, organizing and testing of such systems.

Disasters involving human-created major hazards have reflected industrial growth and the vast increase in scale of high energy industrial processes and high energy inventories on a single site, particularly since World War II (see, e.g., Robens, 1972). The numbers of people at risk have also increased, owing to increasing population density as well as greater system complexity and interactions between systems (see, e.g., Perrow, 1984). According to Waring and Glendon (1998), such disasters emanate from inadequately controlled human-created major hazards which are characterized by:

- Large scale technology or technical activities.
- Large scale storage or use of high energy sources and/or toxic and/or biohazard and/or radioactive materials.
- Potentially large numbers of people at risk of being injured or killed in a single incident.
- Potential widespread environmental and/or property damage resulting from a single incident.
- Special implications for major hazard management, risk assessment and risk control concerning normal, abnormal, and emergency conditions.

Typically, when a human-created disaster occurs, high energy is transferred in a relatively defined area in a short space of time (e.g. major fire, explosion, structural collapse, transportation crash). Sometimes, however, a disaster may be 'slow motion' and possibly unannounced, for example the release of toxic substances from a factory into the local environment over a long period which results in health damage to the local population. Incidents of this type have been reported from China (see, e.g., Liu, 2010; Lu and Zhang, 2009; Yi, 2007).

2. Human-created disaster cases

Table 1 provides some examples of human-made created disasters, selected for their prominence in focusing the attention of governments, relevant professions and the general public on the need for significant improvements in preventing such disasters and limiting their adverse consequences for affected parties.

3. Common underlying characteristics

As reviewed by Le Coze (2013), and Stoop and Dekker (2009), prominent theories of how accidents occur include the 'active and latent failures' model of Reason (1990), the 'migration and socio-technical systems' model proposed by Rasmussen (1982, 1997) and the 'collective mindfulness' model developed by Weick (1995). Le Coze (2013) proposed two new potential models as syntheses of previous models, namely the Systemic and Dynamic Sensitizing Model of Safety (SDSMS) and Socio-Natural-Technical Systems (SNTS). An arguably more controversial sociological theory of accidents is that of Perrow (1984, 2007, 2011, 2013), whose 'normal accident hypothesis' stated that complex, highly coupled systems experience failure modes that are not predictable and therefore are not preventable (i.e. accidents are systemically inevitable as emergent properties of complex systems such as organizations and other human activity systems). Perrow's thesis was extended by others, including Matthewman (2014), and Vaughan (1999, 2004, 2006). Hopkins (2014) offered a critique of the value of such theories in practice.

The author argues, as others appear to, e.g., Le Coze (2005, 2013), Le Coze and Dechy (2005), that such theoretical models and frameworks, which help in understanding how accidents and disasters are likely to occur, also need to be evaluated against empirical case data. As might be anticipated, many of the concepts and themes embedded within such models are discernible in risk