



Issues in safety science ☆



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ABSTRACT

This paper deals with three issues. First, the question of the boundaries of safety science – what is in and what is out – is a practical question that journal editors and reviewers must respond to. I have suggested that there is no once-and-for-all answer. The boundaries are inherently negotiable, depending on the make-up of the safety science community.

The second issue is the problematic nature of some of the most widely referenced theories or theoretical perspective in our inter-disciplinary field, in particular, normal accident theory, the theory of high reliability organisations, and resilience engineering. Normal accident theory turns out to be a theory that fails to explain any real accident. HRO theory is about why HROs perform as well as they do, and yet it proves to be impossible to identify empirical examples of HROs for the purpose of either testing or refining the theory. Resilience engineering purports to be something new, but on examination it is hard to see where it goes beyond HRO theory.

The third issue concerns the paradox of major accident inquiries. The bodies that carry out these inquiries do so for the purpose of learning lessons and making recommendations about how to avoid such incidents in the future. The paradox is that the logic of accident causal analysis does not lead directly to recommendations for prevention. Strictly speaking recommendations for prevention depend on additional argument or evidence going beyond the confines of the particular accident.

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1. Introduction

The call for papers provides me with an opportunity to reflect on the some of the issue that have been gnawing at me for years. These include:

- The boundaries of safety science.
- Problems with theories that are popular in our field.
- Accident analyses: causation and the problem of making recommendations.

These are all identified as foundational issues in the call for paper, and all raise very practical questions that we must grapple with as we go about our work. The reader is warned, therefore, that this is not an integrated paper, but deals with three discrete topics.

First, the boundaries of safety science is a pressing issue for journal reviewers who must decide whether articles are within scope. This paper takes what I imagine will be a controversial view, namely, that the discipline cannot be defined abstractly, but depends on the interests of the safety science community.

Second, normal accident theory, the theory of high reliability organisations and resilience engineering are all theories or theoretical perspectives that have been popular in our field. We cannot

therefore ignore them; we must come to terms with them in some way. I argue here that each is defective in some way, raising questions about why they are so popular.

Third, the call for papers poses the question: “can we learn from past incidents and accidents in order to project useful predictions into the future?” I take this as meaning “in order to make useful recommendations.” As the call notes, “on logical grounds, it is indeed impossible to justify prediction through observation of specific cases to be generalised.” This paper discusses the logical difficulty of moving from accident analysis to recommendations and offers some pragmatic solutions. This is the most complex of the three topics, and for this reason, and not because it is any less important than the other two, it is reserved till last.

Finally in this introduction, a few comments on the style of this paper. One of the purposes of a special issue of the journal is to promote debate. I have taken this as a license to be provocative. As one reviewer put it, the paper provides the “first word” on the subjects touched on, “never anything close to the last”. Moreover, I acknowledge that some of my criticisms are “particularly harsh”. I leave it to the reader to judge whether that harshness is warranted.

2. The boundaries of safety science

As a reviewer for the journal, *Safety Science*, I frequently find myself asking: is the subject of this article really safety science? Is it suitable for this journal? For instance, I recently reviewed an

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article entitled: “A one-piece coal mine mobile refuge chamber with safety structure and less risk of sealing under shock wave”. I returned the paper to the editor saying:

“My view is that this paper is pure engineering and therefore not appropriate for the journal. However this is really a matter of policy so you might like to think about making a policy decision.”

The journal editor subsequently wrote to the author saying: “It seems to me not to be appropriate for publication in the journal”.

Was this the right outcome? It depends on what we mean by safety science.

According to the editorial statement¹:

- *Safety Science* serves as an international medium for research in the science and technology of human safety. It extends from safety of people at work to other spheres, such as transport, leisure and home, as well as every other field of man’s hazardous activities.
- *Safety Science* is multidisciplinary. Its contributors and its audience range from psychologists to chemical engineers. The journal covers the physics and engineering of safety; its social, policy and organisational aspects; the management of risks; the effectiveness of control techniques for safety; standardization, legislation, inspection, insurance, costing aspects, human behaviour and safety and the like.

Taking this statement at face value, the decision referred to above was the wrong one.

But it is not as simple as this. *Safety Science* is a peer-reviewed journal. This can only work if there is some relevant community of peers. If it proves impossible to find people within the safety science community with the necessary expertise to act as reviewers, submissions cannot be assessed. Moreover, even if they can be assessed, they will not be read if they fall quite outside the areas of interest of this particular community. In other words the journal and its contents are inevitably and properly shaped by its readership and by its reviewers, not just by an abstract definition.

My judgment was that the article mentioned above lay outside the areas of expertise and interest of the current readership of *Safety Science* and that it would better sent to some journal of mining engineering, where editors will not have such difficulty finding peer reviewers and it is more likely to be read.

This position has far reaching implications. It involves the exercise of what has been called a “gate-keeping function”. Moreover, influencing the content of the journal in this way necessarily influences the boundaries of safety science itself. The editorial statement above assumes that safety science can be defined independently of its practitioners. I believe, on the contrary, that the content of safety science must be inferred from the activities of its practitioners. This means that as the safety science community evolves, so too will the subject. For instance, climate change is a massive threat to human safety, and is theoretically encompassed by the editorial statement. But climate science is not currently part of safety science, although one can easily imagine the safety science community embracing aspects of climate science in the future, with the journal evolving accordingly.

All this raises the question of what is meant by the safety science community. Again, I think the answer is pragmatic rather than principled. The safety science community consists of people who are associated with self-identified schools of safety science, who go to safety conferences, who read each other’s safety-related

publications, and so on. This is a messy definition, but it is one that recognises the fluid and shifting nature of safety science. It would take a network analysis to identify the community with greater clarity.

As I write these words I see that *Safety Science* has recently accepted for publication an article entitled: “Effect of spark duration on explosion parameters of methane/air mixtures in closed vessels”. I would have judged this to be outside the current community of interest. Clearly other reviewers and editors take a different view. The authors of the article come from the State Key Laboratory of Explosion Science and Technology, Beijing Institute of Technology. It would seem that Chinese researchers are testing the current boundaries and seeking to join what I have called the safety science community.

The preceding discussion is about the subject matter of safety science. It does not deal with the question of whether or to what extent safety science is truly a science. That question will no doubt be addressed by other contributors to this issue.

3. Popular theories

Certain theories have been popular in the safety science community in recent decades, in the sense that they have been widely cited. Anyone who is serious about safety science must therefore wrestle with them. There are three, in particular, with which I have wrestled: normal accident theory, high reliability theory and resilience engineering. The first of these is not mentioned in the call for papers but the latter two are. These theories have various defects, some fatal and others less so. Strangely, although these theories are often referred to in the literature, the difficulties that I shall identify are largely ignored.²

3.1. Normal accident theory

The theory of normal accidents is propounded by sociologist Charles Perrow (1999) in his book, *Normal Accidents*. It offers an explanation for why major accidents in many hazardous technical systems appear to be inevitable. He argues that where a system is characterised by both complexity and tight coupling, accidents are inevitable, *no matter how well the system is managed* (Perrow, 2011:172). The paradigm case of a normal accident for Perrow is the Three Mile Island nuclear reactor near disaster in 1979. The terms complexity and tight coupling have a particular meaning for Perrow, but we do not need to define them for present purposes.

The question I want to ask is: how useful has this theory been in explaining the major accidents of our time? The answer is: not at all. Perrow (1994:218) himself acknowledges that few if any of the high profile accidents of recent decades are normal accidents. They were the result of poor management, cost pressures and the like, not the inevitable result of complexity and tight coupling. Most recently he conceded that the Gulf of Mexico blowout of 2010 was not a normal accident.³

In his book he devotes a chapter to analysing accidents in petrochemical plants, because this industry “provides some of the best examples or system (i.e. normal) accidents that we shall come across” (1984:101). Yet frequently in this chapter he undermines his argument. In one case he notes that “fairly gross negligence and incompetence seem to account for this accident”, but he resists this explanation on the grounds that “a fair degree of negligence and incompetence is to be expected in human affairs, and under production pressures... we can expect forced errors” (1984:111).

² One popular theory I shall not address here is Beck’s “risk society” thesis (Beck, 1992). I offer a critique of this in Hopkins, 2005, chapter 13.

³ <http://theenergycollective.com/davidlevy/40008/deepwater-oil-too-risky> posted July 19, 2010, accessed 18/8/2012.

¹ <http://www.journals.elsevier.com/safety-science/>.

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