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On the ontology of safety

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ABSTRACT

This article explores the philosophical foundations of a selection of safety science approaches through investigating the modus operandi of their development and use. It explicitly addresses the *importance of distinguishing ontology from epistemology*, a claim expressed in the call for papers for this special issue. The importance of rigorous methods when comparing scientific traditions is emphasised, a rigorousness that in this article is ensured by analysing the different safety science approaches from the same point of reference. The underlying ontology of Normal Accident Theory, High Reliability Organisations and Resilience Engineering is explored, as seen through the lens of the prevailing ontology of science and technology studies (STS). The article draws two conclusions. The first is of a theoretical nature: Slightly counterintuitive perhaps, especially considering the enduring debate between Normal Accident Theory and High Reliability Organisations, the three approaches are all found to be based on the same sociotechnical constructivist ontology. The second conclusion explains the ontological difference between the safety theoretical approaches as *not* grounded in their philosophical underpinnings, but in the way that the results from the 'original' studies are adopted and operationalised. This conclusion also illuminates a common and fundamental relational aspect of these safety theories and the danger of compromising their philosophical underpinnings when key concepts of the approaches are decontextualised, black-boxed and adopted uncritically in a new context.

1. Introduction

In the call for papers for this special issue, the importance of *distinguishing ontology from epistemology* is emphasised. Such a distinction is claimed to be a prerequisite for a meaningful debate on whether the world – in terms of risks and safety – should be sought through a *'true' description of reality 'as it is'*, or if we should acknowledge that *our understanding and knowledge of accidents and consequences vary with history and are dependent on social contexts*.

When issuing a debate on the philosophical foundations of safety science, eventually extending the science wars into the safety science domain, the *realist versus constructivist dichotomy* may not be an unreasonable framing as such, but one should be aware that within science and technology studies (STS) one have expended much effort to *repudiate* this dichotomy (see e.g. Latour, 1999b). The difference between realism and constructivism may seem obvious at first. However, it is problematic because the conception of realism is usually supported by a modern world view, whereas most descriptions of constructivism are supported by a postmodern world view; two views that are *both* repudiated by the non-modern world view that one of the foremost spokespersons of STS, Latour, argues so strongly for in the book *We have never been modern* (Latour, 1993). The call to distinguish ontology from epistemology is a related, but slightly different approach to debating the philosophical foundations of safety science. Being even more fundamental terms than realism and constructivism, they will more easily lend themselves to a stringent elaboration and will therefore be used as a lever in this article.

Safety science is indeed a challenging discipline. On one hand, our wish to *predict* safety conditions of industries and processes in order to *prevent accidents from occurring* and our wish to *find causes after an accident has occurred,* by definition seem to presuppose that the world may be described through sequential and unambiguous relations between causes and effects. The prime example of such a world view is Heinrich (1931) Domino model. On the other hand, the acknowledgement of *complexity and intractability* and the increased focus on *systemic approaches* in safety science challenge both the sequentiality and the unambiguity, emphasising the *emergence* of the systems we surround ourselves with and seek to control. One of the influencing traditions that emphasises these aspects is Resilience Engineering (RE) (Hollnagel et al., 2008a, 2011, 2006; Nemeth et al., 2009). In between these linear and complex views, we may identify a range of 'middle positions' with respect to the nature and direction of causality. Examples of these are the epidemiological view represented by writings on manifest and latent conditions (Reason, 1990), the descriptions of High Reliability Organisations (HRO) (La Porte, 1996; La Porte

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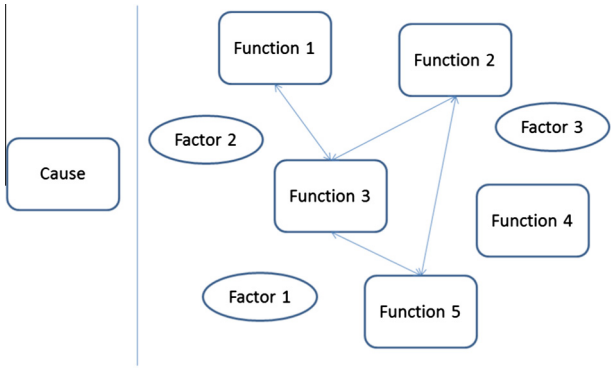

Fig. 1. Functions, factors, relations and causes.

and Consolini, 1991; Weick, 1987; Weick and Roberts, 1993; Weick and Sutcliffe, 2007) and the Normal Accident Theory (NAT) (Perrow, 1984).

Although there is certainly some degree of complementarity between the influential approaches of NAT, HRO and RE (see e.g. Hale and Heijer, 2006; Rijpma, 2003), their differences and even incompatibilities are also frequently highlighted (e.g. Nemeth et al., 2009; Perrow, 1994). To the extent that these approaches or theories aim to reflect an ontological reality, this is problematic. Surely, one may say that they represent different *perspectives*, or even different reali*ties*, but the meaning and the implications of such a world view should in that case be clarified.

By conceptualising and operationalizing the causal structures within each of the three approaches as an alignment of factors, functions, relations and causes, investigations are undertaken at a level on which the three safety theoretical approaches may communicate with each other and be compared with each other without running into ontological clashes. This is explained in detail in Section 5 (and conceptually in Fig. 1). This analytical strategy helps operationalizing generic philosophical issues of safety science, makes potentially highly abstract problems explicit and concrete.

2. Objective and structure of the article

This article addresses and makes explicit the philosophical foundation for a selection of prominent safety science approaches. It does so by exploring the different approaches' modus operandi in the production of knowledge about the world, and by exploring their consistency in the commitment to a clearly defined scientific approach in this process. Such an investigation itself obviously demands a transparent and consistent modus operandi. This is crucial not only to be able to compare the different safety science approaches using an immutable scale, it is also fundamental for maintaining argumentative integrity and to reply to the call without blindly accepting the implicit conditions about ontology and epistemology in the formulation of the call. Indeed, these conditions shall be accepted as a point of departure. Actually, the investigations as such will be aligned as a project to investigate the relationship between ontology and epistemology. It then remains to be seen how far into the empirical investigation this distinction seems plausible.

The structure of the article is as follows: Sections 3 and 4 briefly review the meaning and connotations of *ontology* and *construction* in the STS field. Sections 5 and 6 elaborate on and compare the ontology of some essential features of Resilience Engineering, High Reliability Organisations and Normal Accident Theory, before a brief discussion leads to the conclusions in Section 7.

3. On constructivist ontology and ontological status

The scientific view that guides the line of thought in this article is in general inspired by the STS[1] tradition (Bijker, 1995; Latour, 1988, 1996; Latour and Woolgar, 1986; Shapin and Schaffer, 1985) and the ANT[2] tradition (Latour, 1987, 1993, 1999b, 2005; Latour and Woolgar, 1986) in particular. ANT may be said to rest upon a *constructivist* ontology. But one has to be careful when using such terms. Considering the critique raised against ANT, the challenge of locating a research tradition within a paradigm of knowledge is obvious; natural scientists and hard realists do not hesitate to characterise ANT as *social constructivist* and *relativist*, a source of much frustration among ANT practitioners. Representatives from the SSK[3] tradition (Bloor, 1991), on the other hand, self-declared social constructivist, reject being confused with ANT. The debate (Bloor, 1999; Latour, 1999a) between Latour and Bloor, leading figures within ANT and SSK respectively, demonstrates very clearly how tough the fronts may be between two traditions that to outsiders may not appear very different.

A characteristic feature of ANT and the philosophy of science upon which this article is based, is that facts and truths are *results of historical processes*. A fact may be described as a network of material, technical and social processes that have been stabilised and as controversies that have been closed. The ontological status of a phenomenon is an expression of how well the phenomenon is constructed, how many and heterogeneous are the actors who contribute to its stabilisation and how this network in practice maintains its existence. Thus, that a phenomenon or a fact is constructed does not make it less real. To the contrary – Latour (2005:124) expresses it like this: "fabrication and artificiality are not the opposite of truth and objectivity", and continues:

> When we list the qualities of an ANT account, we will make sure that when agencies are introduced they are never presented simply as matters of fact but always as matters of concern, with their mode of fabrication and their stabilizing mechanisms clearly visible (Latour, 2005:120).

From this perspective, the division between ontology and epistemology is not so obvious. Indeed, in ANT, ontology and epistemology collapse and one does not talk of one reality out there and another reality created by a cognitive subject. What is, what is known about this and how it is known, cannot be separated from each other.

The objective of this article is addressed in accordance with this, by investigating the modus operandi of some different research traditions and based on this, saying something about the ontological status – or the 'existence legitimacy' – of functions, factors, relations and causes. This does not, by the way, seem to be largely discrepant from the pragmatic perception of reality in Resilience Engineering with respect to preventing or managing adverse events:

> Although there is no truth to be used as a point of reference, it is possible to show that one explanation – under given conditions – may be better than another, e.g., in providing more effective countermeasures (Hollnagel et al., 2006:353).

Before proceeding to investigate safety science approaches with reference to ontological status, the scene will be set by briefly presenting a famous example from the STS tradition.

[1] Science and Technology Studies.
[2] Actor-Network Theory.
[3] Sociology of Scientific Knowledge.