On the rationale of resilience in the domain of safety: A literature review

Johan Bergström [a,*], Roel van Winsen [b], Eder Henriqson [c]

[a] Division of Risk Management and Societal Safety, Centre for Societal Resilience, Lund University, PO Box 118, SE-22100 Lund, Sweden
[b] Safety Science Innovation Lab—School of Humanities, Griffith University, Nathan Campus, 170 Kessels Road, 4111 Brisbane, QLD, Australia
[c] PUCRS School of Aeronautical Science, Av. Ipiranga 6681, P10/S106, 90619-900 Porto Alegre, Brazil

ARTICLE INFO

ABSTRACT

Resilience is becoming a prevalent agenda in safety research and organisational practice. In this study we examine how the peer-reviewed safety science literature (a) formulates the rationale behind the study of resilience; (b) constructs resilience as a scientific object; and (c) constructs and locates the resilient subject. The results suggest that resilience engineering scholars typically motivate the need for their studies by referring to the inherent complexities of modern socio-technical systems; complexities that make these systems inherently risky. The object of resilience then becomes the capacity to adapt to such emerging risks in order to guarantee the success of the inherently risky system. In the material reviewed, the subject of resilience is typically the individual, either at the sharp end or at higher managerial levels. The individual is called-upon to adapt in the face of risk to secure the continuous performance of the system. Based on the results from how resilience has been introduced in safety sciences we raise three ethical questions for the field to address: (1) should resilience be seen as people thriving despite of, or because of, risk?; (2) should resilience theory form a basis for moral judgement?; and finally (3) how much should resilience be approached as a trait of the individual?

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1. Introduction

Since safety science's somewhat collective conception of 'resilience engineering' during the Söderköpinge meeting almost a decade ago, 'resilience' has received an increasing amount of attention in both the academic and practical domain of safety and human factors. As such, together with other notions as 'human error' and 'safety culture', resilience (sometimes referred to as 'resilience engineering' or 'RE') is an increasingly prevalent 'object of knowledge' [1] in the scientific discourses of human factors and safety science. Leading authors on cognitive systems engineering, such as Hollnagel and Woods, reintroduced the idea of moving away from error towards seeing both risk and safety as the product of normal organisational processes; performance variability and adaptive capacity in goal-conflicted and resource scarce environments [2-6]. As such, the resilience agenda argues for a focus on operational success and deems the study of normal work more appropriate than safety science's traditional (hegemonic) focus on failures and accidents.

Critics generally claim that the conceptual approach of resilience takes the safety field little further than already done in the late 1980s and 1990s by the school of high reliability theory (HRT) (see, for example Hopkins [7]). This kind of criticism, which asks why we need this new vocabulary, was interestingly already pointed out in the first book on Resilience Engineering:

What is interesting for safety is preventing accidents and not just surviving them. If resilience is used with its common meaning of survival in adversity, we do not see it to be of interest to us. If its definition is extended to cover the ability in difficult conditions to stay within the safe envelope and avoid accidents it becomes a useful term. We would, however, ask whether we do not have other terms already for that phenomenon, such as high reliability organisations, or organisations with an excellent safety culture. [8].

In turn, other researchers have defended the value and novelty of resilience engineering (see, for example Ross et al. [9]). Despite these ongoing debates – whether resilience engineering merely rephrases the ideas of CSE and HRT or if it further develops these fields or even if it is a disruptive kind of innovation in safety science – due to its intuitive appeal and seemingly positive pragmatic yield, after its first explicit conception in 2006, the object immediately took off in the safety literature.

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* Corresponding author. Tel.: +46 46 222 0880.
E-mail addresses: Johan.Bergstrom@risk.lth.se (J. Bergström),
roel.vanwinsen@griffithuni.edu.au (R. van Winsen),
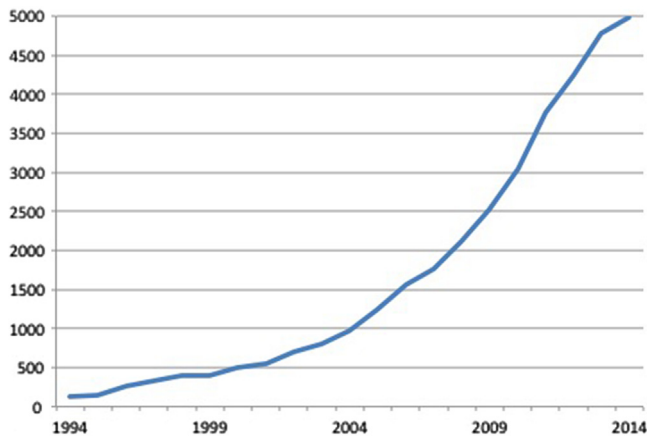ehenriqson@pucrs.br (E. Henriqson).

Fig. 1. Number of resulting papers from the search "resilience" in Scopus (title, keywords, abstract). Period: January 1 1994 to December 31 2014.

Safety science is not the only field that saw an exponential growth of resilience studies (see Fig. 1), as it has now become a prominent object in a number of other disciplines. The heritage of resilience as a word can be traced to Roman times to writings of Seneca the Elder, whereas its first scientific use is attributed to the 17th century writings of Sir Francis Bacon [10]. In contemporary academic use we relate the object of resilience to its heritage in mechanics, where it appeared in 1858 (ibid), its use in ecology [11,12], or its use in psychology [13] and the health sciences [14].

The mechanical heritage of resilience can be most clearly observed in studies of resilience that adopt the stress–strain model and in studies emphasising resilience as the ability of a system (e.g. an infrastructure network [15]) to regain a previous state following a disturbance. In psychology and health sciences, as a scientific object of knowledge, resilience refers to the abilities of a psychosocial subject to cope with adversity, with seminal studies focusing on the resilience of children as part of their psychosocial growth as well as their ability to cope with abrupt shocks [10,16,17]. Building on notions of systems theory [18], Holling's introduction of resilience to the field of ecology in the early 1970s [11] marked a turning point in the study of ecosystems. This turn provided the direction for a great amount of systems research, which culminated in the foundation of the *Resilience Alliance* in 2001, marking the sense of identity and community that the concept has given rise to. Influenced by the use of complexity theory in the neoliberal school of economy, the object of resilience has over the last 20 years also defined the field of social–ecological systems [12,19]. Definitions of resilience, in this sense, include the ability of complex systems to "absorb change without dramatically altering" [11] (p. 7), as well as the dramatic nature of the tipping point when passing the limit of the resilient character.

Finally, the object of resilience has also emerged in other discourses such as climate change-adaptation and societal security and safety. In the latter case, following events such as the 9/11 attacks in 2001 and Hurricane Katrina in 2005, resilience found its way also into societal policy. This trend can be exemplified by campaigns such as the UN's *Making Cities Resilient*-campaign, the Australian Government's *National Strategy for Disaster Resilience,* and the *UNISDR Hyogo Framework for Action 2005–2015*.

With the widening discursive use of resilience, across all these domains, we also see counter voices and critical studies arise: is this a useful object for thinking about the reliability, elasticity or other physical properties of a mechanism, the robustness of a person or ecosystem, or even the strength of a society under adverse pressures? In fields such as societal security [20,21], climate change adaptation [22], political theory [23] and health [24], we see an arising critique directed to the manner in which the resilience object is used and the effects that it has as a powerful discourse in the safety domain.

However, beyond debates whether resilience is a reiteration of HRT [7], this critical stance has so far yet to emerge for the use of resilience in the safety science community. In this paper, we explore one possible line of reasoning for a more critical appreciation of this increasingly prevalent object in the discourse of safety science.

Objects of knowledge, such as resilience, are not 'out there' in the world, waiting for science to discover them. Instead of representing some external reality, French philosopher Michel Foucault argues that the objects of our discourses are historically contingent and arbitrary constructions; they do not mirror an external reality, but rather are the effects of certain historical discursive practices [1]. With his archaeological approach, Foucault aims to investigate how certain discourses—and discursive objects such as resilience—emerge and discursively function. By showing the contingent and arbitrary nature of our knowledges, as well as the effects that our discursive practices may have, Foucault aims to open up possibilities for the examination of some taken-for-granted truths.

Ten years since the Söderköpinge meeting [25], it now seems apt to assess some assumptions behind the agenda of resilience engineering. Inspired by Foucault's archaeological approach, this paper offers a study of how resilience emerges in the discourse of safety science. Based on a structured review of the literature on resilience within the safety science discourse this paper aims to understand how resilience engineering researchers describe the rationale behind the need to be resilient (*why*), the object of resilience (*what* it is to be resilient), and the subject of resilience (*where* is resilience guaranteed, by *whom* and *how*). Eventually, we aim to initiate a critical discussion on how these three aspects combine. We will do so by raising a numer of ethical questions regarding the manner in which the safety science community has so far considered the relationship between resilience and risk and the potential consequences of a normative take on resilience in combination with the subjectivisation of resilience at the level of people.

2. Method

2.1. Literature review

This study was inspired by the 'systematic literature review' approach, which is characterised by its explicit research approach: the sources and search strategies for literature are made explicit and the criteria for selection and analysis of the studies are uniformly applied. This approach allowed for a transparent and reproducible strategy in the processes of articles selection and analysis.

2.2. Selection of literature

This study focused on the discursive use of resilience by the safety science community (typically, but not exclusively labelled as 'resilience engineering'), as opposed to the more practical uses of the object. As the acceptance of the scientific community is most convincingly guaranteed through the peer-review process [26], we decided to limit our study to peer-reviewed academic journal articles. As an analytical choice strategy, conference proceedings and book chapters were deliberately excluded from our examination (we do realise that this is where a vast amount of the research into resilience engineering has been published). Moreover, as the number of citations for a publication is an important indicator of peer recognition [26-29], this study focuses on the most cited (peer-reviewed) articles concerned with resilience in the safety domain.

In systematically selecting the papers for review in our study we used Scopus. To arrive at an understanding of what outlets most resilience engineering scholars publish their work in - that is, academic peer-reviewed journals - we conducted an initial Scopus