How can we improve safety culture in transport organizations? 
A review of interventions, effects and influencing factors

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**A B S T R A C T**

The main objectives of the present study are to (a) map interventions that can be used to develop good safety culture in transport companies within road, sea, air and rail transport, (b) assess expected effects of interventions on safety culture and safety outcomes and (c) identify factors influencing safety culture change. By systematically reviewing the scientific literature, we identify 20 studies that describe and evaluate interventions to improve safety culture in road, rail, sea and air transport organizations. The review is reported according to PRISMA guidelines. The interventions studied vary widely in their comprehensiveness, but a lack of both standardized outcome measures and controlled evaluations means that it is difficult to compare different interventions, either within or across sectors. Most studies, however, report improvements in safety culture where this is measured. We find that attempts to understand the mechanisms of cultural change leading to behavioural change and improved safety performance are lacking. Although safety culture is an organizational measure, we only found one peer-reviewed study of an attempt to improve safety culture in a single air transport organization and no studies of this in the maritime sector. We conclude that on the whole the reviewed safety culture interventions seem to be effective, but comprehensive and resource demanding. We suggest that future research should develop simpler interventions by focusing on the basic requirements of safety culture change. We contribute to this by identifying four key activities (content) which seem to be common in all the reviewed interventions, and eight key factors (process) influencing the success of efforts to influence safety culture. The basic requirements of safety culture change seem to be to institutionalize joint discussions of workplace hazards facilitated by manager commitment and employee involvement.

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1. Introduction

Transport accidents represent a serious public health problem. Recent data shows that 1.24 million people die each year on the world’s roads and between 20 and 50 million people sustain non-fatal injuries (World Health Organisation, 2013). Numerous people lose their lives annually in maritime accidents, including 24,000 in the fishing sector alone (International Maritime Organisation, 2015). In 2015, 1739 people were killed or seriously injured in railway accidents in the EU-28.¹ In comparison, there were on average 611 worldwide air traffic fatalities each year in the period 2006–2015.²

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It is estimated that over a third of all fatal road accidents occurring in Europe are work-related (Adminaite, Jost, Stipdonk, & Ward, 2017; Nævestad, Phillips, & Elvebakk, 2015). Thanks to safety strategies targeting general road user safety behaviours, as well as improvements in technology and infrastructure, the number of road fatalities has steadily decreased (Elvik, Haye, Vaa, & Sørensen 2009). To reduce road accident risks for all road users further, there is a need to encourage employers of people who drive for work to improve safety in their organizations (Adminaite et al., 2017). To do this it may help to learn from safety management strategies developed in the safer transport sectors such as aviation.

Traditionally, transport safety interventions have done little to address safety culture directly (Nævestad & Bjørnskau, 2012; Ward, Linkenbach, Keller, & Otto, 2010). In this current paper we ask whether empirical research on attempts to improve safety culture in transport settings can be used to increase the extent to which it is accounted for by traditional transport safety interventions. Before we describe our aims more precisely, we provide background to the study by describing what safety culture is according to some main approaches, and summarising how it has been accounted for by the four main transport sectors in the developed world to date.

1.1. What is safety culture?

It is widely recognized that safety culture is important in organizational settings in hazardous industries (Nævestad, 2010a). The concept is usually traced to the 1986 Chernobyl disaster, which led to a shift of focus in the investigations and studies of safety in organizations. Several major accident investigations subsequently identified safety culture as a major contributing factor (e.g. Cullen, 1990; NASA, 2003).

Organizational safety culture can be defined as "safety relevant aspects of culture in organizations" (Antonsen, 2009; Hale, 2000; Nævestad, 2010a). These aspects may refer to a range of different cultural phenomena such as: ‘observed behavioural regularities when people interact (language, customs and traditions, rituals), group norms, espoused values, formal philosophy, rules of the game, climate, embedded skills, habits of thinking, mental models, linguistic paradigms, shared meanings and ‘root’ metaphors or integrating symbols” (Schein 1992: 8, in Guldenmund, 2000: 225).

As a consequence of the multiplicity of definitions and operationalisations of culture in organizations, it can be argued that the concept of safety culture is fuzzy, as it is abstract and ambiguous enough to lend itself to a range of different specifications. Researchers have pointed to a fragmented literature (Guldenmund, 2007) and terminological confusion within safety culture research (Glendon, 2008). However, in spite of this diversity in the specifications of safety culture, studies of organizational safety culture often seem to treat safety culture as shared and safety relevant ways of thinking or acting that are (re)created through the joint negotiation of people in social settings (Nævestad, 2010a).

Research on culture in organizations is often subsumed under two approaches: the functionalist and the interpretive approach (Glendon & Stanton 2000).3 Functionalist and interpretive scholars differ in their understanding of what safety culture is, their understanding of how safety culture should be measured, and their views on the manageability of safety culture (Nævestad, 2010a). The functionalist approach views culture as a critical variable (Smircich, 1983) influencing certain outcomes: safety, reliability and so forth. Interpretive researchers, on the other hand, conceive of culture as a root metaphor (Smircich, 1983) for the organization, and approach organizations as if they were cultures.

These approaches give rise to different views on how to measure safety culture. It has been argued that the functionalist approach upholds a reified notion of culture, presupposing that it is an entity that one can measure and then evaluate the effects of (Antonsen, 2009). Interpretive scholars, on the other hand, do not view organizational culture as a distinctive entity within the organization, but as an approach to the organization; as an aspect of all organizational phenomena. The former approach often tends to study safety culture quantitatively, as safety climate, while the latter approach tends to use qualitative methods.

Quantitative studies focus on identifying the key aspects of safety culture and their relations to safety outcomes. Safety culture is generally measured by means of safety climate questionnaires (Guldenmund, 2000), and safety climate can be conceived of as "snapshots", or transient manifestations of safety culture (Flin, Mears, O’Connor, & Bryden, 2000). We use the terms culture and climate interchangeably. The most studied and well-documented characteristic of a good safety climate is senior managers’ commitment to safety (Flin et al., 2000; Pidgeon & O’Leary, 2000). This is the prime factor in measurements of safety climate (Flin et al., 2000). Quantitative measurements of safety climate are necessary to compare scores over time, between organizations and to quantify the relationship between safety culture and safety outcomes. Qualitative studies focus on how safety culture provides a frame of reference that guides individuals' interpretations of actions, hazards and their identities, and which motivates and legitimizes behaviours that have an impact on safety (Antonsen, 2009; Nævestad, 2010a).

Interpretive and functionalist scholars’ different views on what safety culture is give rise to diverging views on the issue of cultural management. Functionalist scholars presuppose that safety culture can be changed through various managerial efforts, indicating the wanted way of doing things in organizations (e.g. Schein, 2004). Interpretive scholars, on the other

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3 These approaches can be referred to as ideal types (Weber, 1997): analytical simplifications that do not exist in their pure form in reality. It is evident that the situation in the research field of safety culture is more complex than this ideal typical outline indicates. Although such simplifications are required to distinguish some of the major differences in research on safety culture, it is important to remember that not all safety culture scholars are explicit about their orientation (i.e. functionalist or interpretive). Safety culture research may be explicitly or implicitly interpretive or functionalist. It may also apply an explicitly or implicitly mixed approach (cf. Nævestad, 2010b).
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