Assessing and facilitating warehouse safety

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ABSTRACT

Purpose: The purpose of this paper is to investigate how warehouse safety can be assessed and facilitated.
Methodology: Through a literature study, we build a theoretical framework to provide insights in how safety in Logistics Service Providers (LSPs) can be assessed and facilitated. We perform a case study at a large Dutch LSP using interviews and questionnaires to determine the relevance of the sub-dimensions to assess warehouse safety.
Findings: Using literature, we identify people, procedures and technology related sub-dimensions of safety culture and safety behavior and factors that may affect how safety culture translates to safety behavior. Using a case study our findings indicate which sub-dimensions and influencing factors LSP employees find important and why. We found differences in the importance assigned to safety, which may point to the existence of sub-cultures across warehouses.
Research limitations/implications: This paper contributes to the limited existing warehouse safety literature in which the factors that influence safety are not well explored. Although the case study investigates one LSP and as such does not generalize across LSPs, it provides valuable insights in important aspects of safety and how they can be influenced.
Practical implications: This paper offers safety managers insights in how to assess and facilitate safety within their warehouses.
Originality: Although warehouse safety is important, there is scarce academic research that explores this issue.

1. Introduction

Workplace safety is important for both employees and firms. In this paper, safety is defined as the result of the whole of actions, measures, mental models, etc. in an organization that lead to increasing performance and lowering (operations-related) losses (definition based on ISO 31000:2009 (2009)). Globally, workplace accidents account for 960,000 injured workers and around 5330 fatalities each day (Hämäläinen et al., 2009). In monetary terms, US firms are estimated to spend almost $1 billion per week on direct costs (e.g. medical and legal costs) associated with injuries and fatalities (Cantor, 2008). A range of academic studies has investigated how to improve workplace safety (Cornelissen et al., 2014; DeJoy, 2005; Farina et al., 2015; Hale et al., 2010; Kines et al., 2013; Mearns et al., 2003; Morillas et al., 2013; Vredenburgh, 2002) and research on safety has covered a wide range of industries, including the energy and chemicals industries (Bragatto et al., 2015; Mearns et al., 2003; Vinodkumar and Bhasi, 2009), various

manufacturing industries (Hermann et al., 2010; Lo et al., 2014; Nenonen, 2013), construction (Choudhry et al., 2007a; Cigularov et al., 2010; Shen et al., 2015), aviation (Evans et al., 2007; Liao, 2015; O'Connor et al., 2011), and mining (He and Song, 2012; Paul and Maiti, 2007; Saleh and Cummings, 2011).

Safety is especially important in the logistics services industry. Data from 2014 indicates that in the United States the transportation and warehousing sector accounts for the second highest number of fatalities (U.S. Bureau of Labor Statistics, 2015). Additionally, its injury rate of 13.5 persons per 100,000 workers is around four times as high as the average injury rate across industries (U.S. Bureau of Labor Statistics, 2015). This can be explained by several factors: the logistics services industry is labor intensive and requires a high level of materials handling (Cantor, 2008; Goode et al., 2014); heavy vehicles such as forklifts move around in close proximity to workers; and the workforce operates under time pressure (De Koster et al., 2011). Academic research on safety in logistics has mainly focused on transportation and in

particular on safety in relation to motor carriers (Cantor, 2008). Surprisingly, literature on safety in warehousing is scarce (De Koster et al., 2011).

In this paper, we focus on safety culture and safety behavior in warehouses. We found that in this context several issues regarding warehouse safety remain unaddressed. It is unknown how an organization's safety culture and safety behavior can be measured within the logistics services industry. The term 'safety culture' was used for the first time in 1986 by the nuclear industry in a Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident (Edwards et al., 2013; International Nuclear Safety Advisory Group, 1991). Since 1991 many definitions have been proposed based on a variety of studies undertaken by diverging disciplines. Despite widespread agreement about the importance of the concept, a single definition has yet to emerge and gain widespread acceptance within the scientific community (Edwards et al., 2013; Guldenmund, 2000; Strauch, 2015). Recent research by Vierendeels et al. (2016) conceptualizes a safety culture as consisting of observable, perceptual, and psychological elements.

For the purpose of this study, we focus on observable safety culture (hereafter referred to as safety culture). Safety culture can be seen as the integrated sum of certain observable factors that should be a proxy for the existence, quantity, and quality/adequacy of safety procedures, work instructions, a safety management system, safety-related technology, safety software, safety practices, safety training, safety behavior, safety knowledge, safety communication, etc It is assumed that the observable aspects of a safety culture strongly depend on available resources for safety within a firm (Reniers, 2010). Reniers (2010) and Reniers et al. (2011) argue that the aspects of a strong safety culture can be grouped under three dimensions: people, procedures, and technology (Reniers, 2010; Reniers et al., 2011). A majority of (near) accidents is caused by human error (Fuller and Vassie, 2004). Therefore people—who may, or may not, have e.g. safety knowledge and skills, be involved in safety issues, or place a high priority on safety—are an important dimension of a safety culture. The second important dimension of a safety culture, procedures, is interpreted broadly and includes, for instance, rules on how to work safely, how to handle emergencies, or how to operate equipment. The third dimension, technology, is important because it may, for instance, help to prevent or minimize hazardous situations. The interplay between these dimensions determines whether a safety culture is present (Reniers et al., 2011). While a safety culture is shared by members of an organization (Edwards et al., 2013), actual safety-related behavior, e.g. the (in)correct use of a forklift truck by a warehouse employee, takes place at the individual level. However, individuals are also members of the organization; thus, safety behavior is arguably shaped by the underlying safety culture (Myers et al., 2014). We therefore interpret safety behavior as related to the same three dimensions as safety culture (people, procedures, and technology). In the remainder of this paper we consider safety behavior as related to these three underlying dimensions.

It is unknown which factors influence the translation of safety culture into safety behavior in the logistics services industry (but also in other industries). What is known is that behavior is influenced by culture but also by contextual factors that interact with culture (Edwards et al., 2013). Extrinsic factors such as rewards can be used to induce safe behavior (Zohar and Erev, 2007). This implies that there are contextual factors that can influence how safety culture shapes safety behavior which is in line with Schein (2010). In this study, we address the measurability of safety culture and safety behavior, as well as the factors influencing the translation from a safety culture to safety behavior (see Fig. 1).

Through our study, we aim to make several theoretical and practical contributions. First, we aim to contribute to the safety literature by providing insights into how warehouse safety can be assessed. In doing so, we are answering a call for safety research to be undertaken in operational settings (e.g. Das et al., 2008). Second, we aim to contribute to the identification of factors influencing the translation of safety
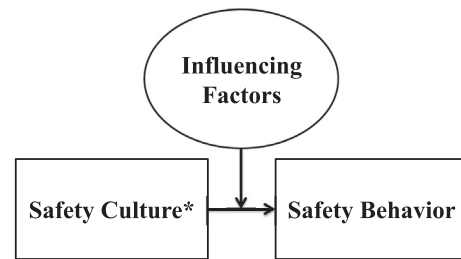

Fig. 1. Conceptual model. * Measured via its observable factors.

culture into safety behavior. Not only would this effort complement existing safety literature in other industries, it also benefits warehouse managers struggling with safety issues on a daily basis (Goode et al., 2014; De Koster et al., 2011). Interventions to improve safety require an understanding of the factors that influence safe behavior (Fugas et al., 2012). By making these two contributions, we also aim to further clarify both safety culture and safety behavior from a theoretical standpoint. Although these are different concepts (Myers et al., 2014), the literature seems to implicitly assume that a safety culture automatically results in safe behavior (Guldenmund, 2000).

In order to investigate the issues mentioned, we present a literature study to explore the concepts under investigation and relate them to each other. We then refine and empirically assess the concepts and their relationships through a case study at a large Logistics Service Provider (LSP), considered to be a leader in its industry. Case research is considered appropriate given the exploratory nature of our study (Eisenhardt and Graebner, 2007; Voss et al., 2002; Yin, 2009). For the case study, we interviewed employees working at different hierarchical levels (i.e. managers, team leaders, and workers) at three different warehouses of the company (see also the Methodology section).

The remainder of the study is organized as follows. In Section 2 we define, explore, and link together the key concepts. In Section 3 we present our research method and instrument, as well as our data analysis procedure. In Section 4 we present the outcomes of the case study and in Section 5 we discuss results, acknowledge the limitations of our study, analyze the theoretical and practical implications, and reflect on directions for further research. Section 5 ends with summary conclusions.

2. Literature study

2.1. Introduction

Academic research on safety in logistics has mainly focused on transportation, and in particular on safety in relation to motor carriers (Cantor, 2008). Among others, studies investigate characteristics of professional drivers (e.g. personality, health, attitude), stressors they face (time pressure, fatigue, stress) and how these relate to safety behavior and/or accidents (Douglas and Swartz, 2009, 2016; Grytnes et al., 2016; Kemp et al., 2013; de Vries et al., 2017). Recently, warehouse safety has started to gain attention. For instance, De Koster et al. (2011) analyze which factors impact warehouse safety. They find that hazard-reducing systems (HRS; safety processes and procedures such as safety markings, mirrors, personal protection like safety shoes) and safety-specific transformational leadership (SSTL; a leadership style motivating employees to 'go the extra mile') have a large influence on warehouse safety. Interestingly, they also find that safety consciousness (one's awareness of safety) does not mediate the effect of SSTL on warehouse safety. Subsequently, de Vries et al. (2016) find that prevention focused leaders (who focus on rules, procedures, duties and responsibilities) are more likely to show SSTL, which in turn is associated with lower accident rates.

Regulations regarding the storage of products in warehouses are substantial particularly in the context of hazardous materials.