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A mixed methods research design for bridging the gap between research and practice in construction safety

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ABSTRACT

One perspective on construction safety practice and knowledge sees them as mutually constituted and intertwined. As such, it is important that construction safety research generates knowledge and understanding which is closely connected with safe working practices across contexts. This paper reviews the construction safety literature in order to explore the extent to which the knowledge generated by research considers the situated nature of safety learning and, therefore, addresses the needs of industry practice. The research methods adopted in 88 construction safety articles published by five highly-ranked international journals and one international conference proceedings were evaluated. The analytical results show that nearly half (43.2%) of the safety papers used quantitative methods while about a quarter (23.9%) applied qualitative methods and very few (9.1%) adopted mixed methods research. The remainder was review or conceptual papers. The implications of the research methods adopted in the 88 papers are discussed in terms of their relationship with the kinds of safety knowledge, safety learning processes, and safety management practices that they inform and/or generate. It is argued that a greater use of mixed methods research might act to better integrate the realms of theory and practice by enabling the co-production of safety theories and knowledge between university researchers and industry practitioners. The research design proposed in this paper provides a framework as a point of departure for academic researchers and industry practitioners to work together to improve construction safety performance.

1. Introduction

1.1. Importance of construction safety

Construction is one of the major industries that contributes to national and global economies. It represents a $7.5 trillion market accounting for 13.4% of the world's economic output (Betts et al., 2009). The construction industry also employs about 200 million people, contributing significantly to the world's employment (Murie, 2007). Furthermore, the industry has an important role in supporting other industries, such as the concrete, steel, timber, paint, and heavy manufacturing (Jackson, 2004). Despite these contributions, however, it is notorious for being one of the most dangerous industrial sectors (Lingard and Rowlinson, 2005; Murie, 2007; Safe Work Australia, 2012a, 2012b). About 30–40% of the world's work-related fatal injuries occur in the construction industry, which equates to approximately 100,000 fatalities annually (Murie, 2007). The high rates of accidents and fatalities have caused much pain and suffering (Lingard and Rowlinson, 2005) as well as financial losses. Accidents can lead to prosecution and claims that will incur extra costs, delays, adverse publicity, and may threaten the financial health of a company (Holt, 2005). The reputation of a company is at stake when it does not implement proper safety measures to protect the safety and wellbeing of its employees (Lingard and Rowlinson, 2005).

The increasing interest in and focus on construction safety has supported the growth of a body of construction safety research, and a concurrent expansion of the types of research methods and processes being undertaken (Zou and Sunindijo, 2013). However, despite this, there has not been a systematic examination of the nature of construction safety research or the kinds of knowledge that the research generates. If a gap exists between the direction taken by construction safety researchers and the nature of construction safety practice and safety learning, research may fail to inform the development of approaches which resonate with practice perspectives.

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1.2. Construction safety learning and knowledge development

Safety can be seen as a set of practices constituted by competences that a person learns through engagement and participation in daily activities (Baarts, 2009). This learning is fundamental for maintaining and improving safety performance in the construction industry. Although many have recognized the importance of organizational learning and knowledge management, critics argue that current organizational practices ignore the problems and complexities in the process of knowledge making and learning (Styhre, 2006). As pointed out by Gherardi and Nicolini (2000, 2002), many organizations consider learning simply as an acquisition of knowledge which can be achieved through instruction and training in a classroom setting, and that knowledge is available somewhere and learners need to acquire and store it in proper compartments of their minds. This view sees learning as being achieved by simply 'plucking an item from the tree of knowledge' (Tsoukas and Mylonopoulos, 2004). Many educational and training approaches adopt a philosophy that views learning as a product that can be simply added to the mind or readily stored and transmitted via some kind of electronic technology (Hager, 2004). Consequently, much organizational learning literature and studies have focused on the codification, packaging and dissemination of knowledge throughout organizations and workplaces.

Although the approach described above may seem practical and straightforward, a countervailing view would be that learning does not comprise a technological device, but something that is situated in local practices where people collaborate and cooperate to solve daily issues (Styhre, 2006). From this perspective, safety should be considered as the final outcome of a collective construction process. A safe workplace, therefore, is the result of constant engineering of diverse elements (e.g., skills, materials, interpersonal interactions) which are integral to the work practices of various project stakeholders. In other words, learning about safety involves taking part in the social world, i.e., learning takes place among and through others (Gherardi and Nicolini, 2002).

In the reality of construction projects, many problems do not neatly fit into predetermined categories, thus forcing construction practitioners to employ novel solutions and creative strategies to manage non routine situations (Wadick, 2006). Saurin et al. (2008) support this view by stating that construction workers are often required to make important decisions in a dynamic work environment. This kind of work environment demands them to talk to each other about potential hazards while they are in action and employ their own adaptive accident prevention strategies without waiting for site management approval.

In a workplace, learning (including safety learning) often occurs via peer learning or collaboration between peers and fellow professional groups. Seeing, saying, showing, telling, reading, reflective thinking, and learning-by-using are how individuals acquire new skills and knowledge (Styhre, 2006). Gherardi and Nicolini (2002) suggested that knowledge is integrated and distributed in everyday activities, and so learning cannot take place if participation in those activities is not possible. Due to this reality, Wadick (2006) argued that construction practitioners, especially workers, do not consider safety regulations, training, and research as something beneficial for them. They believe that many safety rules do not address their real safety concerns, but merely an attempt by powerful bureaucrats to dominate and subjugate their subjects. As a result, they resist such instructions by doing as little as they can to comply, a far cry from the 'best practice' that those regulations, training, and research often try to achieve (Wadick, 2006). Furthermore, other studies (e.g., Burke et al., 2006, 2011; Laukkanen, 1999) have shown that a classroom-like training setting only has short-term impacts on safety performance. After a short period of time, workers tend to forget what they have learned and as a result safety performance returns to where it was before (Laukkanen, 1999).

Most research is designed and implemented based on the assumption that knowledge and learning are primarily individual and mental processes (Gherardi and Nicolini, 2000). Although the importance and necessity of this approach is undeniable, construction safety research should recognize the alternative paradigm where safety knowledge and learning are seen as social and cultural phenomena developed through interactions of individuals with each other and with non-human artifacts while working on sites (Wadick, 2006). In other words, learning should not only be seen as a product, but also a process where the learner is part of the environment. This view of learning emphasizes the context and the influence of cultural and social factors in the learning process (Hager, 2004). Due to this reality of safety learning in practice, a modification to the methods of conducting construction safety research may be needed to investigate this alternative paradigm. This point was also raised by Gherardi and Nicolini (2002).

1.3. Mixed research methodologies and methods in construction management and safety

A special issue on research methodologies in construction engineering and management published by the *Journal of Construction Engineering and Management* in 2010 (Vol. 136 Issue 1) presented and exemplified a diverse range of methods for exploring various problems relating to the organization and management of construction. Thirteen papers were published in that special issue in which five elaborated the application of quantitative methods (i.e., archival data analysis (Lucko and Mitchell, 2010), experimental research (Bernold and Lee, 2010), empirical modeling (Flood and Issa, 2010), multiobjective optimization (Kandil et al., 2010), and discrete event simulation (Martinez, 2010)), while the other five on the application of qualitative methods (i.e., ethnography (Phelps and Horman, 2010), best practice of charrettes or structured workshops (Gibson and Whittington, 2010), observation (Leicht et al., 2010), action research (Azhar et al., 2010), and Delphi method (Hallowell and Gambatese, 2010)), and three papers offered methodological insights that apply to a range of research methodologies, namely research validation (Lucko and Rojas, 2010), contextualist research (Green et al., 2010) and mixed method research (Abowitz and Toole, 2010). Together these 13 papers provide a comprehensive picture of the methods that have been used by construction management researchers in the past 15 years and offer critical insights that challenge current practice to further research in this area (Taylor and Jaselskis, 2010). Two of these papers hold especial relevance here. The first presented the benefits of the knowledge co-production mode of research (Green et al., 2010). This suggested that research outputs not only provide short-term benefit for industry partners, but also contribute to the advancement of the conceptual understanding beyond the immediate context of the research. A second paper of interest here was that by Abowitz and Toole (2010), which supported the application of mixed methods research in construction research, arguing that this let to the improved validity and reliability of research outcomes. It remains to be seen, however, whether either research approach is prevalent within construction safety research or how relevant dominant approaches are to construction safety practice.

1.4. Research aims and objectives

Given the practical, social and "in-situ" nature of safety learning described above, there is a need to examine current construction safety research to ensure that the kinds of knowledge and understanding developed by the research are aligned with the need to