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Putting into practice error management theory: Unlearning and learning to manage action errors in construction

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ABSTRACT

Error management theory is drawn upon to examine how a project-based organization, which took the form of a program alliance, was able to change its established error prevention mindset to one that enacted a learning mindfulness that provided an avenue to curtail its action errors. The program alliance was required to unlearn its existing routines and beliefs to accommodate the practices required to embrace error management. As a result of establishing an error management culture the program alliance was able to create a collective mindfulness that nurtured learning and supported innovation. The findings provide a much-needed context to demonstrate the relevance of error management theory to effectively address rework and safety problems in construction projects. The robust theoretical underpinning that is grounded in practice and presented in this paper provides a mechanism to engender learning from errors, which can be utilized by construction organizations to improve the productivity and performance of their projects.

1. Introduction

> A prudent man foresees the difficulties ahead and prepares for them; the simpleton goes blindly on and suffers the consequences." Proverbs 22:3

Within construction, errors have a negative influence on the quality and safety performance of projects (Love et al., 2004; Wanberg et al., 2013). For example, a lack of quality workmanship often follows a deviation from a standard or protocol. Consequently, this requires additional work (i.e. rework) to ensure it conforms to specified standards. When such additional work is undertaken, it has been revealed that the likelihood of a safety event occurring significantly increases (Love et al., 2015a). The corollary being the suggestion that a symbiotic relationship exists between quality and safety performance (Husin and Adnan, 2008; Wanberg et al., 2013; Love et al., 2015a,b). Both rework and safety incidents are issues that the construction industry has been trying to tackle for decades, but with limited avail. Contributing to this lack of success has been the absence of a theoretical underpinning that can be applied to redress the issues associated with rework and safety incidents (Love et al., 2016a). With this in mind, error management theory is drawn upon to examine why and how a project-based organization, which took the form of a program alliance, was able to significantly reduce and contain its errors. In doing so, the program alliance embarked on a task of rejuvenating itself through a metamorphosis that was engendered by *unlearning*. This enabled the alliance to simultaneously improve its quality and safety performance, and cultivate a mindfulness that enabled people to improvise and effectively handle its errors.

The research presented in this paper provides a much-needed context to demonstrate the relevance of error management theory to effectively address rework and safety problems in construction. In addition, the insights and experiences derived from the case study provide learning opportunities for organizations that are seeking to improve their quality and safety performance of the projects that they are charged with delivering.

2. Error management

Errors are difficult to define (Van Dyck et al., 2005). Reason (1990) suggests that the study of error is largely an inductive mode of enquiry, and does not demand precise axioms and definitions at the outset, as do the deductive sciences. The ambiguity surrounding the meaning of an error led Hollnagel (1993) to state "most authors wisely refrain from giving a clear definition" (p. 5). Putting aside this equivocality, it is generally assumed that human error manifests itself when something is done that is "not intended by the actor; not desired by a set of rules or

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an external observer; or that led the task or system outside its acceptable limits" (Senders and Moray, 1991: p.25). In essence, an error is a deviation from intention, expectation or desirability. Human actions can fail to achieve their goal in two different ways (Reason, 1990; Hollnagel, 1993): (1) the actions can go as planned, but the plan can be inadequate, which can result in mistakes; (2) or, the plan can be satisfactory, but the performance can be deficient, which can lead to slips and lapses occurring. A detailed review of 'what errors are and what they are not' can be found in Gold et al. (2014, 2016).

Errors have been typically deemed to be indicators of poor performance and negligence (Mangels et al., 2006). When errors materialize, there is a natural reaction to apportion blame and engage in hindsight bias. Moreover, the fear of being caught for making errors can result in people hiding them when they occur. A negative mind-set is created toward error-making. According to Frese and Keith (2015) people do not like to be seen making an error and therefore the tendency is for an error prevention approach to be adopted. Love and Smith (2016) have suggested that many construction organizations have been prone to adopting an error prevention strategy as they typically hide and do not admit to undertaking rework, despite it adversely impacting their bottom-line. Nonetheless, it must be recognized that errors, which contribute to rework, are ubiquitous and cannot be prevented. Accordingly, Frese and Keith (2015) state "errors cannot be completely prevented; the cognitive apparatus of humans is made for error-prone heuristic processing and not for potentially error-free algorithmic processing" (p.665).

2.1. Unlearning and learning

Organizational learning has been positively linked to a construction organization's performance (Wong and Lam, 2012) and project performance (Wong and Cheung, 2008). A plethora of definitions for organizational learning abound in the normative literature; it is, however, basically "a process of embedding and applying knowledge, integrated by individuals and directed toward organizational success" (Wong and Lam, 2012: p.1203). Many construction organizations do not have the capability to learn (Wong and Lam, 2012). Therefore, if learning cannot be accommodated in their existing routines, their ability to initiate the behavioral changes that are often needed to generate performance and productivity improvement, can be thwarted (Akgün et al., 2006).

When learning does occur in construction organizations, it is generally single-looped (SL) (Dikmen et al., 2005; Wong et al., 2009); errors are recognized and corrected to ensure the anticipated outcomes. In contrast to SL, double-loop learning (DL) requires a revision of the fundamental assumptions and actions after undertaking a comprehensive review of root causes of errors. For a construction organization, DL is required when error management is fully embraced. A pre-condition to implementing error management is unlearning old routines and beliefs so new ones can be adopted. Through a process of 'unlearning', the mind-set of the organization can be modified to accommodate the belief that the existence of errors can stimulate learning and the sharing of knowledge about their occurrences. However, a construction organization must have a legitimate reason for switching from error prevention to an error management focus (Akgün et al., 2006). Accordingly, Carmeli and Schaubroeck (2008) state that the unlearning process can be triggered when an organization's basic assumptions are challenged by undesirable outcomes, or when survival is threatened by changed market conditions.

Attending to an error that requires rework can be stressful due to the prevailing cost, time and resource constraints (Love et al., 2004). During the rectification process, workers are often subjected to time pressures and are prone to committing more errors. It is, however, impossible to reduce errors to zero, which is a core aim of error prevention. Recognizing the fallibility of people, Frese (1991) introduced the concept of error management as a supplementary approach to initiate learning and knowledge sharing about error occurrences. Fig. 1 identifies the difference between error prevention and error management.

Error management commences once an error has occurred and seeks to alleviate its negative consequences or impact through design and training (Frese and Zapf, 1994; Hofmann and Frese, 2011). It involves coping with errors to avoid their negative consequences. In doing so, they are attended to as quickly as possible to control any adverse impact that may arise. Knowledge relating to the causes of errors are identified and shared to reduce their future occurrence. Moreover, error management also optimizes the positive consequences of errors to engender long-term learning, performance and innovations (Frese and Keith, 2015).

The common error management practices include (Van Dyck et al., 2005): (1) analyzing error (2) communication error, (3) knowledge error sharing, (4) error assistance (5) handling and coordinating error. According to Van Dyck et al. (2005), communication about errors is the most important practice as it allows for the development of shared knowledge. Open communication about errors provides the basis for people to assist in minimizing their adverse consequences in a timely manner.

3. Research method

The research presented in this paper focuses on *action errors* that manifest themselves during the construction process. Action errors are defined as "unintended deviations from plans, goals or adequate feedback processing as well as incorrect action that results from a lack of knowledge (Van Dyck et al., 2005: p.1229). Action errors can result in rework and safety events materializing during construction.

Under the umbrella of error management theory, a case study approach is used to examine 'why' and 'how' a program alliance was able to significantly improve its quality and safety performance because of implementing a project lifecycle Safety, Quality and Environment (SQE) program in conjunction with a rework containment and reduction strategy. As a result of implementing these initiatives and establishing a cooperative learning culture (Love et al., 2015b), the National Safety Council of Australia (NSCA) bestowed both the 'Pinnacle Award' for excellence in workplace health and safety, and the award for 'Best Safety Leadership Program' in 2013 to the alliance. It was this award that drew the researchers' attention to the unique initiatives being implemented to combat rework incidents and improve safety performance. The alliance established a culture of willingness to openly report and communicate rework and safety issues; this is a rare occurrence in construction.

The program alliance was charged with delivering 129 water infrastructure projects over a five-year period to a value of AU$375 million. It went about reducing safety incidents and rework through a process of context-specific learning that was engendered by authentic leadership, engagement and empowerment and a strong focus on continuous improvement. The specific details of the 'change management process' that led to the alliance developing their rework containment and reduction strategy in their project lifecycle SQE program can be found in Love et al. (2016b).

3.1. Data collection

To understand the context and subsequent impact of the program alliance's SQE program, a triangulated approach was adopted to overcome problems associated with bias and validity. Unstructured interviews, documentary sources (e.g., lessons learned database, workshop notes, and reports), and non-participant observation which involved site visits, formed the cornerstones of the data collection process (Fig. 2).

Data on quality and safety incidents that arose from 2010 to 2014 were derived from the alliance's database. To supplement this data and gain insights into how the alliance embraced an error management