Are you sure you want me to follow this? A study of procedure management, user perceptions and compliance behaviour

Lisette Kanse[a,*], Katharine Parkes[a,b], Melinda Hodkiewicz[a], Xiaowen Hu[a,c], Mark Griffin[a]

[a] The University of Western Australia, 35 Stirling Highway, Perth, WA 6009, Australia
[b] Department of Experimental Psychology, University of Oxford, South Parks Road, Oxford OX1 3UD, United Kingdom
[c] Queensland University of Technology Business School, 2 George Street, Brisbane, QLD 4000, Australia

ARTICLE INFO

ABSTRACT

Adherence to procedures is critical to the safety and performance of maintenance tasks; however, few studies of procedure compliance among maintenance personnel have been reported. The present study evaluated a theoretical model in which management approaches to procedure compliance were linked to compliance outcomes through user perceptions of positive and negative procedure attributes. New scales were developed to assess these variables; hypotheses derived from the model were tested in survey data collected from maintainers in the mining industry (N = 176). A structural equation model showed acceptable fit statistics; findings were broadly consistent with the initial hypotheses.

As predicted, positive and negative dimensions of procedure attributes and compliance/non-compliance were perceived as distinct constructs, and were implicated in different pathways of the model. Also supporting the initial hypotheses, user involvement and managers' learning-oriented responses to non-compliance were linked to favourable compliance outcomes through perceived procedure attributes. Learning-oriented responses were also directly associated with greater compliance. In addition, and contrary to prediction, punitive management responses positively predicted compliance. As discussed in the paper, these findings contribute new insights, relevant in both research and industry contexts, to understanding procedure compliance among maintainers.

1. Introduction

The maintenance of physical plant and equipment is essential to the safety and smooth running of industrial operations, particularly in hazardous work environments. High standards of maintenance performance are necessary to ensure the safety of maintenance workers and the reliability of equipment returned to service. One specific aspect of maintenance performance with critical implications for safety is the extent to which maintainers comply with the formal rules and procedures that specify how particular tasks should be carried out. However, few empirical studies of factors associated with procedure compliance among maintenance personnel have been reported, even though evidence suggests that maintainers tend to be over-represented in the fatality statistics of heavy industries (Department-of-Mines-and-Petroleum, 2014), and procedure violations have been identified as contributory factors in several accident investigations (Miskell, 2013; Sterling, 2013; Thomas, 2007). The present study addresses the topic of compliance with maintenance procedures in the mining industry; this work environment exposes maintenance personnel to a wide range of complex tasks, and to hazardous physical work conditions (e.g. heavy machinery, electrical power sources, and close proximity to moving vehicles). Thus, safety issues are particularly salient and the challenge of ensuring compliance with procedures is a fundamental concern for safety researchers and practitioners.

In the present paper, in line with Hale and Borys (2013a), the term 'procedure' is used to refer to any instruction specifying how a job has to be done. Maintenance procedures include both general rules and detailed task-specific instructions, both of which have safety implications; thus, if rules are disregarded, or if steps in the procedure are not correctly followed, an accident or hazardous situation may result. A widely-held view of procedures, noted by several authors (Hale and Borys, 2013a; Reason et al., 1998; Weichbrodt, 2015), is that procedures provide a means of standardizing and controlling behaviour, and thus reduce human error and accident risk. The view that procedure-following is the way to achieve safety corresponds to 'Model 1' of procedures, as noted by Dekker (2003) and later by Hale and Borys (2013a). However, many researchers consider that there are limits to the effectiveness of using procedures to prescribe and control behaviour (Amalberti et al., 2006; de Brito, 2002; Hale and Borys, 2013a; Hudson et al., 1998; Oltedal and Engen, 2011; Reason et al., 1998). Use of

* Corresponding author.
  E-mail addresses: lisette.kanse@uwa.edu.au (L. Kanse), xiaowen.hu@qut.edu.au (X. Hu).

multiple procedures tends to limit the flexibility with which employees can achieve desired work goals under non-standard conditions, or in changing work environments, while frequent procedure amendments may create uncertainty about which actions are, or are not, still permitted.

In some instances, a procedure may not be relevant to the task concerned; if so, violation or modification may be the most appropriate action (Hudson et al., 1998; Reason et al., 1998). Dekker's 'Model 2' of procedures (Dekker, 2003), reflects this point of view, treating procedure use as a cognitive activity in which operators make skilled judgements about adapting procedures to circumstances. Consistent with this approach, a recent study of pilots showed that some flight situations they encountered were much more complicated than anticipated in the relevant procedure. To cope with these non-standard situations, pilots combined information from a range of available resources, interleaving fragments of checklists with other relevant data (Carim et al., 2016). Thus, procedures represented 'resources for action' rather than prescribed rules for discrete responses. These insights point to the effects of procedure characteristics on procedure following behaviours. Moreover, Hale and Borys (2013b) and Weichbrodt (2015) suggest that these behaviours can be influenced by how procedures are managed.

It is therefore important to consider the extent to which compliance with procedures is influenced by procedure attributes, and by the effects of different approaches to procedure management. In the following sections, we review literature addressing these issues. This review forms the basis of the hypotheses from which our two-stage research model is developed. The model represents pathways by which perceived procedure attributes and procedure management strategies impact on procedure-following behaviours.

2. Factors influencing procedure following

2.1. Literature review

Reflecting the increasing research interest in the topic of procedure following, studies that identify factors associated with compliance or non-compliance with procedures have been carried out in a wide range of industries, particularly aviation and transport. As a background to the present study, Table 1 summarises findings from relevant research. From this overview, it is clear that both procedure attributes and how procedures are implemented and managed by the organization play important roles in determining procedure-following behaviours.

2.1.1. Procedure attributes

Several of the studies summarised in Table 1 identify procedure attributes associated with poor compliance. Thus, procedures that are perceived to be difficult to access (Dahl, 2013), unclear (McDonald et al., 2000), vague (Dahl et al., 2013), poorly written (Oltedal and Engen, 2011), outdated (Lawton, 1998), providing too much or too little information (Laurence, 2005), inappropriate for the task, and/or unworkable (Lawton, 1998) are likely to lead to poor compliance, which in turn may jeopardise the quality of the work carried out (Hobbs and Williamson, 2002). For instance, Laurence (2005) found that the most frequently reported problems with procedures were lack of real-world understanding, too many to remember, too inflexible, not written in plain language, and poor or wrong in content. Similarly, Hale (1990) refers to a study of Dutch railway employees in which 85% of workers reported that it was difficult to find the procedure required, 70% perceived the procedures to be too complex, and 95% did not think the work could be finished on time if all procedures were followed.

As maintenance requirements vary widely and many tasks occur only infrequently, an extensive set of procedures may be necessary to provide sufficient information to allow users to carry out tasks correctly. The level of detail required depends on the competence of the staff, the complexity of the task, and how frequently the procedure is carried out (Mason et al., 2000). To ensure that procedures are followed

correctly, they should be up-to-date, presented clearly, workable, and relevant to the task in hand; if instructions are poorly presented, unduly complex, or difficult to access, staff will resist using them. These important aspects of effective procedure design and documentation are summed up in the concise advice of Besnard and Greathead (2003), *"design workable instead of exhaustive procedures"*. Moreover, explaining the purpose of controls and checks included in the procedure increases operators' understanding of the task and its potential hazards, and thus reduces the likelihood of non-compliance (Mason et al., 2000). These points, and other issues of procedure presentation and usability, are set out in reviews concerned specifically with maintenance procedures (Mason et al., 2000; Reason and Hobbs, 2003) and with procedure use in general (Alper and Karsh, 2009; Hale and Borys, 2013a).

2.1.2. Management of procedures

Compliance with procedures is not solely determined by procedure attributes; how procedures are managed also has important implications for procedure-following behaviours. Three aspects of procedure management are particularly relevant to the present study: first, the extent to which users are involved in the development, implementation and updating of procedures, second, the extent to which managers use instances of non-compliance or poor compliance as opportunities for feedback, learning, and skill development and, third, the related issue of punishment-oriented approaches to the management of procedure compliance.

2.1.2.1. User involvement in the design and modification of procedures.
The extent to which users have opportunities to contribute to the modification and improvement of procedures plays an important role in encouraging compliance; conversely, lack of involvement in procedure design tends to reduce compliance. Thus, Hale and Borys (2013a) found that non-participative management styles and poor co-operation between supervisor and workers, both of which tend to reduce opportunities for operators to be involved in procedure development, were related to non-compliance. Similarly, Simard and Marchand (1997) reported that a cooperative workgroup-supervisor relationship, which was associated with participatory supervisory management, was the most important predictor of compliance with safety rules.

More generally, Weichbrodt (2015) identifies the involvement of users in rule creation and adaptation as one of four strategies of good procedure management, whilst observing that participation is more likely to occur when adaptations are made to existing rules (including updating and modification) than in the design of entirely new rules. He cites studies in which the participation of employees in rules revision had favourable effects on safety culture, incident rates, and compliance; other benefits included a reduced number of safety rules, more workable rules, and increased 'psychological ownership' of the rules by the workforce.

2.1.2.2. Management of non-compliance: learning-oriented responses.
Managers have important responsibilities for encouraging good practices in relation to procedure following, and for correcting violations and poor compliance. Treating instances of non-compliance as opportunities for feedback and learning represents a positive approach to managing procedure violations. Thus, supervisory responses to non-compliance may include identification of the operator's reasons for not following the required procedures (e.g. lack of clarity, unduly complex, or out-dated), provision of information about the correct procedure, ensuring that the operator understands the need for the specific requirements (Mason et al., 2000) and, if appropriate, arranging further training (Weichbrodt, 2015). Procedure modifications and improvements in procedure quality may also be considered (Hudson et al., 1998). Communication and feedback about non-compliance facilitates individual learning, and potentially leads to favourable perceptions of procedures, and to increased