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Leading and lagging indicators of occupational health and safety: The moderating role of safety leadership

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ABSTRACT

In response to the call for empirical evidence of a connection between leading and lagging indicators of occupational health and safety (OHS), the first aim of the current research is to consider the association between leading and lagging indicators of OHS. Our second aim is to investigate the moderating effect of safety leadership on the association between leading and lagging indicators. Data were collected from 3578 employees nested within 66 workplaces. Multi-level modelling was used to test the two hypotheses. The results confirm an association between leading and lagging indicators of OHS as well as the moderating impact of middle management safety leadership on the direct association. The association between leading and lagging indicators provides OHS practitioners with useful information to substantiate efforts within organisations to move away from a traditional focus on lagging indicators towards a preventative focus on leading indicators. The research also highlights the important role played by middle managers and the value of OHS leadership development and investment at the middle management level.

1. Introduction

Occupational health and safety (OHS) measurement relies heavily on lagging indicators, such as incidents of workplace injury, as these measures provide important feedback information about deficiencies and safety incidents that have occurred (Reiman and Pietikäinen, 2012). Lagging OHS indicators are, however, a reactive measurement approach to safety management and measure events or outcomes that have already happened (Hopkins, 2009; Laitinen et al., 2013; Reiman and Pietikäinen, 2012). As such, lagging indicators are "failure-focused" (Sinelnikov et al., 2015). Recent research emphasises a more proactive evaluation of OHS activity that emphasises leading indicators, or inputs, that allow organisations to predict safety concerns and that may reduce the likelihood of an OHS incident occurring (Grabowski et al., 2007; Lingard et al., 2011; Reiman and Pietikäinen, 2012). Leading indicators can be thought of as eliminating or controlling the precursors to harm and as such offer organisations the opportunity to detect and mitigate risks or risk increases before an OHS incident occurs or a hazardous state is reached (Sinelnikov et al., 2015).

Sinelnikov et al. (2015), in their study of the state of knowledge and practice on the use of leading indicators of OHS, explained that although there is increasing interest in leading indicators, there is a need for further evidence of the link between leading and lagging indicators. These authors also noted the potential enabling impact of leadership in terms of implementing leading indicators. As recognised in the social information processing perspective (SIP), leadership behaviour is an important determinant of the development of employee job attitudes and behaviours (Chen et al., 2013). The aim of the current research is to address the research gaps noted above by considering: 1) the association between leading and lagging indicators of OHS, and 2) the moderating effect of safety leadership on the association between leading and lagging indicators.

The structure of the paper is as follows. First, the literature on leading and lagging indicators of OHS will be reviewed. Hypotheses are then developed in relation to how leading and lagging indicators are likely to be associated and whether this association is moderated by safety leadership. Second, the methods used for the study are described. The third section of the paper presents the results of the study, while the fourth section provides a discussion of the study's results and contribution. The final section of the paper provides an overview of the study's limitations and avenues for future research.

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2. Theory

The following sections review the literature on leading and lagging indicators of OHS and, drawing from a social information processing (SIP) perspective, an argument is made for the moderating effect of safety leadership on the association between leading and lagging indicators.

2.1. Leading and lagging indicators of OHS

Injuries and accidents in the workplace can engender potentially damaging consequences for individual employees and have serious work performance outcomes at the organisational level (Battaglia et al., 2015; LeBeau et al., 2014). Lagging indicator data provide necessary information on safety performance related to injuries and accidents that can motivate people to work on improving safety performance (Reiman and Pietikäinen, 2012). Relevant lagging data include workplace injuries and near misses (Goldenhar et al., 2003; Li et al., 2013; Probst et al., 2013), often based on self-reported incidents (Wachter and Yorio, 2014).

Sinelnikov et al. (2015) have explained that leading indicators, in contrast, can eliminate or control the precursors to harm and provide early warning signals of potential failure. Leading indicators are associated with active, positive steps that organisations can take to avoid an OHS incident (Baker et al., 2007; Blair and O'Toole, 2010; Grabowski et al., 2007; Lingard et al., 2011). Lagging indicators on the other hand are failure focussed and measure OHS incidents that have already happened (Hopkins, 2009). Leading indicators are valuable therefore as they enable organisations to identify and correct deficiencies to prevent or mitigate the worst effects of injuries or damage.

Despite the potential worth associated with leading indicators of OHS, definitions of the construct are unclear (Reiman and Pietikäinen, 2012). Writers, for example, have used a variety of terms to depict leading OHS activity including upstream, heading, positive, and predictive indicators (Hinze et al., 2013). One approach to defining leading indicators is to focus on how they can be differentiated from lagging or trailing indicators (Dyreborg, 2009; Hopkins, 2009; Kjellén, 2009). The distinction is not, however, without its complications. It is possible that a lagging indicator may also act as a leading indicator if, for example, it is able to predict another OHS outcome or event (Dyreborg, 2009).

Hopkins (2009) provided a considered discussion of leading and lagging terminology within the context of personal and process safety. Personal safety problems refer to problems that affect individuals and the term "lagging" typically relates to injuries and fatalities. Process safety hazards, on the other hand, are those arising from the processing activity in which a plant may be engaged and result in damage to the plant and have the potential to generate multiple fatalities. For such events, a lagging indicator relates to harm and failure and may include a major catastrophic event such as an explosion or a fire. These, however, are rare events and it becomes difficult to create a meaningful measure over time. In the case of personal safety, the distinction between leading and lagging indicators is somewhat less problematic. In this context, the term lagging indicator generally refers only to measures of OHS incidents, such as reported OHS incidents, unreported OHS incidents, and near misses. In contrast, leading indicators are those that directly measure aspects of the OHS management system, such as the frequency or timeliness of audits.

Having established the importance of leading indicators, we draw attention to ongoing discussion about the content of leading indicator domains. The following list of leading indicators represents a synthesis of the leading indicator literature that highlights specific domains (also see Shea et al., 2016).

Accountability for OHS that involves a proactive OHS workplace culture and emphasises a sense of shared responsibility and accountability for OHS is important. Such a culture promotes active scrutiny and transparency in reporting and is likely to positively influence safety behaviour in the workplace (Dyreborg, 2009; Fernández-Muñiz et al., 2009).

Audits and workplace OHS inspections, designed to provide appropriate and comprehensive information, are seen to be of value with the proviso that appropriate and timely corrective action is taken to address identified issues (Carson and Snowden, 2010; Hallowell et al., 2013; Sinelnikov et al., 2015).

Consultation and communication about OHS is considered a priority, including regular, formal and informal communication and consultation about OHS (Dejoy et al., 2004; Grabowski et al., 2007; Health and Safety Executive, 2005).

Empowerment and employee involvement in decision making about OHS encourages employees to take responsibility for their behaviour and leads to positive safety behaviour outcomes (Nahrgang et al., 2011; Wurzelbacher and Jin, 2011).

Management commitment and leadership is valuable and is demonstrated in active engagement in areas such as OHS information gathering, behaviour as OHS role models and support for OHS as a high priority across the organisation (Choudhry et al., 2007; Frazier et al., 2013; Health and Safety Executive, 2005; Lingard et al., 2011; Zohar, 2010).

Positive feedback and recognition for OHS is considered to be a leading indicator but not including rewards that might lead to under-reporting of incidents or injuries (Daniels and Marlow, 2005).

Prioritisation of OHS, embedded in the organisation having primacy alongside efficiency and productivity, has emerged as an important leading indicator (Glendon and Clarke, 2016; Health and Safety Executive, 2005; Van Dyck et al., 2013; Zanko and Dawson, 2012).

Risk management of OHS, including risk assessment, control, inspection and maintenance of psychosocial, physical and/or physiological dimensions of OHS, has emerged as a valuable priority (Fernández-Muñiz et al., 2009; Hopkins, 2009; Kjellén, 2009; Pidgeon, 1991).

Systems for OHS are important and are typically implemented and maintained by managers and in work groups. Such systems include workplace policies, processes and practices designed to control and monitor OHS (Frazier et al., 2013; Payne et al., 2009; Pidgeon, 1991; Wachter and Yorio, 2014; Wurzelbacher and Jin, 2011).

The provision of OHS training, information, tools, and resources that promote preparedness to act and provide relevant response plans are key leading indicators of OHS (Health and Safety Executive, 2005; Lingard et al., 2011).

Based on the above review, we propose that the construct of leading indicators of OHS, that eliminate or control the precursors to harm, offers organisations the opportunity to detect and mitigate risks, or risk increases, before an OHS incident occurs or a hazardous state is reached (Grabowski et al., 2007; Lingard et al., 2011; Reiman and Pietikäinen, 2012; Sinelnikov et al., 2015). The following hypothesis is formed to reflect the impact of leading indicators of OHS on mitigating OHS incidents:

H1 Leading indicators of OHS will be negatively associated with lagging indicators of OHS

2.2. Safety leadership as a moderator

Safety leadership has emerged within the OHS literature as a key construct. Wong et al., 2016, for example, in their review of the safety leadership literature concluded that workplace supervisors have substantial influence on the safety performance of their