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Development and evaluation of an industry safety leadership toolkit

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Abstract

Despite decades of improvement workplace safety still has a long way to go (Dekker, 2019). Many thousands of workers continue to be injured across the globe (ILO, 2019). Even in developed countries like Australia, injury rates are stalling, and even increasing in some industries (Safe Work Australia, 2019), and workers' compensation claims are on the rise (Work Cover Qld, 2019). Consequently, research on ways to improve workplace safety is still very much in demand. Since the late 1970s, organisational culture's role in contributing, firstly, to large-scale disasters (Turner, 1979), and later, to positive capabilities for successful and safe performance (Weick & Roberts, 1993), prompted the coining of the term 'safety culture' (INSAG, 1991).

A safety culture is widely considered to be a subset of the broader organisational culture of relevance to safety (Griffin & Curcuruto, 2016), or alternatively, an analytical lens from which to examine and evaluate the broader organisational culture for its effects on safety properties (Guldenmund, 2018). Yet, empirical intervention research on safety culture is still in its infancy (Aburumman et al., 2019). My programme of research aims to contribute to this gap in academic and practical understanding.

In this research, I develop an integrative and situationally-based model of safety leadership that contributes to a positive safety climate and culture through the implementation of various 'control strategies' (Leverage, Energise, Adapt, and Defend; LEAD). The research programme consists of theoretical development, followed by a series of studies designed to develop and validate a new measure of safety leadership. The final study tests an intervention toolkit designed around the new model, drawing on a multi-organisational setting.

The theoretical paper describes how the LEAD model can be used to exert an influence over workers' safety performance by creating a shared social context regarding the applicability and utility of various 'bundles' of safety practices (i.e., control strategies). This model is linked to a number of theories in safety science, including high reliability organising, Rasmussen's (1997) control model, as well as the extant literatures around safety culture, climate, and leadership.

In the second section of the research programme, four studies are undertaken to create, test, and evaluate the psychometric performance of a LEAD scale. Qualitative interviews were undertaken with 25 subject matter experts and an item pool built from coded and thematically-analysed comments. Next, an item pool was subjected to testing

and refinement. The LEAD factor structure was established through exploratory factor analysis. Finally, two separate applied studies confirmed the LEAD model's factor structure and provided evidence of its predictive validity insofar as accounting for variance in safety performance and motivation.

The final study involved the development and evaluation of a LEAD toolkit that was designed for industry. The toolkit consisted of separate worker and leader training programs, a senior manager workshop, and a survey tool with results debrief. Six organisational units within a much larger academic institution participated in the intervention research. Training feedback was positive overall, and increased in positivity as the sessions progressed. Comparisons before and after the training, and between training participants and non-participants, showed that the toolkit did influence self-reported safety performance and perceptions of two LEAD dimensions: Adapt and Defend.

The thesis concludes with a general discussion, including an extended treatment of directions for future research, and a personal reflection.

Keywords

Safety culture, safety leadership, safety climate, training evaluation, scale development.

Declaration by author

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly-authored works that I have included in my thesis.

I have clearly stated the contribution of others to my thesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, financial support and any other original research work used or reported in my thesis. The content of my thesis is the result of work I have carried out since the commencement of my higher degree by research candidature and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution. I have clearly stated which parts of my thesis, if any, have been submitted to qualify for another award.

I acknowledge that an electronic copy of my thesis must be lodged with the University Library and, subject to the policy and procedures of The University of Queensland, the thesis be made available for research and study in accordance with the Copyright Act 1968 unless a period of embargo has been approved by the Dean of the Graduate School.

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Tristan W Casey
09/01/2020

Publications included in this thesis

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Other publications during candidature

Books

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Contributions by others to the thesis

A number of authors contributed to the conceptualisation of ideas represented in this thesis, as well as the mechanics of thesis writing, reviewing, and evaluation.

My primary supervisor, Prof. Andrew Neal, was involved throughout the production of this thesis, providing opportunities to conceptualise early concepts, discuss research methodology, and review and contribute to manuscripts.

My secondary supervisor, Prof. Mark Griffin, provided ongoing support in a similar capacity to Prof Neal. The LEAD model was originally conceptualised by Prof. Griffin and I am honoured to have contributed to its evolution through this research programme.

Mr Flatau-Harrison co-authored the first publication included within this thesis, and contributed by reviewing the safety climate literature, writing relevant introductory sections of the paper, and various editing/reviewing tasks.

Ms Urutia Guada co-authored the third publication included within this thesis, and assisted greatly with the project management, implementation, and evaluation of the LEAD toolkit as described in Chapter 4 of this thesis. Ms Urutia Guada also assisted with statistical analyses for the third publication (50% contribution), with written sections (25% contribution), and reviewing early versions of the manuscript.

Statement of parts of the thesis submitted to qualify for the award of another degree

No works submitted towards another degree have been included in this thesis.

Research Involving Human or Animal Subjects

The research conducted here was evaluated and approved by the School of Psychology Ethical Review Committee (obtained prior to centralisation of ethics applications). In terms of ethical approval, I conducted the main activities (e.g., training development, interviewing, survey implementation) in my substantive employed role at the Office of Industrial Relations (OIR). I then obtained ethical approval (including a letter from the Director of OIR) to share the data with myself, as a UQ student, for the purposes of conducting analyses and writing up publications.

The ethics approval number is: 17-PSYCH-PHD-19-JS

A copy of the ethics approval letter is contained in the Appendix.

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Australian and New Zealand Standard Research Classifications (ANZSRC)

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FoR Code: 1701, Psychology, 75%

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List of Abbreviations

CFA – Confirmatory Factor Analysis

EFA – Exploratory Factor Analysis

OIR – Office of Industrial Relations

WHSQ – Workplace Health & Safety Queensland

Chapter 1: Introduction

Despite marked progress in health and safety management (Hofmann, Burke & Zohar, 2017), injuries and fatalities still occur in Australian workplaces. According to Safe Work Australia (2017), 182 fatalities occurred in 2016. Examining workers' compensation claims data, 104,770 serious injuries and illnesses occurred between 2015-16. When reclassified in terms of severity rather than lost time, serious injury rates may actually be increasing in Australian workplaces (O'Neill & Wolfe, 2017).

Safety-related incidents carry many costs, both moral and economic. In 2012-13, workplace injuries and illnesses cost the Australian economy $61.8 billion (Safe Work Australia, 2015). Further, the median compensated cost of workplace safety incidents increased by 30% from $5,200 to $6,800 between 2015-16 (Safe Work Australia, 2017). Taken together, further work is clearly needed to prevent workplace injuries and illnesses across Australia.

Today, many organisations share their frustration about the safety plateau. First coined by James Reason (1997), the safety plateau is a region of organisational performance whereby incidents and injuries reduce to a certain amount, but fail to reach zero. Typically, organisations' strength of safety management waxes and wanes in response to the recency of safety incidents. Scholars and practitioners alike have taken to this problem with vastly different strategies and methods. Some argue that an even greater resolve and Zero Accident Vision is required to make further advancements (Zwetsloot et al., 2017). Others believe that the very nature of safety requires redefinition, moving away from a focus on negatives and towards a positive focus such as the creation of resilience, capacity, and potentials for success (Hollnagel, 2014; Dekker, et al., 2016). Safety culture and climate researchers present another avenue for safety improvement, which arguably encapsulate and transcend these other movements in safety science as they seek to understand the shared patterns of thinking that underpin safe organisations (e.g., Antonsen, 2017; Naevestad, 2009; Naevestad, 2008; Reiman & Rollenhagen, 2014).

Indeed, safety culture and safety climate are "critically important" (Hofmann et al., 2017; p.382) to making improvements in health and safety performance. Defined loosely as group level and shared perceptions, values, norms, and beliefs around health and safety, safety culture and safety climate extend safety science and practice to include the social phenomena that influence workers' safety behaviour. Safety culture, largely through retrospective case studies, has been shown to enhance understanding of why catastrophic

organisational incidents occur, particularly with reference to high profile events such as Deep Water Horizon (Reader & O'Connor, 2013), Challenger (Vaughan, 1997), and Pike River (Black, 2014). Safety climate has a much firmer empirical base and a more consistently-demonstrated relationship with group- and individual-level safety performance. Numerous meta-analyses have demonstrated strong predictive relationships with safety compliance and proactive safety behaviours (Christian, Bradley, Wallace & Burke, 2009; Clarke, 2006; Clarke, 2010).

Safety culture and climate are important to advance the future of safety science and performance because they are 'soft controls' over worker behaviour. In contrast to 'hard controls' like engineering-based solutions; physical machine guarding, ventilation systems, and pedestrian barriers, social phenomena like safety culture and safety climate offer additional ways to safeguard the welfare of workers, prevent process disruptions, and even generate additional productivity and profitability (Fabius et al., 2013; Lamm et al., 2006). Hence, finding evidence-based and effective ways of improving safety culture and safety climate is high on the research agenda.

Yet, despite the utility of these constructs, there remains significant theoretical and practical issues to be resolved. Safety culture and safety climate exhibit considerable conceptual murkiness and overlap, to the extent that the terms are often used interchangeably (Glendon & Stanton, 2000; Gadd & Collins, 2002; Hofmann et al., 2017). Safety culture is theoretically underspecified and detached from the more established organisational culture literature (Guldenmund, 2010), to the extent that it has been labelled a 'concept in chaos' (Hopkins, 2006; Antonsen, 2009). On this point, safety culture has become conceptually 'bloated' with it being labelled as a catchall term that has lost intrinsic meaning (Borys, 2014; Guldenmund, 2010). Some scholars have even referred to safety culture as the 'new human error' (Dekker, 2019). Both safety culture and safety climate suffer from heterogeneity in dimensionality, with no clearly agreed set of higher order factors or aspects around which consistent measures can be developed and tested (Flin, Mearns, O'Connor & Bryden, 2000). Finally, although there have been many theories put forward as to how safety culture's and safety climate's effects translate through into behaviour (Griffin & Curcuruto, 2016), empirical research testing these ideas is in its infancy (e.g., Zohar, Huang, Lee & Robertson, 2015).

An alternative to safety culture and climate is safety leadership. Safety leadership is an established antecedent of workplace safety behaviour, both directly, and indirectly via constructs like safety climate (Clarke, 2013). It is based on tangible practices and

behaviours that can be trained (Barling et al., 2002; Mullen & Kelloway, 2009). Safety leadership also benefits general work and employee outcomes including organisational commitment, innovation, knowledge management, and job satisfaction (Donovan et al., 2017). Not only can safety leadership be demonstrated by those in official or formal roles such as supervisors. Co-workers can also demonstrate safety leadership by teaching others about safety topics, stopping the job if risk is unacceptable, and generally being proactive, self-starting and showing initiative toward safety (Hofmann et al., 2003). These properties make safety leadership an attractive alternative for industry looking for ways to improve safety performance using readily-implemented initiatives. In the next section I present a brief overview of the safety leadership literature, and explain how this research programme aligns with and extends this literature in new directions.

A brief overview of safety leadership research

The phrase ‘safety leadership’ first appeared in the scholarly literature in the mid-1980s and early 1990s, through conference publications by safety engineers and other industry professionals (e.g., Cosad et al., 1998; Pater, 1984; Rosenfield, 1980). Definitions of safety leadership at that time were largely informal and atheoretical, reflecting the practitioner-centric audiences and industry-driven research context. For example, Carrillo and Simon (1999) described safety leadership as a ‘grass roots’ style of leadership that focusses on consultation, participation, and establishing safety as a core value and cultural assumption, as per Edgar Schein’s writings on organisational culture.

Also in the 1980s, Dov Zohar coined the phrase ‘safety climate’, which emphasised the role of management actions in driving safety performance, through creating shared behaviour-outcome expectancies among workers. These expectancies concerned the value and priority of safety relative to other demands like production and efficiency (Zohar, 1980; Zohar, 2000). Management commitment to safety, a common dimension of safety climate (Flin et al., 2000), was thereafter established as a safety leadership-esque construct. To this day, it remains unclear how safety climate is distinguished from safety leadership (Molnar et al., 2019; Oah et al., 2018).

In 1994, a type of ‘proto-safety leadership’ concept was explored by Simard and Marchand. Building on the original propositions of Heinrich (1931) and industry consultants regarding the importance of supervision in leading safety outcomes, the authors investigated the effects of supervisory practices on safety. Although the term ‘safety leadership’ and even ‘leadership’ weren’t mentioned, Simard and Marchand (1994)

showed that a participatory style of supervision (involvement in safety activities) predicted positive safety performance among workers.

In 1999, Hofmann and Morgeson explored the effects of a general leadership theory, leader-member exchange, on safety communication and accidents. They argued that higher levels of organisational support and better-quality leader-member relationships would activate norms of reciprocity, leading to greater willingness among workers to speak up about safety. The findings suggested that investing in genuine and high-quality relationships at work could improve safety performance.

It wasn't until 2001 that O'Dea and Flin published on safety leadership in the mainstream safety science literature. Safety leadership was loosely defined as a form of 'participative management' whereby leaders became actively and visibly involved in safety activities, and conducted frequent, informal communications between workers and management about safety. Open-ended survey comments revealed four themes or dimensions of safety leadership among offshore oil and gas managers: visibility, relationships, workforce involvement, and proactive management (O'Dea & Flin, 2001).

The seminal study done by Barling and colleagues (2002) was the first peer-reviewed article to coin the term 'safety-specific leadership'. In this study, the construct was safety-specific transformational leadership, which reflected a domain-specific application of Bass and Avolio's full range leadership model (1989). A definition of safety-specific transformational safety leadership is: "leaders who inspire, intellectually stimulate, and consider workers as individuals in the context of safety" (Vignoli et al., 2018). Barling's study was the first to advocate for a split between general leadership and safety-specific leadership.

At the same time, Zohar had branched out to explore leadership in safety. He approached the issue from both a general leadership perspective and a safety-specific leadership perspective. In Zohar (2002a), the effects of general transformational and transactional leadership on safety climate and injuries were found to be moderated by the leader's perceived safety priority. In Zohar (2002b), this evidence was used as the basis for a facet-specific measure of transactional safety leadership. Workers were asked to recall the nature of interactions with their superior, and the responses classified into either safety-oriented or production-oriented, or both. An intervention was designed to increase the frequency of safety-related transactions between supervisors and leaders, which improved safety performance. Thus, this study added weight to the safety-specific leadership debate.

Thereafter, research on both general leadership for safety and safety-specific leadership exploded. Of note, safety-specific leadership has expanded to include not only the full-range leadership model, but also more nuanced and bespoke models derived from qualitative research. In the next sections we explore general leadership and safety, as well as safety-specific leadership research, by drawing on recent studies.

General leadership and safety

The argument for using general leadership concepts to explain safety outcomes is as follows. The lived reality of leaders is that multiple goals and demands compete for their attention simultaneously (Inness et al., 2010). Leadership is something leaders do constantly, not in separate silos of “safety”, “productivity”, “quality”, “staff wellbeing” etcetera. To the extent that safety leadership is a specific concern, this should be represented by considering whether leaders place priority on safety, rather than constructing a fully separate leadership construct just for safety. As well as being unnecessary, creating a separate construct for safety leadership is likely to create overlap between the way we measure “safety leadership”, “safety climate”, and “safety”. This overlap will make it hard to measure the effects of safety leadership on safety by conflating separate constructs and positively inflating associations between predictor and criterion variables (Inness et al., 2010).

A recent review by Donovan and colleagues (2016) mapped the landscape of general leadership and safety performance. The review identified five core general leadership theories that have been applied to the safety context: transformational, transactional, leader-member exchange, empowering leadership, and authentic leadership. The authors identified associations between leadership styles and organisationally-relevant outcomes, ranging from safety climate, to safety behaviours (typically compliance and participation), and non-safety outcomes such as job satisfaction and organisational commitment. Donovan et al (2016) emphasised the fact that most research in this space is cross-sectional, which makes causal inferences inappropriate. Nevertheless, their review provides evidence that general leadership plays a role in supporting safety outcomes.

More recently, Donovan and colleagues (2018) further explored the role of general leadership in safety by categorising specific instances of leadership behaviours into the major theories. It was found that in emergency situations, leaders draw on a wide repertoire of behaviours that improve safety, such as coaching, inspiring, and role-

modelling. General leadership behaviours that concentrated on relationship-building were particularly important for safety, with increased flow of communication a direct result. This study showed that general leadership models, when applied to safety decision-making, are a useful tool to identify specific practices that constitute 'safety leadership'.

Safety-specific leadership

The most popular approach to operationalizing safety leadership has been to apply Bass and Avolio's (1989) 'full range leadership' model, which includes both transactional and transformational safety-specific leadership (Clarke, 2013). Transformational safety-specific leadership was borne out of work by organisational psychologists, who adapted existing and established measures such as the multifactor leadership questionnaire (MLQ) by adding the word 'safety' to existing items (Barling et al., 2002; Kelloway et al., 2006). Others applied components of the full range leadership model such as passive or laissez-fair leadership (Kelloway et al., 2006) and transactional leadership (Zohar, 2002) to safety-specific contexts. The seminal work of Barling and colleagues (2002) remains the most influential, with over 1,000 citations (Google Scholar, 2019). Barling and associates (2002) were the first to coin the term 'transformational safety leadership' and explored its relationship with safety climate, and a new variable they termed safety consciousness (general awareness of safety issues at work) using a cross-sectional design. Transformational safety leadership was associated with safety climate and safety consciousness, which in turn was correlated with safety injuries and incidents.

Despite the methodological shortcomings of Barling's et al. (2002) work, such as cross-sectional data, small sample sizes, the model providing "reasonable but not outstanding fit to the data" (p.493, Barling et al., 2002), and lack of stringent construct validity testing such as confirmatory factor analysis, transformational safety-specific leadership became entrenched as the dominant perspective. Subsequent and more recent studies (albeit, without adequately addressing the original methodological shortcomings) have reinforced this approach through gathering evidence of correlations with safety behaviours (e.g., Fernandez-Muniz et al., 2014; 2017; Mullen et al., 2017; Smith et al., 2016). Indeed, a meta-analysis by Clarke (2013) showed that transformational safety leadership was strongly related to proactive and citizenship-oriented safety behaviours, whereas transactional safety leadership was related to safety compliance behaviours. This result painted a simple yet compelling picture regarding the differential impact supervisors could have over worker behaviour through the employment of different leadership styles.

Yet importantly, no published study to date has explicitly tested the construct validity of transformational safety leadership in the context of general transformational leadership, despite repeated calls to do so (Conchie et al., 2012).

Workers will take cues regarding the priority of safety through observations of leadership practices in specific contexts, such as safety, and infer what is emphasised or valued by the organisation as a result (in the form of reciprocated safety behaviours). This line of argument is largely supported by a program of work undertaken by Zohar and colleagues (2002; 2008; 2014) whereby leaders adopted a largely transactional approach by communicating the priority of safety relative to other work demands, with the results of a communication-focussed intervention demonstrating meaningful impacts on both subjective (i.e., safety climate) and objective (i.e., microaccidents, behavioural observations) outcomes. Nevertheless, reliance on these studies as evidence that transformational safety leadership and general leadership are separate constructs, is arguably problematic. It is difficult to imagine a scenario where a leader regarded as 'transformational' in the general sense (which includes a dimension regarding 'individualised consideration' or care and concern for the welfare of team members; Seltzer & Bass, 1990) would explicitly compromise safety while still retaining an overall favourable leadership evaluation. In other words, the correlation between safety-specific transformational leadership and general transformational leadership is likely to approach 1.0, which questions its discriminant construct validity.

Other safety-specific leadership researchers have adopted a purely qualitative or mixed-methods approach. Under this perspective, safety leadership is operationalised as a distinct construct that is separate to general leadership and doesn't explicitly reference the full range leadership model (Daniel, 2015; Donovan et al., 2016; Grill & Nielsen, 2019; Molnar et al., in press; O'Dea & Flin, 2001).

Daniel's (2015) qualitative investigation of safety leadership in the Australian construction industry showcases this approach. Following in-depth interviews with 20 leaders at different organisational levels, a model of safety leadership was presented. Interestingly, despite "the viewpoint that safety leadership is a separate category from leadership reaching a minority consensus" (p.7; Daniel, 2015), the author argued for a set of safety-specific practices including use of discipline, articulating a safety vision, showing honesty, and role-modelling safety. These dimensions overlap considerably with existing general leadership theories such as transactional, transformational, and authentic leadership.

Summary of previous safety leadership research and ways forward

General leadership and safety have received some attention, but are underutilised by practitioners and industry given the intuitive appeal of a 'safety-specific' leadership construct. Nevertheless, the work by Donovan and colleagues (2016; 2018) highlights the array of general leadership theories and their positive associations with safety performance.

The concept of transformational safety-specific leadership has dominated the literature to date. According to this work, an effective safety leader shows both transactional and transformational safety-specific behaviours. Yet, this approach runs the risk of muddying the waters when it comes to distinguishing leadership from similar constructs such as safety climate. Other research in this area seeks to identify the 'secret sauce' of safety-specific leadership; behaviours that are unique to the safety leadership construct. However, these attempts to identify a safety-specific leadership construct are still in their infancy, with some models showing considerable overlap with general leadership, or being couched within specific samples and organisational contexts that limits generalisability.

A novel area in which safety leadership could continue to be explored concerns the 'what and when to apply' aspect of leadership; namely, situational leadership (Hersey & Blanchard, 1969). Based on contingency concepts, situational leadership proposes that successful leaders adapt their approach based on the requirements of the work situation. Recently, these ideas were applied by Casey and colleagues (2017; 2019) to a model of leadership that proposes to improve safety performance by contributing to a strong situation or shared social context around safety. Specifically, leadership was conceptualised as a 2x2 contingency matrix consisting of four bundles of safety-relevant practices shown by supervisors and co-workers collectively: Leverage, Energise, Adapt, and Defend. Each 'control strategy' is thought to align with a specific work situation to achieve the best safety performance, and over time, contribute to an improve safety climate and culture via motivational and social learning mechanisms (Casey et al., 2017). From this perspective, safety leadership is considered from the angle of its effects on the team rather than the behaviours and qualities of the leaders themselves. The model also provides a theoretical scaffold that links specific leadership practices through to individual performance via self-regulation and motivational states in subordinates.

Research program overview

Workplace safety performance globally requires ongoing improvement, particularly as we experience the technological and social challenges of the 21st century (Hu et al., in press). Also, there is a dearth of published studies on safety culture and climate improvement interventions (Aburumann et al., 2019), not to mention safety leadership interventions (e.g., Mullen & Kelloway, 2009). Therefore, this programme of research involved the development and evaluation of an industry safety culture improvement 'toolkit' that targets safety leadership as the mechanism for improving the social context for safety. This research is desperately needed because many organisations in Australia are struggling to improve safety to levels required by legislation, let alone to levels that would reduce or eliminate injuries. For instance, proactive visits from safety inspectors rose 6% and reactive visits rose 12% between 2016-2017 across Australia, yet injury rates have remained stable or even worsened in some industries (Safe Work Australia, 2018).

The timing of this research was fortuitous as the regional work, health and safety regulator (Workplace Health & Safety Queensland) had recently implemented a state-wide safety leadership program, instated a Board of industry stakeholders with a strategic priority to build a culture of health and safety across high-risk industries, and approved a project to develop an evidence-based industry toolkit. Furthermore, there was a recent move towards 'hard compliance' from the regulator in response to several high-profile safety-related tragedies, which put additional pressure on Queensland businesses to look for ways to improve safety performance (OIR, 2019). This 'perfect storm' was leveraged to maximise the relevance and practical impact of this research.

In total, this research generated three academic publications. The research consists of one theoretical examination (outlining our general propositions and theoretical framework), four separate studies that developed and validated a measurement tool, and a final applied intervention study that evaluated the effect of an industry toolkit developed by the author as part of his role at OIR. These scholarly works are described in the chapters that follow.

Chapter 2: Safety climate and culture: Integrating Psychological and Systems Perspectives

Abstract

Safety climate research has reached a mature stage of development, with several meta-analyses demonstrating the link between safety climate and safety outcomes. More recently, there has been interest from systems theorists in integrating the concept of safety culture and to a lesser extent, safety climate into systems-based models of organizational safety. Such models represent a theoretical and practical development of the safety climate concept by positioning climate as part of a dynamic work system in which perceptions of safety act to constrain and shape employee behaviour. We propose safety climate and safety culture constitute part of the enabling capitals through which organizations build safety capability. We discuss how organizations can deploy different configurations of enabling capital to exert control over work systems and maintain safe and productive performance. We outline four key strategies through which organizations to reconcile the system control problems of promotion versus prevention, and stability versus flexibility.

Introduction

It has been almost 40 years since the concept of safety climate was originally introduced by Zohar (1980). Broadly, safety climate refers to shared perceptions held by members of a team or organization about the way safety is managed within the organization (Griffin & Neal, 2000; Zohar, 1980). After a slow start, interest in the concept increased during the mid-1990's, and has grown rapidly since. According to Web of Science, only 11 articles included 'safety climate' in the title between 1980 and 1996. Since 1996, 429 articles included 'safety climate' in their title; of these, 70 were published between 1997 and 2006, and 359 were published between 2007 and 2016.

Research in safety climate has reached a mature stage of development within the psychological and management literature (Zohar, 2010). For example, several meta-analyses provide good evidence of the link between safety climate and safety outcomes (Christian, Bradley, Wallace, & Burke, 2009; Clarke, 2006, 2010; Nahrgang, Morgeson, & Hofmann, 2011). These studies consistently demonstrate that people work more safely when there is a shared social context where safety is prioritized and valued. Consequently, safety climate is firmly established as an organizational antecedent of safety performance.

Despite the progress in understanding safety climate and its impact, there remain limitations that might be addressed in future research. Specifically, the construct domains of safety climate and the broader concept of safety culture are often blurred and overlapping (Cox & Flin, 1998; Guldenmund, 2000), with both researchers and practitioners conflating the meaning of culture and climate (Griffin & Curcuruto, 2016). Safety climate and culture also tend to be treated as static variables, which does not reflect the more dynamic orientation of contemporary systems-based models of organizational safety. Recently, Griffin et al. (2014) introduced the concepts of safety capability and enabling capitals, which although are more compatible with systems thinking, add further conceptual complexity to discussions of safety climate and culture. The net result is poor understanding of how climate, culture, and capability interrelate and evolve over time, as well as how these concepts contribute to the overall safety of an organizational system.

We propose that a systems-based approach is needed to address current limitations in safety climate and culture literatures. Systems approaches provide a dynamic representation of the way safety develops and breaks down in complex operations (Hollnagel, Paries, Woods, & Wreathall, 2011; Leveson, 2011). Although these approaches incorporate concepts of safety culture at a broad level, there are few specific

links between concepts of safety culture and safety systems (Reiman & Rollenhagen, 2014). While safety culture has received some attention from systems theorists (Goh, Love, Stagbouer, & Annesley, 2012; Marais, Saleh, & Leveson, 2006; Pidgeon & O'Leary, 2000), safety climate has largely been ignored. This lack of attention is unfortunate because safety climate lends itself more readily to integration within systems-based models given its transient, multi-level, and multidimensional properties (Zohar, 2010).

Adopting a systems approach enables the dynamic nature of safety to be integrated with concepts of safety culture, climate, and capability. From a systems perspective, safety can be conceptualized as a control dilemma, meaning that threats and disturbances that may destabilize the system are identified, monitored, and controlled (Griffin, Cordery, & Soo, 2015). We propose that this control dilemma is best resolved by developing safety capabilities across two key domains: stability/flexibility and promotion/prevention. We position safety climate and culture within a framework of enabling capitals such that climate and culture represent the mechanisms through which this safety capability can be operationalized allows disturbances can be managed.

In the following sections, we first review the development of safety climate concepts and provide some practical distinctions between safety climate and culture. In the second part of the paper, we review key systems perspectives of safety and accident causation. In the final part of the paper we present an integrative systems model incorporating safety culture and climate concepts.

Safety Climate, Culture, and Capability

Safety climate: State of current knowledge

There is now a large body of research examining the relationships among safety climate, safety behaviour, and accidents. Accidents are workplace events that result in physical harm to people, property, or the environment, while safety behaviour is any form of workplace behaviour that affects the likelihood of physical harm to people, property or environment (Beus, Dhanani, & McCord, 2015). The two forms of safe work behaviour that have most commonly been examined are safety compliance and safety participation. Safety compliance refers to the core activities that individuals need to carry out to meet mandated safety requirements, which are typically specified in the form of rules and procedures (Griffin & Neal, 2000; Neal, Griffin, & Hart, 2000). Safety participation involves behaviours that do not directly contribute to an individual's personal safety, but which help to develop an environment that supports safety. These include helping co-workers and

demonstrating initiative (Griffin & Neal, 2000; Neal et al., 2000). A closely related construct is safety citizenship, which is defined as the degree to which employees are willing to enlarge their role beyond normal job requirements by engaging in behaviours such as whistleblowing (Hofmann, Morgeson, & Gerras, 2003). Both safety participation and safety citizenship are important concepts as they represent the extent to which individuals engage in positive safety behaviours over and above what is simply expected of them.

There have been several meta-analyses (Christian, Bradley, Wallace, & Burke, 2009; Clarke, 2006, 2010; Nahrgang et al., 2011) and systematic reviews (Beus, McCord, & Zohar, 2016) of this literature in the past decade. Meta-analyses have confirmed that safety climate is positively associated with both safety compliance (Nahrgang et al., 2011) and safety participation (Clarke, 2006), and suggest that the relationship between safety climate and safety participation may be stronger than that between safety climate and safety compliance (Christian, Bradley, Wallace, & Burke, 2009; Clarke, 2006). This is consistent with the theory that a positive safety climate is more likely to encourage safety behaviours over and above basic procedural adherence due to the norm of reciprocity established when individuals and teams perceive management as placing an adequate emphasis on workplace safety (Clarke, 2006).

Meta-analyses have also confirmed that safety behaviour is associated with accidents. Clarke (2006) and Christian, Bradley, Wallace, and Burke (2009) found that both compliance and participation were negatively associated with accidents. Furthermore, Christian, Bradley, Wallace, and Burke (2009) found that a broad composite of safety behaviour was more strongly associated with accidents than specific safety behaviours, and that safety behaviour mediated the relationships between safety climate and accidents. Nahrgang et al. (2011), in contrast, found that compliance was negatively associated with accidents, but participation was not, although participation was associated with adverse events, such as near misses. Nahrgang et al. (2011) argued that the differences between the results of these two meta-analyses might be due to the inclusion of driving-related studies in their meta-analysis, as the factors that predict accidents in the transport industry appear to be different to those in other industries. Furthermore, we would not necessarily expect participation to be strongly related to accidents at the individual level, because the effects of participation are indirect, reducing the risk of harm to other people, rather than to the self (Griffin, Neal, & Parker, 2007).

Further research has investigated variables mediating the relationship between safety climate and safety behaviours. Most of this work has examined the role of safety

knowledge and motivation. Safety knowledge refers to an individual's understanding of safety practices and procedures and safety motivation refers to an individual's willingness to work safely (Griffin & Neal, 2000). Two types of safety motivation have been identified: valence, which is the perceived value, or importance, of safety to the individual (Neal & Griffin, 2006); and instrumentality, which is the extent to which the person believes that working safely will be recognized and rewarded (Scott, Fleming, & Kelloway, 2014; Zohar, 2011). From the perspective of self-determination theory (SDT), valence is a type of autonomous motivation in which individuals are motivated by the intrinsic value of safety, while instrumentality can be seen a type of controlled motivation in which individuals are motivated by external contingencies (Gagné & Deci, 2005). Meta-analyses have confirmed that safety knowledge and safety motivation mediate the relationship between safety climate and safety behaviour (Christian, Bradley, Wallace, & Burke, 2009), although there is not yet enough research to draw conclusions regarding the relative contribution of different forms of safety motivation.

A separate body of research informed by the job demands resource (JDR) model (Bakker & Demerouti, 2007) has examined how job demands and resources influence safety behaviour (Nahrgang et al., 2011). Job demands are physical, psychological, social, or organizational aspects of the job that require sustained physical and/or psychological effort (Schaufeli & Bakker, 2004). Job resources, on the other hand, are physical, psychological, social or organizational aspects of the job which reduce job demands, or in some other way aid in the achievement of work goals or stimulate personal development (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001). Safety climate is seen as a job resource from the perspective of the JDR model.

The JDR model suggests that job demands exhaust an individual's mental and physical resources, leading to burnout, which is a state of exhaustion, cynicism and lack of efficacy (Maslach & Leiter, 2008). Job resources, such as safety climate, on the other hand, are thought to protect against burnout by replenishing resources. People are thought to be more likely to work unsafely, and have accidents, when their energy levels are depleted due to burnout (Nahrgang et al., 2011). Meta-analytic results confirm that job demands are positively, and job resources are negatively, associated with indicators of burnout (anxiety, stress and depression) in the predicted direction (Nahrgang et al., 2011). Indicators of burnout, in turn are positively associated with accidents, but not unsafe behaviour, although relatively few studies have examined these relationships.

Meta-analyses have also examined the relative strength of effects at the individual and group levels of analysis, and the direction of the relationship between safety climate and accidents. Christian, Bradley, Wallace, Burke, and Spears (2009) found that the relationships between safety climate on the one hand, and safety behaviour and accidents on the other, were stronger at the group level than at the individual level, which is consistent with the argument that climate is an emergent group-level construct. Beus, Payne, Bergman, and Arthur (2010) found that safety climate was both a leading and lagging indicator of safety, although the correlation between prior accidents and safety climate was marginally stronger than the correlation between safety climate and future accidents. Focusing on the subdimensions of safety climate, Beus, Payne, Bergman, and Arthur (2010) found that management commitment to safety, which is the core element of safety climate, is more predictive of future accidents than prior accidents. More recently, Bergman, Payne, Taylor, and Beus (2014) examined the relationship between safety climate and accident rates across 42 worksites at multinational chemical manufacturing company over a four year period. They found that safety climate was both a leading and lagging indicator of accidents, but that the effect differed, depending on the type of incident and the time lag. The relationship between safety climate and reportable accidents diminished after three months, while the relationship between safety climate and low level (not reportable) accidents sustained for two years.

Limits of current understanding

Substantial progress has been made in understanding the relationship between safety climate and safety behaviour. However, our understanding of the underlying process is limited in a number of important ways including the methodological challenges associated with the assessment of safety climate and safety behaviour. The field is still dominated by cross-sectional studies examining relationships at the individual level of analysis, although more studies are examining relationships at the group or organizational levels (e.g., Brondino, Silva, & Pasini, 2012; Lee & Dalal, 2016).

From a theoretical perspective one issue is the need to develop a better understanding of safe and unsafe work behaviour at different levels within an organization, and the mechanisms through which they have an impact on safety outcomes. There is a need to incorporate a broader range of factors into models of safety behaviour, so that we can account for the different ways in which people act to reduce, or increase, the risk of harm to themselves or others. For example, key behaviours that are now being included in

models of safety include adaptivity, proactivity and teamwork (Griffin et al., 2007). These types of behaviour are important when the risks and hazards associated with a particular work system are unpredictable, and the system is highly interdependent, meaning that the actions of one person have an impact on others.

A second general issue is the need to better understand the mechanisms by which safety climate influences safe and unsafe work behaviour. In part, this can be achieved by more systematically considering factors that shape behaviour such as competence, motivation, energy, and opportunity. Competence includes factors that determine what a person can do, such as knowledge, skill and expertise. To date, the safety climate literature has focused on explicit knowledge of rules and procedures, and has ignored the tacit knowledge and skill that people develop as they acquire expertise in a domain. The skill and expertise of staff is arguably more important than their knowledge of rules and procedures (Hollnagel, 2009). For example, the human factors literature focuses on situation awareness as a key factor that influences safety in a dynamic and uncertain environment (Durso & Sethumadhavan, 2008), yet situation awareness is largely ignored within the safety climate literature, possibly because it is a dynamic variable and difficult to measure using employee surveys.

Motivation determines what a person is prepared to do, and the reasons why they are prepared to do it. The safety climate literature has not yet considered the consequences of different forms of safety motivation, such as extrinsic and intrinsic safety motivation. Zohar, Huang, Lee, and Robertson (2015) recently argued that safety climate induces extrinsic safety motivation, and undermines intrinsic safety motivation. They found that the relationship between safety climate and compliance was stronger for people who reported lower levels of work engagement, suggesting that extrinsic safety motivation may compensate for a lack of intrinsic safety motivation. However, to the best of our knowledge, studies have not yet measured extrinsic and intrinsic safety motivation directly, or examined whether extrinsic safety motivation can undermine intrinsic safety motivation. Furthermore, we would expect that the effects of extrinsic and intrinsic safety motivation would depend on the type of safety behaviour being examined. Specifically, intrinsic safety motivation is likely to be particularly important for discretionary behaviours, such as participation, citizenship, adaptivity and proactivity, which are important for the safety of the system as a whole.

Energy provides the drive for behaviour, while situational factors provide the opportunities and constraints that limit the behaviours that are possible. While Nahrgang et

al. (2011) identified engagement and burnout as energetic states that have the potential to influence safety behaviour. However, these constructs were not directly assessed in their meta-analysis. Variables such as anxiety and depression were used as indicators of burnout, while participation, communication and information sharing were used as indicators of engagement. The most direct way to assess the effects of low levels of energy is to measure fatigue, yet fatigue is largely overlooked within the safety climate literature, which is surprising given that it is known to be one of the major causes of industrial accidents (e.g., Hockey, 2013). On the positive end of the scale, activated positive affect, such as feelings of energy and enthusiasm, is an important determinant of proactive and prosocial behaviours (Parker, Bindl, & Strauss, 2010). Again, these factors are largely overlooked within the safety literature. In addition, the choices that people make are limited by the opportunities that are available to them, and the constraints that they are acting under. Relatively little attention has been given to the role that opportunities and constraints play in shaping safety behaviour. One exception is a recent study by Lee and Dalal (2016), who found that a strong safety climate, indexed by high levels of within-group agreement, constrained the expression of individual differences.

Finally, to better understand the mechanisms through which safety climate influences safety behaviour, we need to take a more dynamic approach. Theories of self-regulation can be used to understand the process by which people adapt to task demands, and explain the choices that they make in relation to the goals that they are pursuing (Neal, Ballard, & Vancouver, in press). This is a dynamic process, and as such, needs to be studied at the within person level, using repeated measures designs, together with sophisticated statistical models, such as latent change models (Liu, Mo, Song, & Wang, 2016) that are capable of directly testing a theory of change. The safety climate literature currently paints a picture of safety that is fairly static, rather than dynamic.

Culture and Capability

The concept of safety climate overlaps with the concepts of safety culture and safety capability. In this section, we examine how these concepts can be better understood in relation to each other.

Safety culture

Safety culture represents an organization's core values about the importance of safety and the underlying beliefs and assumptions that guide behaviour and decision

making (Reason, 1998). Safety culture not only shapes the externally visible elements of an organization, but also the things that are “not said” or reflected only in symbolic actions. For these reasons, safety culture is often described in terms of “deep” meaning whereas safety climate is described as the “surface features” (Denison, 1996). Guldenmund (2000) identified three layers of safety culture. The core layer of culture is described as the basic and fundamental assumptions about safety and the middle layer consists of espoused values and attitudes. The outer-most layer is described as artefacts, which represent behavioural manifestations of the underlying safety culture and physical symbols such as safety posters and signage.

Safety climate can be understood as perceptions of the middle and outer layers of safety culture at a given point in time. From this perspective, safety climate is an indicator of the underlying shared assumptions that comprise an organization’s safety culture. Safety climate then provides an assessment of how effectively various safety practices at different levels of an organization have been implemented, resulting in a shared sense of the overall value, priority, and importance placed on safety (Zohar, 1980, 2010).

When it is systematically invoked for practice or research, this layered metaphor of culture highlights useful distinctions between culture and climate. For example, culture is likely to be harder to change than climate, because it reflects deeper and more pervasive assumptions. Climate, on the other hand, is more amenable to change through deliberate organizational actions such as safety training, strategic planning, and participative decision making (Beus, Payne, Bergman, & Arthur Jr, 2010).

Despite its advantages, the layer metaphor is limited in the degree it captures interactions within and between layers, obscuring important links among implicit beliefs, organizational practices, human decision-making, and actions. In particular, it provides a limited view of the types of capabilities that an organization needs to operate safely. This limitation is particularly important when trying to understand safety from a systems perspective, as safety culture is only one component within a broader socio-technical system (Reiman & Rollenhagen, 2014).

Safety capabilities

Safety capability can be defined as the capacity of an organization to maintain safe operations in dynamic and uncertain operating environments, and is generated via human, social, and organizational processes termed “enabling capitals” (Griffin et al., 2014).

Enabling capitals are foundational building blocks that include technologies, structures, processes, and importantly, social aspects including safety culture and climate. Organizational capital is thought to include both human resource management, such as high-performance work systems, and safety management practices such as risk management procedures. Social capital refers to capacities embedded in social relationships, such as culture and teamwork. Human capital refers to individual competences such as the knowledge, skills, abilities, experiences of employees within the organization.

Unlike safety capability, enabling capitals are hypothesized to be directly observable and hence, measurable and amenable to change (Griffin et al., 2014). Enabling capitals can be considered as the system components that shape safety processes at different levels within an organization. Figure 1 provides an overview of these three capitals and how they might relate to both the underlying safety culture and to the more observable safety climate. Each enabling capital can be mapped across the layers of Schein's culture model (Schein, 2004). Moving from the centre of the figure, core inner layers are considered less tangible and distal in terms of their influence over behaviour than successive outer layers. The middle layer represents the core assumptions regarding safety and effectiveness that are held by members of the organization. These assumptions underpin all three types of capital.

The middle layer represents the foundations upon which each capital is built. For human capital, this includes the abilities, dispositions, beliefs, attitudes, values and motives of people. For social capital, these foundations include the pattern of network ties and configurations, the shared understanding across members of the network, and the norms and trust that enable exchange relationships to work effectively. For organizational capital, the foundations include structure, technology and resources.

The outer layer in Figure 2.1 represents the factors that directly influence safety. For human capital, this includes the expertise, motivation and energy of people; for social capital, factors such as leadership and teamwork; for organizational capital, factors such as safety information systems, policies, procedures and practices.

Figure 2.1. Organizational, social, and human enabling capitals.

To elaborate an example, consider a maintenance engineer who is injured by a release of high-pressure steam after failing to isolate a critical process because s/he believed the process had no impact on task safety. This erroneous belief can be viewed from a number of perspectives within the framework of enabling capitals. In terms of human capital, the erroneous belief might reflect a limitation in the knowledge of maintainers about safety procedures and the connection between work processes. Regarding organizational capital, the belief might be influenced by practices which affect the task, or the knowledge maintainers have about the task. For example, the training system might not have conveyed adequate information, or the design might reflect a failure to isolate processes effectively. In relation to social capital, and at the most tangible level, a failure by supervisors to communicate risk or promote the value of training might limit the opportunity of maintainers to acquire a more accurate belief. At the deepest level, a shared cultural belief about the nature of the process hazard risk and its controllability may have been implicated as a distal influence over cognitions and/or behaviour.

The individual, social, and organizational aspects of the failure described above can be assessed using a range of different measurement methods ranging from personal assessments through to safety climate and culture surveys, and system audit tools. These tools provide a window into the nature of the constraints that control and shape individual and team safety behaviour when faced with system disruptions. For example, individuals might hold beliefs about the role of safety in successful performance, norms around leadership style might shape the way supervisors communicate safety goals, and embedded industry practices might constrain the role of training. At the deepest level, implicit assumptions form the essence of the organizational safety culture and hence the most basic mechanisms for system control.

Our capability framework clarifies some distinction between the observable features of safety climate and the more implicit elements of safety culture. The framework places safety climate within the domain of social enabling capital, differentiating it from the organizational and human capitals. Safety climate is therefore conceptualized as perceptions of behavioural norms and espoused values around safety, aggregated at different levels of the organization (e.g., team, department, company). In the following section, we integrate safety capability and these enabling capitals with systems theory to explore how safety culture and climate can act as forms of control.

Integrating Systems Approaches with Climate and Culture

Socio-technical systems approaches treat safety as an emergent property of the organizational system and adopt a control orientation to disturbances in the system (Leveson, 2011). Decision makers at each level of the organization pursue goals, which may be set or influenced by other actors at different levels (Rasmussen, 1997). Performance and the achievement (or not) of goals can be affected by disturbances that affect the availability or quality of inputs, or disrupt the process by which inputs are transformed into outputs, which in turn reduces system control. For example, external market forces can influence a firm’s investment in safety measures, operational schedules can be disrupted by congestion or weather, and front-line operations can be disrupted by problems with equipment or supplies. An accident can only occur if there the level of control over a work system reduces to the point of failure. There are three ways that loss of control can occur: external disturbances might not be handled effectively; components within the system may fail; or components of the system may interact in unexpected ways (Leveson, 2011).

The control problem

One of the critical challenges that organizations face is maintaining effective control in a dynamic and uncertain environment (Griffin et al., 2015). Control is particularly difficult to achieve when the system is subject to unexpected disturbances, there are complex interdependences among the components of the system, and there are lags or delays in the response of the system, or in the provision of feedback to the people making the decisions. To maintain effective control, an organization needs the capability to: a) monitor the output of the system and act to correct any discrepancy between the output and the goal (feedback control); and b) learn from experience, and anticipate or predict the future state of the system to prevent discrepancies from occurring (feed-forward control). A control system that is unable to learn from, adapt to, and anticipate, change, is unable to operate effectively (Hollnagel, Woods, & Leveson, 2007).

Controls act to constrain the system so that it remains within the limits of acceptable performance. According to Rasmussen (1997), the boundaries for safety and economic viability define the feasible operating space for an organization. The operating point location is determined by forces that push the system towards or away from each of these boundaries. In most situations there is uncertainty regarding the exact location of the boundary for unacceptable safety, and an organization will only know that it has crossed the boundary when an accident occurs. For this reason, the organization struggles to keep away from the safety boundary. Rasmussen (1997) argues that, over time, this produces a marginal safety boundary that marks the limit of acceptable safety.

One of the key insights of socio-technical systems theory is that organizations in high risk industries tend to operate close to the marginal safety boundary (Mitropoulos & Cupido, 2009). Management pressure to improve efficiency, and worker pressure to manage the effort necessary for goal achievement push operations closer to the unsafe zone (Hollnagel, 2009; Rasmussen, 1997). The organization's safety management system exerts a counter-pressure, resisting movement towards the boundary. When an organization operates close to the marginal safety boundary, temporary control failures will cause it to cross into the buffer zone. Over time, deviations into the buffer zone become normalized, and the marginal boundary is shifted, reducing the safety margin.

Culture and climate as system controls

We propose that safety culture and climate enable organizations to solve the safety control problem through constraints that shape performance in ways that optimize both

productivity and safety goals. Safety culture is a distal control mechanism because it is deeply embedded in the organizational functions, it is implicit rather than explicit in actions, and is slow to change (Antonsen, 2009). Core assumptions at the heart of safety culture facilitate control by supporting a shared way of interpreting situations and identifying appropriate responses or ways of acting (Choudhry, Fang, & Mohamed, 2007). For example, assumptions regarding the nature of human activity determine the extent to which people should take initiative or await instruction (Guldenmund, 2000). A belief that people should take initiative is likely to foster more effective responses to emergency scenarios when system control is lost. Conversely, a belief that people should always await instructions before acting may result in catastrophe. This distinction in belief content is apparent in the concept of safety culture maturity (Parker, Lawrie, & Hudson, 2006) whereby organizations are seen to possess varying types of beliefs that are more or less conducive to safety. At one extreme, the shared beliefs held by an organization may be described as 'pathological' insofar as they detract from the goal of system safety, and at the other extreme, 'generative' in the sense that safety beliefs generalize to all aspects of system operation. From this perspective, implicit safety beliefs (the essence of safety culture) therefore influence system safety through establishing a shared understanding of how to act and think in an organization (Antonsen, 2009; Guldenmund, 2010).

Conversely, safety climate is a proximal control mechanism because the shared perceptions of safety priority and practices at a given point in time can be modified through specific organizational, supervisor, and co-worker practices, and is more closely related to safety behaviour (Neal et al., 2000). Organizations can invest resources to build a more positive and coherent safety climate, thus reducing the risk of future accidents. Dimensions of safety climate represent control strategies that elicit specific operating behaviours by enhancing the competence of employees, motivating them effectively, energizing them, and removing constraints. For example, management safety commitment is commonly identified as a key dimension of safety climate (Flin, Mearns, O'Connor, & Bryden, 2000). By establishing managerial practices (e.g., genuine safety walkarounds) and safety interactions, social exchanges activate the norm of reciprocity, obligating employees to behave in ways that are aligned with formal safety procedures and policies.

Control dilemmas

Turner and Pidgeon (1997) explored the complex role of safety culture in disasters and elaborated ways that culture could simultaneously direct attention toward some

hazards yet deflect from others. We explore this duality for both culture and climate in relation to two core control dilemmas for organizational systems. The first dimension represents the relative emphasis that the organization places on reliability as opposed to flexibility. The second dimension represents the way that the organization frames the goals that people are expected to pursue.

Reliability vs flexibility

One of the key dilemmas that any organization faces is balancing the need for reliability with flexibility (Quinn & Rohrbaugh, 1983). On the one hand, an organization needs to be able to operate reliably under routine operational conditions. When uncertainty is low, as is often the case under routine conditions, it is possible to specify what needs to be done, and how it should be done, using instructions and procedures (Griffin et al., 2007). This is a top-down style of control that is directive and prescriptive. Many organizations try to achieve control over safety using this approach (Rasmussen, 1997) and in fact is the approach taken by most safety management systems (McDonald, Corrigan, Daly, & Cromie, 2000). On the other hand, organizations need flexibility to respond to unanticipated in adaptive ways. This type of response often requires decentralized decision making using local expertise and knowledge (Pidgeon, 1998).

The goal of the top-down approach is to ensure that known risks and hazards are eliminated or controlled. It assumes that work can be decomposed into a set of independent steps, the risks identified for each step, and appropriate controls put in place, typically in the form of procedures. Compliance with safe work procedures is monitored and enforced. This style of control can be effective when the task, corresponding hazards, risk control mechanisms, and the external environment are well-known and isolated from unplanned disruption (Hale & Borys, 2013; Hollnagel, 2011). A top-down control approach is reflected in many safety climate and culture measures, for example, assessing whether people are adequately trained in the use of and comply with safety procedures (Zohar, 1980; Zohar & Luria, 2005).

However, top-down control is problematic in a dynamic and uncertain work environment because it is not possible to write a set of rules to cover every potential circumstance. As a result, the top-down approach is largely reactive, requires large investments of resources to maintain, limits learning, and is more likely to fail under nonroutine conditions (Mitropoulos, Abdelhamid, & Howell, 2005). Top-down control also emphasizes uncertainty reduction, whereby prescriptive rules and standardization aim to

minimize uncertainty and achieve reliable performance (Grote, 2007). It is particularly problematic when the top-down control mechanisms interact in unforeseen ways, creating conflicting goals and increasing uncertainty (Grote, 2007, 2015). The locations of safety performance boundaries may become obfuscated or shift, especially when efficiency pressures regularly drive performance closer to the boundary of acceptable performance and these deviations become accepted ways of doing work (Dekker & Pruchnicki, 2014). Top-down control strategies may also impair the quality of feedback loops about control implementation and effectiveness from lower to higher levels (Leveson, 2015).

An alternative approach is to emphasize flexibility, using bottom-up control, in which people are given autonomy to make decisions within their area of competence. When uncertainty is high, people need the autonomy to decide what needs to be done, and how to do it (Griffin et al., 2007). Within socio-technical systems theory, this bottom up process is captured by the principle that variance should be controlled as near to the point of origin as possible (Cherns, 1976). Autonomy has been shown to enhance performance when uncertainty is high, because it: a) allows problems to be detected and solved more quickly and effectively; b) enables decision makers to learn from experience and acquire higher levels of expertise; c) enhances intrinsic work motivation; and d) makes people more proactive and innovative (Parker et al., 2010). In addition to formal changes in how work is done and organized, organizations may also invest in informal and “soft” (Grote, 2007) control mechanisms such as leadership and culture that not only motivate proactive work behaviours, but also elicit normative pressures and constraints on behaviour during uncertain system states that require flexibility. Such constraints also aim to manage risk through increasing uncertainty – cultural standards for behaviour such as speaking up is an example of how uncertainty can be increased yet risk managed effectively through flexibility(Grote,
2015).

High reliability organizations are a type of work system that can balance the competing demands for reliability and flexibility. These organizations are thought to operate at consistently safe levels close to the acceptable performance boundary using a combination of top-down and bottom-up control (Cook & Rasmussen, 2005). Top-down control is achieved by setting goals or objectives for people to achieve, rather than directing people what to do and how to do it. Procedures are used to standardize operations under routine conditions to ensure consistency and facilitate coordination amongst different actors in the system. However, local operators are given the autonomy

to manage disturbances. For example, they are allowed to improvise where necessary, and do what is needed to stabilize the system and respond to threats/disruptions effectively (Weick, 1987; Weick & Sutcliffe, 2001). Achieving optimal levels of both flexibility- and reliability-inducing control strategies should be a goal of high-risk organizations (Grote, 2015).

Promotion versus prevention

A second control dilemma that organizations-as-systems must successfully reconcile is between promoting gains and preventing losses. Other ways of conceptualizing this control dilemma include the efficiency-thoroughness trade-off (Marais & Saleh, 2008) and the protection-production goals conflict (Wang, Ding, Love, & Edwards, 2016). Given that production--focused promotion goals exert a continual pressure on system operations, pushing closer to the boundary of acceptable performance (Rasmussen, 1997), reframing promotion goals in terms of safety and/or exerting a counter-pressure through prevention goals is critical to achieve safety goals/targets and avoid accidents. Recent research has shown that individual differences in regulatory focus influence risk-taking behaviour, with alignment between control strategy and regulatory focus resulting in higher safety performance and misalignment (e.g., negatively-framed safety campaigns for promotion-focused individuals) resulting in lower safety performance (Hamstra, Bolderdijk, & Veldstra, 2011).

As noted above, goals are a key mechanism through which control is achieved in an organization. From a psychological perspective, the framing of a goal as something positive that a person strives to achieve, as opposed to something negative to avoid or prevent, has a profound impact on behaviour (Arnold & Reynolds, 2009). According to Regulatory Focus Theory (Higgins, 1997), a promotion focus fulfils fundamental needs of nurturance and growth, is underpinned by strong ideals, aspirations, and desirable end states, and motivates approach behaviours that may include risk-taking and exploration. On the other hand, a prevention focus satisfies needs of security and safety, is underpinned by a sense of obligations, and motivates avoidance or risk-averse behaviours such as rule-following and risk minimization.

From an organizational perspective, it is important to achieve a balance of promotion and prevention. Prevention is essential for organizational survival. The organization needs to respond to economic, social and environmental threats in ways that reduce risk and withdraw from adverse situations to avoid system failures (Weick, Sutcliffe,

& Obstfeld, 1999). A focus on duties and obligations keeps people alert to risk, and ensures compliance with minimum standards. On the other hand, an excessive focus on prevention may limit personal initiative, and emphasize compliance behaviours such as rule-following (Aryee & Hsiung, 2016). Promotion, on the other hand, is essential for prosperity. An organization needs to pursue opportunities for growth and development (Scott & Davis, 2015) and a focus on ideals and aspirations keeps people striving for continuous improvement (Wu, McMullen, Neubert, & Yi, 2008).

For example, Wallace and colleagues (Wallace & Chen, 2006; Wallace, Johnson, & Frazier, 2009) found that a prevention focus is negatively associated with injuries because workers are more likely to show vigilance and care, following rules and adopting safety responsibilities. Conversely, a promotion focus was positively associated with injuries as speed and efficiency strategies tended to be used over safe and cautious work behaviours.

Others have found that employees' promotion focus was positively related to safety performance through safety initiative – proactive safety behaviours that are self-starting and focused on changing the organization's safety practices to improve them (Aryee & Hsiung, 2016; Kark, Katz-Navon, & Delegach, 2015). In the latter case, it appears that safety can be framed in terms of aspirations and ideals, meaning that promotion-focused safety goals complement prevention-focused goals through elicitation of proactive behaviours that tap into personal and shared values (Kark et al., 2015).

Framing safety as a promotion goal entails describing a future state where work tasks are completed efficiently and without hazard release. Thus, a promotion-focused safety goal means the work system is operating as close as possible to the boundary of safe operations, and is able to do so without unacceptable risk through proper coordination and management of performance variability (Cook & Rasmussen, 2005). A promotion-oriented safety goal also emphasizes ongoing adjustments to performance, resulting in successful variability, continuous improvement, and flexibility to anticipated threats (Curcuruto, Mearns, & Mariani, 2016). Importantly, simultaneous optimization of both prevention- and promotion-focused orientations at work appears to be not only possible, but desirable in terms of performance outcomes, including safety (Kark et al., 2015; Wallace & Chen, 2006).

Practical Control Strategies

From a control systems perspective, differences in safety culture and climate configurations represent differences in the types and effectiveness of various control strategies that organizations can employ. The arguments above highlight different ways that organizations strive to solve the safety control problem. These strategies and their associated policies, procedures, and practices are amenable to influence through safety culture and climate. As explained below, the combination of these two control dimensions produce four different types of control strategy.

We expect that the need for these strategies may vary depending on the state of the system, but that over time, organizations are best served by using a balance of all strategies, and dynamically shifting their emphasis on each strategy in anticipation of or in response to changes in system state. Through modifying leadership and safety management practices, which in turn make aspects of the underlying safety culture salient and establish a particular safety climate, organizations are able to deploy appropriate control strategies that return the system to a safe and stable state.

Defend

The first strategy is termed ‘defend’. The defend strategy emphasizes reliability and has a prevention orientation, so is primarily reactive. Defend is employed during system states where a safety incident or near-miss has occurred, and the organization is reacting in ways to bolster its barriers to future reoccurrences. Defend may also be used when the system’s risk levels are deemed high such as when routine violations like workarounds or other unsafe acts are occurring. In these system states, high management production pressure and workers’ desire to invest the least effort to complete tasks result in tendencies to sidestep rules to get the job done.

Accordingly, the defend strategy uses control measures that seek to protect against harm or economic loss in a stable environment. These control measures exert a counterpressure that resists the operating state moving into the unsafe zone, and tightly constrains operating variability. This control is achieved by establishing and enforcing safety standards, monitoring compliance, and acting to correct deviations. The emphasis is on top-down supervisory control. It is a reactive strategy that is most effective when dealing with well-known risks and hazards that are encountered during routine operations. Defend is best described as an uncertainty reduction control strategy, whereby prescriptive action rules and automation are used to centralize control over work systems and achieve

reliable and stable operations (Grote, 2015). These practices serve to constrain the variability of performance through prescriptive rules and exerting a counter-pressure in the form of traditional safety campaigns that emphasize rule-following behaviour.

Safety climate, as the shared perceptions of safety procedures, creates a ‘strong situation’ that restricts behaviour. At a deeper level, shared beliefs and assumptions about the nature of rules exert constraints by providing a referent for how rules should be thought about and acted on. Beliefs regarding the process of justice and power are additional cultural constraints that shape the performance of system operators.

In some organizations, a defend control strategy may become excessively bureaucratic, with increased formalization of safety procedures resulting in apathy and poor quality upwards feedback about system operations from lower levels (Marais et al., 2006). Another disadvantage of the defend strategy is that is sets up a tension with production/efficiency goals, meaning that operators may be inclined to implement workarounds or fail to provide accurate feedback data to higher levels of the organization. Another disadvantage of the defend strategy is the attempted elimination of uncertainty, which may impair safety-related innovation (Grote, 2015). These points suggest that reliance on defend as the primary safety control mechanism is likely to be inadequate.

Adapt

The second strategy is termed ‘adapt’. The adapt strategy emphasizes flexibility and has a prevention orientation, so is also primarily reactive in nature. Adapt is most useful when the system has crossed the boundary of acceptable performance and a hazard has been released. In this situation, the variability of system operations becomes erratic and tightly-coupled, whereby small perturbations in the work system can result in marked changes that could result in disaster (Cook & Rasmussen, 2005). The system objective is to return to a controlled and safe state as quickly as possible.

The adapt control strategy implements constraints that seek to protect against harm or economic loss during non-routine operations, such as when new hazards are encountered for the first time. Adapt exerts control through providing local operators with the flexibility they need to respond quickly and effectively to unexpected disturbances, and to do what is needed to move the system out of the unsafe or unproductive zone. They also enable local operators to learn from mistakes and errors, and to prevent the same problems from occurring again by engaging in proactive safety behaviours such as raising improvement suggestions. At higher levels within the organization, they enable

procedures, practices, technology or strategy to be adjusted to suit changing circumstances, thereby obtaining better control over the location of the operating point and performance boundaries, and pulling the operating point to move back into a safe state.

Perceptions of emergency readiness and continuous improvement practices, such as error management, represent the types of constraints exerted by safety climate. Relatedly, climate perceptions around psychological safety, the perception that it is safe to take interpersonal risks, (Edmondson, 1999) are also likely to be important for successful implementation of the adapt strategy. A positive psychological safety climate is related to higher levels of speaking up behaviour, such as when a safety incident is first noticed (Grote, 2015). Beliefs about the consequences for speaking up about an error or mistake, and assumptions about the causes of accidents are additional deeper constraints over thinking and behaviour within the work system.

Leverage

The third strategy is termed ‘leverage’. The leverage strategy emphasizes the achievement of an optimum balance between production and safety, and so is most effective during normal operational states. Leverage is most useful when the system is operating in stable conditions, and by virtue of production pressures that seek to push the operating state closer to the boundary of acceptable performance, at risk of crossing into the unsafe zone. The location of the acceptable performance boundary may become obfuscated or shift, especially when efficiency pressures routinely drive performance closer to the boundary and these deviations become accepted or ‘normalized’ through implementation of practices and shared understandings across the organization (Dekker & Pruchnicki, 2014). In this situation, operators become complacent to hazards (Marais et al., 2006) and have ‘forgotten to be afraid’ (Reason, 1997).

Leverage uses control measures that seek to simultaneously promote both safety and productivity in a stable environment. These control measures exert a force that pushes the system toward the boundary of acceptable performance, and maintains a dynamic equilibrium over production and safety goals. Leverage achieves optimal balance through promotion-focused goals. These goals appeal to employees’ sense of nurturance and achievement, being challenging in nature and rewarded once attained. Importantly, safety is framed according to a promotion-focused orientation, such as positive targets to be achieved. Recognition of successful task behaviours that achieve promotion goals without compromising safety is a key practice underpinning the leverage control strategy.

In this way, the system implements reinforcing loops to encourage future repetition of successful behaviours that optimize both production and safety goals (Goh, Brown, & Spickett, 2010). Leverage requires the removal of barriers or constraints that impede progress, typically by ensuring that activities and operations are appropriately planned and coordinated. Effective coordination of activities between levels of an organizational system is critical for safe performance (Leveson, 2011). Without effective coordination, inappropriate control actions may be issued, resulting in disaster. There must also be clear allocation of accountability for safety performance, and operators need to have the appropriate for the means for achieving accountability (Grote, 2015).

From a safety climate perspective, shared perceptions of reward/recognition, safety communication, and planning practices establish strong behaviour-outcome expectancies that shape performance ‘at the pointy end’ of system operations. Culturally, shared assumptions and beliefs about the nature of human relationships and agreement around accountabilities and responsibilities are relevant constraints afforded by the leverage strategy. Culture has long been associated with methods to achieve coordination of independent organizational actors using an approach that deemphasizes effortful surveillance and verification (e.g., Weick, 1987). Using a socio-technical model of safety culture, Grote (2007) described shared practices, norms, and attitudes that achieve coordinated action in ways that are compatible with the leverage control strategy. Examples include measurement of safety indicators, resource planning focused on safety promotion, and collective safety awareness.

Energize

The final strategy is ‘energize’. The energize strategy emphasizes flexibility and has a promotion orientation, so is proactive in nature. This strategy uses control measures that seek to promote safety and/or productivity in a changing environment. These changes can arise from factors such as new technology, the availability of supplies or resources, customer demand, competitors, organizational strategy, structure, or operating conditions. Changes in production technology may put organizations at risk (Marais et al., 2006). Advances in technology may result in hidden sources of risk due to a lack of understanding around how the technology will interface with existing system structures, constraints, and operators. The risk carried by organizational change may be further exacerbated if these produce short-term production benefits, with safety decreasing in importance as a result.

The energize control measures exert a force, pushing the system towards the boundary of acceptable performance. Control is maintained in this situation through constraints such as a shared vision for safety or productivity, inspiring a collective sense of purpose or commitment to these goals, and providing autonomy for people to be able to make it happen. Internalization of company values means that operators look for ways to simultaneously enhance both productivity and safety. Given this emphasis on autonomy and internalization of company goals, energize exerts control over system operators primarily through its effects on internalized forms of motivation. Energize is characterized by proactive work behaviours, such as initiating change in a future-focused manner (e.g., making suggestions to improve efficiency and/or safety of the system). Energize control strategies build employees' level of autonomous and intrinsic motivation, resulting in increased role breadth self-efficacy and role flexibility, appraisals of being in control of work tasks, and openness to change (Curcuruto et al., 2016; Parker, Williams, & Turner, 2006).

Safety climate exerts control through shared perceptions of practices such as employee consultation and involvement in organizational decision-making. Consulting with employees on safety-related changes not only increases their sense of ownership and engagement (Geller, Roberts, & Gilmore, 1996), but also provides upwards feedback information to equip controllers with additional information about how such changes may impact on boundaries and performance. Safety culture exerts control through shared assumptions about the nature of human activity, specifically, the expectation that safety-related proactivity and initiative are desirable behaviours. Also, shared organizational values related to participation and involvement mean that employees are likely to internalize company goals and strive to achieve them. These values can be embedded in systems such as safety rules, with decisional latitude built-in to how rules should be implemented (Grote, 2007).

Table 2.1. Summary of LEAD control strategies.

Energize	***Adapt***
Control measures that seek to promote safe production in a changing environment (e.g., changes in technology, the availability of supplies or resources, customer demand, competitors, organizational strategy, structure, or operating conditions). These control measures change the system boundaries to enhance efficiency and safety performance. This is done by developing a shared vision for safe production as an aspirational goal, inspiring a collective sense of purpose or commitment to these goals, providing autonomy, and involving operators in decision-making. Safety climate: Perceptions of employee consultation and involvement practices. Safety culture: Beliefs around the nature of human activity, and specifically safety initiative. The system is proactive and forward-looking with a view to exploring new opportunities and capitalizing on them to improve efficiency and/or safety.	Control measures that seek to protect against harm or economic loss in novel accident scenarios (e.g., loss of process control, hazard release). These control measures exert a counter-pressure that pulls the system operating point back into the safe zone. This is achieved by implementing well-practiced emergency routines, and adjusting procedures, practices, technology or strategy to prevent future reoccurrences. Safety climate: Perceptions of emergency readiness and error management practices. Safety culture: Beliefs about the consequences of speaking up about errors/mistakes, and the causes of accidents. The system is reactive and reflective with a view to improving future performance through exploiting current capabilities to restore safety, and ensuring the system adapts and learns from its failures.
Leverage	***Defend***
Control measures that seek to promote safe production in a stable and routine environment. These control measures push the system towards an optimal production/safety balance. Constraints are established through setting aspirational standards, monitoring progress, and rewarding success and accomplishment. It requires the removal of barriers or constraints that impede progress. Effective planning and coordination are hallmarks of this control strategy. Safety climate: Perceptions of safety recognition, communication, and planning practices. Safety culture: Beliefs about the nature of human relationships, particularly cooperation to achieve shared safety goals. The system is proactive and forward-looking with a view maintaining a dynamic equilibrium between safety and efficiency.	Control measures that seek to protect against harm or economic loss in a stable and routine environment. These control measures exert a force that pulls the operating state back into the safe zone and constraints variability to reduce risk as low as possible. Defend exerts control by setting and enforcing safety standards, monitoring compliance, and acting to correct deviations. The emphasis is on top-down control. Disciplinary practices aim to eliminate violations and performance variability. Safety climate: Perceptions of safety procedures and practices. Safety culture: Beliefs about the nature of rules, organizational justice, and distribution/use of power. The system is reactive and reflective with a view to eliminating sources of performance variability and resisting the pressures exerted by production and efficiency goals.

Conclusion

Recent advances in fields such as cognitive systems engineering and resilience engineering have started to integrate safety culture into models of organizational systems.

Safety culture tends to be referenced more frequently than safety climate in these systems models. However, safety culture is best considered as an embedded, intangible, and distal influence over system performance, whereas safety climate is more dynamic and malleable, and applicable across multiple levels of analysis. These properties mean that safety climate is readily applied to systems-based models of safety and acts as a proximal mechanism for managing system safety.

Scholars within the resilience engineering discipline have developed novel assessment techniques that are being used to measure the nature and effectiveness of control efforts such as those using signal detection theory, (Abdelhamid, Patel, Howell, & Mitropoulos, 2003) and the resilience analysis grid (Hollnagel, 2009). However, the concept safety climate has largely been absent from these investigations. In light of this work, we recommend that future research should examine the safety climate and culture components that underpin each of the described control strategies, and relate assessment data across these to performance outcomes. Such data will provide organizations with the direction needed to develop the control capabilities required to achieve resilient and safe operations under a range of operating conditions. An additional avenue for research is examining more dynamic models of safety climate that elucidate how climate perceptions can be 'deployed' or strategically implemented by decision-makers at different levels of an organizational system to shape and constrain behaviour. Such longitudinal research designs will help to establish the control functions afforded by different dimensions of safety climate, and help to inform practical recommendations for industry in terms of implementing safety climate as a form of social control over safety performance.

Perhaps the most compelling rationale for including safety climate and culture within systems models is the notion of bottom-up control. Bottom-up control is likely to be more effective and sustainable under the types of conditions faced by high hazard organizations in the modern age, where uncertainty, interdependence, and dynamic environments are encountered routinely.

Chapter 3: LEAD operational safety: Development and validation of a tool to measure safety control strategies

Abstract

This paper describes four studies, which together develop and validate a new measurement tool for team-level safety leadership. Leadership has long been associated with exemplary safety performance, but is difficult to characterise and measure. Further, safety practices shown by co-workers have been studied in isolation. The new measure that we develop in this research operationalises work by Casey and colleagues (2017) that suggests self-regulation states provide the mechanism by which leadership practices influence safety behaviours. This theory predicts that there are four main 'control strategies' used to maintain safety performance. Each strategy makes use of a distinct set of safety practices, and gives rise to a specific self-regulation state in workers. These states in turn predict both compliant and proactive safety behaviours. In Study 1, we interviewed 25 subject matter experts to extract safety leadership practices and develop a draft measurement tool. In Study 2 we evaluate the measurement tool and inform its refinement through empirical means. In Study 3 we evaluate a shortened version of the tool. In Study 4 we provide further validation evidence for the shortened tool and examine associations with self-regulation mediators and safety performance. We found support for all of our hypotheses, which supports the idea that safety leadership practices are related to self-regulation states within workers, which in turn are associated with different safety behaviours. This study is among the first to empirically evaluate an integrative model that seeks to link safety leadership practices through to safety behaviour via self-regulation theories.

Introduction

As organisations become more complex, competitive, and dynamic, traditional accident models are failing to accurately predict or prevent workplace accidents (Reason et al., 2006). Consequently, there is an ongoing search for positive capacities that both prevent incidents and promote the achievement of successful work outcomes (Hollnagel et al., 2015). Safety-specific practices that influence individuals' motivations to work safely, such as those shown by supervisors and co-workers, represent one such positive capacity that could simultaneously promote proactive behaviours and prevent non-compliant or at-risk behaviours. Supervisors and co-workers, being most proximal to workers at the front line, have the potential to exert the most influence over safety behaviours and subsequent performance (e.g., Brondino et al., 2012; Fugas et al., 2012; Fugas et al., 2011; Lingard et al., 2010).

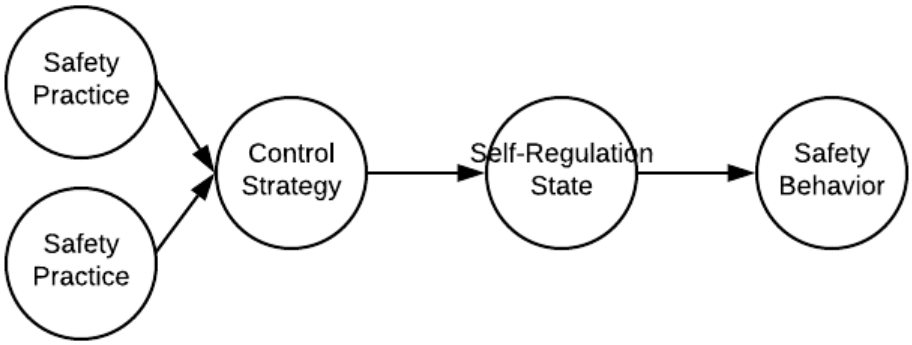
Although much work has been done on examining primarily the influencing practices of supervisors (under the umbrella of safety leadership), this literature has been criticized for its reliance on transformational and transactional leadership theory, which has problems because 1) it conflates safety leadership and safety climate, 2) relies on static styles or almost personality-like conceptualizations of leadership (e.g., charisma), and 3) may not accurately represent the reality of safety leadership practices in the field (Donovan et al., 2016; Nayani et al., 2018; Pilbeam et al., 2016). Further, there have been calls to examine safety leadership from a more dynamic perspective given there has been little prior consideration of how work context influences the selection and demonstration of leadership style, with one systematic review concluding that specific aspects of leadership practice encourage different safety behaviours among employees, given the activation of different motivational pathways (Pilbeam et al., 2016).

A promising avenue through which safety practices may exert effects over safety behaviour is via motivational pathways such as self-regulation (a motivational state that enable a person to guide goal-directed activities through the use of strategies; Karoly, 1993). Through applying the science of self-regulation, it should be possible to identify specific bundles or combinations of practices that teams can implement to induce combinations of self-regulatory states, in turn, driving specific behaviours. This idea stands to benefit health and safety performance due to the dynamic deployability of a wider repertoire of safety behaviours (e.g., proactivity) in response to environmental circumstances.

Self-regulation has been studied in the safety domain. For instance, Wallace and Chen (2006) found that safety climate induced a prevention-focus, which in turn flowed through to safety compliance. In the leadership space, Kark and colleagues (2015) found support for transformational leadership predicting promotion focus, and in turn, being related to safety initiative. Ayree and Hsiung (2016) found that there is a differentia relationship with safety outcomes via promotion and prevention-focus. The contribution of our paper is the integration of these multiple and separate lines of inquiry into one overarching framework, linking safety leadership practices with safety outcomes via different combinations of regulatory focus. We also introduce a new self-regulatory construct called 'uncertainty management', which makes further inroads into understanding how safety leadership shapes and moulds operators' safety behaviours in response to various team practices. Further, we contribute to safety science by elucidating a dynamic model of self-regulation, whereby different combinations of regulatory focus states are seen to influence different configurations of safety behaviour. The measure we develop in this paper will help to stimulate and drive additional research to explore the dynamic associations between self-regulation and safety behaviour, via leadership. Thus, overall this paper contributes to safety science by both integrating work that has come before, as well as striking new ground to understand more about what drives safety performance in the context of safety leadership.

Recently, Casey, Griffin, Harrison and Neal (2017) argued that organizations can use a range of different control strategies for achieving their safety objectives, and that these strategies should be reflected in workers' perceptions of safety climate. Casey et al. (2017) argued that these different aspects of safety climate have an impact on safety behaviour via different motivational pathways. As safety climate operates at the strategic or organizational level, we extend the ideas explained in the Casey et al (2017) paper by applying them at the operational level (see Figure 3.1). Operational influences such as those extended by supervisors and co-workers are most proximal to the 'sharp-end' where work is done, and so stand the most chance of exerting effects over individuals' safety behaviours (Lingard et al., 2010).

Figure 3.1. Overview of theoretical model used in this research.



In this paper, we use the Casey et al. (2017) framework to develop a new measure that combines various supervisor and co-worker practices into ‘bundles’ that are predicted to influence safety performance in purposeful ways. We also conduct a preliminary examination of the role of self-regulation as an important mediator through which the operations-level control strategies influence safety behaviour. We targeted teams given prior research has shown that proximal practices shown by supervisors and co-workers exert a strong influence over safety behaviour (Brondino, Silva & Pasini, 2012; Lingard et al., 2010).

Although a plethora of safety leadership scale exist, most are derived from straightforward adaptation of existing measures such as the multifactor leadership questionnaire (e.g., Barling et al., 2002). Few have been derived inductively from qualitative research (e.g., Wu, 2005), and none to our knowledge have been operationalized with respect to self-regulation theories or systems-based concepts. Such a reoperationalization of supervisor and co-worker safety practices would be advantageous to practitioners because it would draw together many different studies and concepts, provide a unified instrument and consistent set of dimensions, and specify a psychological mechanism through which safety practices influences safety behaviour (potentially informing the development of new interventions).

Regulatory focus theory (Higgins, 1997) describes two orientations or mindsets that people adopt when striving towards goals; a promotion-focus and a prevention-focus. With a promotion-focus, individuals are oriented toward gains such as achievement and success. With a prevention-focus, individuals are oriented toward minimizing losses such errors and accidents. We also describe new theoretical constructs of self-regulation and how they relate to safety, which we label ‘uncertainty management’. The current research generally builds on the premise that uncertainty is an important component of health and

safety management, for instance, increasing uncertainty by promoting safety voice or speaking up (which may promote exploratory actions to rectify issues), and providing flexible and principle-based rules to promote adaptive performance (Grote, 2015). We propose two uncertainty management mental states; a flexibility-focus and a stability-focus. With a flexibility-focus, individuals are primed to approach uncertainty and explore it to develop new capabilities. With a stability-focus, individuals are conversely primed to reduce uncertainty through exploiting existing capabilities. Integrating these theories with the ability to induce different self-regulatory states through environmental factors such as safety climate (Wallace & Chen, 2006) and practices such as safety leadership (Kark et al., 2015) may provide a powerful way for organizations to exert nuanced and strategic effects over the performance of operators within a work system.

Based on the framework of Casey et al., (2017), we propose that different team-level control strategies form distinct bundles or dimensions of practices. Each dimension is linked to different self-regulation states, which in turn, influence behavioural outcomes of safety compliance and safety proactivity. In the following sections, we first identify the tensions or dilemmas that teams resolve through the implementation of teams' control strategies, and how these control strategies influence self-regulation and behaviour for individuals. In total, we outline four separate studies in this paper: a qualitative investigation to identify specific bundles of practices that could be used to develop a measurement scale, two scale development studies using diverse samples, and a final study to provide a preliminary test of the relationships with self-regulation and performance variables.

Control strategies and self-regulation

The socio-technical systems approach treats safety as a control problem (Leveson, 2002; Rasmussen, 1997). Organizations need to ensure that operations remain within safe boundaries, which is difficult when the environment is dynamic, uncertainty is high, and there are complex interdependencies among the elements of the system. Casey et al. (2017) argued that perceptions of safety climate are influenced by the control strategies through which organizations maintain system safety. To be successful at maintaining system safety, these control strategies require the management of two fundamental tensions or dilemmas by system controllers: promotion versus prevention; and stability versus flexibility. The most proximal system controller to individuals performing work activities is the supervisor. Supervisors have considerable discretion in how and when they

implement safety control strategies, such as organizationally-endorsed policies, procedures, and practices (Zohar, 2000). Co-workers also shape individuals' safety behaviours through exerting their own influences such as discouraging unsafe behaviour, communicating about safety matters, and supporting co-workers to complete work successfully (Fugas et al., 2012; Hofmann et al., 2003). Below we outline the background to these tensions and their relevance to operational (group level) safety behaviour management. We then develop hypotheses that will be tested in the final study to provide evidence of the proposed relationships between aggregated scale scores, self-regulation variables, and safety behaviours.

Promotion and prevention tension

The first dilemma that organizations need to control involves the need to minimize or eliminate negative events (i.e., prevent unsuccessful and unsafe outcomes) while maximizing and achieving positive events (i.e., promote successful and safe outcomes). This tension between promotion and prevention control strategies is evident in the changing emphasis of safety management over recent decades. Traditional approaches to safety management tend to focus on the prevention of accidents and injuries. Under this approach, which has been termed "Safety I" (Hollnagel et al., 2015), safety is framed as a prevention goal where the aim is to minimize harm or loss events. An alternative approach, which has been termed "Safety II", is to frame safety as a positive outcome where effort is directed toward success and achievement (Hollnagel et al., 2015). Although the concepts of Safety I and Safety II have not yet been subject to rigorous empirical testing, they are consistent with a long history of research in psychology demonstrating that the distinction between positive and negative outcomes plays a fundamental role in human motivation (Carver, 2006; Elliot & Thrash, 2002; Higgins, 1997).

These different control strategies align with the motivational orientations of self-regulation theory. Regulatory focus theory predicts that when a goal is framed in terms of the potential benefits to be gained, people are likely to adopt a promotion-focus, in which goals are viewed as ideals to which the person strives (Higgins, 1997). A promotion-focus motivates strategies that emphasize hopes, accomplishments and advancement, and increases the likelihood of risk-taking (e.g., innovation) in the pursuit of gains. Casey et al. (2017) argued that when workers have a stronger promotion-focus, they are more likely to work proactively to enhance the safety of their work environment. This is because a

promotion-focus motivates behaviours that involve exploration, creativity, and innovation, and require personal initiative.

On the other hand, when a goal is framed as a negative outcome to be prevented or minimized, regulatory focus theory predicts that people are likely to adopt a prevention-focus. When a prevention-focus is induced, people are more likely to emphasize safety, responsibility, and security; goals are viewed as obligations and oughts; people tend to be vigilant; and take extra care to avoid mistakes and errors. Casey et al. (2017) argued that when workers have a stronger prevention-focus, they are more likely to comply with safety rules and procedures. This is because a prevention-focus motivates behaviours that minimize risk and enable the person to meet their duties and obligations. A prevention-focus is characterized by practices including risk aversion, cautiousness, and vigilance.

There is evidence to support the argument that prevention- and promotion-focus play an important role in explaining safety behaviour (e.g., Aryee & Hsiung, 2016; Kark et al., 2015; Wallace & Chen, 2006). Wallace and Chen (2006) found that safety climate was positively associated with prevention-focus. Of relevance to this research, Kark et al (2015) showed that supervisor transformational leadership was positively associated with promotion-focus, which was positively related to safety initiative. More recently, Ayree and Hsiung (2016) found that promotion-focus was related to safety-related events and injuries via safety initiative, whereas prevention-focus was related to safety-related events via unsafe behaviour such that a higher prevention-focus predicted fewer unsafe behaviours and safety-related events. However, these research studies also highlight some inconsistencies that may be explained through adopting a more nuanced framework that considers other self-regulation pathways. Ayree and Hsiung (2016) did not find an association between prevention-focus and injuries via unsafe behaviour, and Kark et al (2015) did not find a consistent relationship between prevention-focus and compliance behaviour.

Stability and flexibility

The second dilemma for system controllers involves resolving the tension between stability and flexibility. Organizations need to be able to operate reliably and safely under routine conditions (Leveson, 2011). To do this, they need to be able to identify and control known risks and hazards. This control is typically achieved using top-down and hierarchical managerial strategies characterized by specifying what people have to do ahead of time (e.g., pre-job planning and risk assessment; Zanko & Dawson, 2012), how

they do it (e.g., standardized work procedures; Adler & Borys, 1996), and monitoring compliance (e.g., transactional leadership; McCoy et al., 2001). In other situations, such as when hazards are unexpected, failure is experienced, or novel threats and opportunities arise, organizations need flexibility to achieve successful outcomes. This is typically achieved by giving people job autonomy (Dekker & Leveson, 2014), deferring to operators' expertise for decision-making (Weick & Sutcliffe, 2011), and engaging in active consultation to inform changes (Dollard & Bakker, 2011). Again, a team's direct leader and co-workers are often responsible for the implementation of such practices, meaning that they serve as a critical lynchpin to manage the daily variability of work and adopt specific strategies to achieve success.

Most theories of human motivation propose that individuals seek to reduce uncertainty, particularly when uncertainty is perceived as aversive (Berker et al., 2016). When teams pursue their safety goals using strategies that emphasize stability and minimize uncertainty, we expect individuals will adopt a mindset that reflects this approach. With this focus, individuals are more likely to pursue goals in ways that exploit current capabilities, such as drawing on existing knowledge, planning, and predicting how a situation may turn out in the future. We describe this state as 'stability-focus' which is more likely when control strategies implemented by supervisors and team members emphasize clear goals, rules, procedures (e.g., supervisors emphasizing the importance of particular work objectives/targets during a pre-start meeting), and feelings of inherent danger or risk in the work environment (e.g., a co-worker's emphasis on job hazard assessment and risk monitoring). Under conditions that induce a stability-focus, we expect individuals will be more likely to engage in compliance-related safety behaviours that concentrate on exploiting existing capabilities such as complying with rules and procedures, and using established risk management practices.

When teams pursue their safety goals using strategies that emphasize flexibility and take a more proactive approach to uncertainty, we expect that individuals will adopt a more flexible mindset. We describe this mindset as a 'flexibility-focus'. Control strategies that might induce a flexibility-focus involve an emphasis on support, development and growth, and learning. These strategies (practices/procedures) signal that individual needs and concerns will be addressed, and that there is a supportive and 'psychologically-safe' social environment in which exploration of uncertainty can take place. Under conditions that induce a flexibility-focus, individuals may be more likely to engage in more proactive safety

behaviours that involve exploring new capabilities and opportunities, such as safety voice (Tucker et al., 2008) and initiating safety-related change (Hofmann et al., 2003).

Safety performance

Traditionally, safety performance has been defined as a combination of safety compliance and safety participation (Neal & Griffin, 2002). Safety compliance behaviour is widely defined as rule-following and procedural adherence. Safety participation is defined as actively engaging in discretionary safety activities such as promotion initiatives and voluntary meetings. Subsequent studies have broadened the conceptualization of safety performance, pointing to a more nuanced set of behaviours. For instance, Burke and colleagues (2002) found that 'general' safety performance consists of four dimensions: using personal protective equipment, engaging in work practices to reduce risk, communicating health and safety information, and exercising rights/responsibilities. Hofmann and colleagues (2003) applied the concept of organizational citizenship to health and safety, resulting in an adapted scale replete with six different performance dimensions. More recently, further nuanced conceptualizations of safety performance have been developed. For example, Hu and colleagues (2018) proposed a new model whereby safety compliance is divided into three elements: deep (engaging fully in safety activities and compliance tasks), surface – show (going through the motions or making a 'show' of complying), and surface – effort (doing the least possible to comply).

Taken together, these studies strongly support the notion that safety performance is more complicated than simply following rules and procedures. A combination of both compliant and proactive/innovative work behaviours are required for organizations to meet legislated and voluntary standards such as those specified by ISO:45001 (ISO, 2018). For example, the ISO standards prescribe the features of an effective safety management system, which include both prevention- and promotion-focused behaviours: encouraging compliance with health and safety procedures, contributing to improvement processes, participating in consultation, and controlling risks. Accordingly, it is behest of organizations to encourage flexible and dynamic behavioural responses from workers to achieve exemplary safety performance.

The LEAD Model

In this section we outline specific bundles of safety practices that are associated with the different safety control strategies. The dimensions are based on Casey et al. (2017), who identified four different control strategies (leverage, energize, adapt, and

defend, which together form the second-order factor LEAD) that organizations can use to achieve superior health and safety performance. In the current research, this theory is applied to teams rather than organizations. These strategies represent different ways that teams can solve the safety control problem, and require the deployment or use of different types of practices in anticipation of or in response to different work situations. We propose that supervisory and co-worker practices should influence self-regulation and behaviour via distinct dimensions. These dimensions are summarized in Table 3.1, and explained briefly below.

Table 3.1. The four LEAD control strategies and underpinning self-regulatory mechanisms through which system control is established.

Promotion and flexibility Energize Used in situations where conditions are changing, such as introducing new procedures or technologies Practices include consultation, involvement, and training/development centered on employee growth	Prevention and flexibility Adapt Used in situations where an incident is occurring or has occurred, and the focus is on learning/improvement. Practices include reflection on work, effectiveness of emergency routines, and learning from failure
Promotion and stability Leverage Used in situations where conditions are routine and low-risk, and the focus is on optimizing multiple work goals at once Perceptions of practices including goal specification, recognition of achievement, and planning/coordination of work	Prevention and stability Defend Used in situations where high-risk work is being undertaken Perceptions of practices including risk management, driving accountability, and monitoring performance

The leverage strategy encourages a promotion-focus and emphasizes stability. Implementation of the leverage control strategy requires the use of team-level practices such as reward and recognition for successful safety performance; high-quality coordination and communication within- and between-teams as work is carried out; and effective forward-planning practices that include the identification of safety goals and establishment of strong behaviour-outcome expectancies.

The energize strategy encourages a promotion orientation and emphasizes flexibility. This strategy is proactive in nature, giving teams the capability to maintain safety in a dynamic and changing work environment. The energize control strategy exerts an influence on safety through practices such as communicating a specific vision or direction for safety-related change, encouraging collective purpose and commitment to goals, and enabling autonomy and growth opportunities for staff. Energize also requires the use of consultative and participative approaches to safety management.

The adapt strategy encourages a flexibility- and prevention-focus. The adapt control strategy consists of implementing practices such as emergency readiness routines, reflection on past performance, and error management techniques. In particular, emergency readiness routines remind operators of the dangers and risks they can face in the workplace, continuous improvement practices such as after action reviews encourage critical reflection-on-practice and learning (Baird, Holland & Deacon, 1999), and error management techniques such as talking openly about mistakes and fixing problems before they become major issues fosters a preventative and flexible approach (Cigularov, Chen & Rosecrance, 2010).

The defend strategy encourages a stability- and prevention-focus. Defend is best described as an uncertainty reduction control strategy that concentrates on stability and prevention, whereby drawing attention to rules and standardized procedures centralizes control over work systems and achieves reliable and stable operations (Grote, 2015). The defend control strategy centres on team members and supervisors emphasizing standardized rules and procedures around high-risk work (e.g., ‘Golden Rules’, Safe Work Methods Statements - SWMS), highlighting legislated duties and obligations (e.g., safety acts and regulations), carefully monitoring compliance and initiating corrective actions when expectations aren’t met, and making sources of danger and risk salient in the work environment.

Overview of Research Program

This paper consists of four separate studies conducted across a period of 12 months. Overall, the studies chart the creation, fine-tuning, and validation of a new scale of team safety practices that are theorized to predict different configurations of self-regulation, and in turn, safety behaviour. Study 1 adopts a qualitative methodology, using interview data from 25 subject matter experts to develop a pool of survey items. The objective of Study 1 was to lay a firm foundation for the measurement instrument through extensive consultation with experts. Subsequent studies adopt a quantitative methodology as we switched from scale creation to psychometric evaluation and fine-tuning. Study 2 sought to establish the scale's construct validity and develop a shorter, 12-tem version of the survey in line with the research project's practical requirements (i.e., to develop a short, evidence-based safety leadership scale). We draw on a large sample from 30 different organizations for this purpose. Study 3 builds upon Study 2 by providing validity evidence in a new sample, using the shorter 12-item scale. Again, a diverse and large sample drawn from 22 companies was used for this purpose. Study 4 provides a final test of the construct validity of the survey instrument, and an opportunity to replicate the findings from Study 2 using a new sample. Throughout the studies, different dependent variables were used in light of the project's practical requirements (i.e., provide participating organizations with measures that could be used to inform safety improvement initiatives) and to demonstrate a wider range of relationships to shore up the survey's construct and criterion validities.

Study 1

The objective of Study 1 was to explore the practices that underpin each of the LEAD control strategies at the operational level (i.e., supervisors and team members) through semi-structured interviews with subject matter experts. This information was then converted into a pool of LEAD survey items for psychometric evaluation.

Method

Participants

Through consulting the safety science literature, we recruited subject matter experts in the areas of safety culture, safety climate, safety leadership, resilience-engineering, and systems thinking. An initial scan of the literature identified 28 academics with aligned research interests and outputs. In addition, the views of practitioners were sought. The first

author broadcast an invitation to participate across the Queensland health and safety regulator (Workplace Health & Safety Queensland). As inspectors and advisors interact with a number of different workplaces through their regulatory activities, they were deemed appropriate sources of information about safety control strategies. Each of these personnel had over 12 months regulatory experience (and some with over 20 years). Of the 13 personnel from this subgroup, 11 elected to participate. Overall, 25 (61%) total number subject matter experts voluntarily participated in this research.

Procedure

A semi-structured interview protocol was developed for this study. Following an initial description of each control strategy and the underpinning theory surrounding self-regulation, participants were asked to describe specific safety-related practices that they believed would characterize each of the four control strategies.

The first author acted as interviewer for all participants. Basic interviewing techniques such as use of minimal encouragers and paraphrasing were used to clarify and probe participants' answers. Interviews were scheduled for one hour, and ranged between 20 minutes and two hours, with most lasting between 30-45 minutes. With the consent of each participant, the interviews were recorded. Thereafter, the interviews were transcribed by an independent third party and the written transcripts submitted for analysis.

Regarding the procedures for our analysis of the qualitative data, the methods outlined by Braun and Clarke (2006) regarding thematic analysis were consulted. Thematic analysis was deemed appropriate for this research because it is unbounded by epistemological and theoretical approaches (it sits across a range of different approaches and is essentially constructionist in its philosophy), it offers considerable flexibility in the identification of themes, and the fact that our intention was to adopt a more descriptive approach rather than engage in theory building (where an approach like grounded theory may have been more appropriate; Braun & Clarke, 2006). In this research we adopted a 'theoretical' or deductive approach rather than inductive, whereby the existing LEAD theoretical propositions described by Casey et al. (2017) were used as scaffolding to sort, analyse, and interpret the data corpus. We also adopted a 'semantic' approach to identifying themes, which is more descriptive in nature than an approach that seeks to identify latent constructs. Our procedure for conducting the thematic analysis closely followed the approach outlined by Braun and Clarke (2006):

1. Data immersion and familiarization,
2. Generation of initial codes (done independently by the lead author, which were later discussed and verified by the whole research team),
3. Identification of themes (done independently by the lead author),
4. Review of themes (done with the entire research team), and,
5. Defining and naming the themes.

Results and Discussion

Following descriptive first-cycle coding, codes were then grouped together into common categories. Within these categories, the data were also separated into each of the four LEAD control strategies, based on the answers provided by participants. In total, 155 codes were extracted for safety practices. Table 3.2 shows the breakdown of practices codes per LEAD strategy and participant group (practitioners and academics).

Table 3.2. Tally of practices codes extracted from the data and allocated to the LEAD framework.

LEAD Dimension	No. Codes	No. Academics	No. Practitioners
Leverage	37	26	11
Energise	32	16	16
Adapt	31	17	14
Defend	55	36	19
Total	155	95	60

These categories were then grouped into themes, and the most prevalent themes were selected for inclusion in the conceptual model— five practices themes were selected for each strategy. This approach ensured that only the themes that most closely represented each control strategy were used to develop scale items. Specific themes falling under each control strategy are summarized by Table 3.3. Notably, many practices that emerged are typical of safety climate surveys, such as ensuring adequate training and enforcement of safety standards. However, other practices not typically included in either safety leadership or safety climate measures also emerged, such as integration of safety with production activities, standardization of work processes, conducting after action reviews, and collaborative team planning. These results suggest that the operationalization

of existing safety leadership and safety climate measures could be broadened to capture a wider repertoire of safety-related practices.

Table 3.3. Summary of organizational practices across the four LEAD factors.

Factor	Dimension	Description
Leverage	Collaboration	Shared planning processes. Leaders seek information about work from operators. Support is given to ensure task objectives are met.
	Performance recognition	Reward and recognition programs that acknowledge workers who show high safety performance.
	Integration	Safety is integrated with and made a part of production processes.
	Multiskilling	Investment in workers to develop safety skills across multiple domains.
	Preparation	Multidisciplinary planning, scheduling, workload modelling, and buffering.
Energize	Consultation	Interaction with workers at all levels to solicit input and inform safety-related changes.
	Local autonomy	Workers are permitted to make decisions in the absence of a supervisor's explicit direction.
	Involvement	Workers actively participate in safety decision making.
	Informed	Communication is two-way and regular between workers and leaders.
	Safety vision and priority	Leaders articulate a clear safety vision that are translated into team-level objectives, and safety is seen as an important work priority.
Adapt	After action review	Following unsuccessful work operations, workers meet to discuss what went wrong and how to prevent reoccurrence.
	Temporary structures	During emergency situations, operations and centrally organized, but locally executed.
	Emergency routines	Well-rehearsed emergency routines and preparatory activities (e.g., drills and practice runs).
	Incident investigation	Thorough investigations uncover all causes of incidents.

Leverage practices. These practices consisted of shared planning processes to decrease team uncertainty and achieve stability in work activities. Recognition and reward were also identified as a core practice, acknowledging workers who meet or exceed safety expectations. Integration of safety with production activities was also identified as a core practices, such as integrating safety activities with standard operating activities. Providing workers with skill development across multiple domains was identified, as was engaging in thorough processes to understand upcoming workloads and apply mitigating strategies such as buffering.

Energize practices. Consultation with staff emerged as an important practice for this control strategy, as did providing workers with autonomy to make decisions about health and safety independent of supervisor oversight or approval. Another related practice was involving workers using a participative decision-making style. High quality two-way communication, which is similar to the consultation practice (although the latter focused more on communication prior to major safety changes being implemented) was also identified. Finally, developing and communicating a specific team safety vision was a theme.

Adapt practices. Reflecting on past performance and identifying lessons learned to improve future performance (e.g., after action review) was a core practice identified for the adapt control strategy. A ‘deference to expertise’ theme was identified, meaning that temporary decision-making structures are employed (i.e., a flattened hierarchy) during emergency situations. Practicing emergency drills and routines was also a theme for the adapt control strategy. Finally, high quality incident investigations and ensuring lessons learned are shared broadly with all team members were two additional practices identified.

Defend practices. Regarding defend, enforcement of safety standards and monitoring of safety performance (i.e., checking for compliance) were identified as themes. Effective risk management techniques such as identification and control of hazards was another theme. A theme relating to standardization of work processes when in the context of high risk hazards was also identified. Finally, ensuring staff have adequate competence and capability to understand safety procedures and requirements was identified as a team practice.

These themes and the examples provided by the subject matter experts were then used to generate a list of 60 items. These items were provided back to the interview participants for review, and their feedback used to make further refinements and we shortened the scale to 24 items.

Consultation with subject matter experts in safety leadership, safety climate, and safety culture enabled us to identify a list of practices relevant to each LEAD control strategy and develop an item pool for statistical evaluation. We supplemented the ideas put forward by Casey and colleagues (2017) with the experience of the recruited experts, combined with the results of a brief literature scan, to build and refine the draft item pool down to 24 items. We then undertook a series of quantitative studies to identify the factor structure of the LEAD scale and collect evidence of reliability and criterion validity.

Study 2

The objective of Study 2 was to evaluate the construct validity of the draft LEAD measure, and draw on structured techniques to revise the item pool down further to a short 12-item measure in line with the practical requirements of this research program. Measures of regulatory focus at work and uncertainty management were included in this study to a) demonstrate evidence of discriminant validity, and b) explore associations between the LEAD scale and outcome variables, in line with methods to establish criterion or predictive validity.

Method

Participants

Study participants were 2,131 workers drawn from across 30 different organizations who participated in a larger project to develop a LEAD toolkit (Queensland industry). These organizations were spread across construction, education, health care, transportation, public administration, manufacturing, and professional services. 51% (1,071) of the sample reported being employed in their current position for 10 years or longer. A similar number (51%, 1,075) were workers without supervisory responsibilities.

Procedure

Workplace Health and Safety Queensland maintains a database of over 2,000 individuals who have voluntarily signed up to the Safety Leadership at Work program (SLAW). The SLAW program provides advice, guidance, resources, and events to members through a free or low-cost fee structure. The database includes a range of workers and leaders from multiple industries, with greatest representation from construction, healthcare and social assistance, manufacturing and transport, and government-owned organizations.

Following ethical clearance and permission from the regulator, one of the authors broadcast an invitation out to all 2,000 SLAW members. The invitation described the research project and outlined how in return for participating, each organization would receive a customized results report and debriefing session. A total of 85 organizations responded to the initial call for participants. Of these, 30 progressed through to data-collection. Two companies did not complete their data collection due to competing priorities. Response rates at the company level ranged from 5% to 100%, and the average response rate was 38%.

After agreeing to participate, each organization was given a 'toolkit' that included example communications templates, survey administration training materials, and a preparation document. Some minor customizations of item language and demographics was permitted; however, the extent of these customizations was carefully constrained to enable measurement and structural equivalence across the combined dataset.

Employees completed the survey during work hours and with the support of the host organizations. Data were collected online in most cases, with anonymity managed through provision of a generic and non-identifiable link. A minority of companies required hardcopy surveys to reach parts of their workforce. These were sealed in envelopes and data-entered by the research team to ensure anonymity of the participants.

Analytical approach

Stata version 12 (StataCorp, 2011) was used for all descriptive statistics, and SPSS version 23 (IBM, 2015) was used for exploratory factor analysis. Mplus v5.2 (Muthen & Muthen, 1998-2008) was used to conduct confirmatory factor analyses. The full maximum likelihood estimator with robust standard errors was used for the analyses. Model goodness of fit was evaluated with a number of established indices including the Tucker Lewis Index (TLI >0.95; Tucker & Lewis, 1973), the comparative fit index (CFI >0.95; Bentler, 1990), the root mean square error of approximation (RMSEA = <.05; Hu & Bentler, 1999), and the standardized root mean square residual (SRMR = <.05).

Measures

LEAD. The 24-item version of the LEAD scale was used. Respondents indicated their agreement to each statement using a 5-point Likert scale (1=Strongly disagree to 5=Strongly agree). Overall, internal consistency estimates were acceptable; combined scale α=0.96, leverage α=0.91, energize α=0.91, adapt α=0.87, and defend α=0.89. Items are shown in Table 5.

Regulatory focus at work. The full 12-item scale validated by Wallace, Johnson and Frazier (2009) and originally developed by Wallace and Chen (2006) was used for this study. Internal consistency alphas for both prevention-focus (α=0.90) and promotion-focus (α=0.86) were acceptable. An example promotion-focus item is “Getting my work done no matter what”. An example prevention-focus item is “Doing my duty at work”.

Uncertainty management. Two three-item subscales were adapted based on the trait measure originally developed and validated by Greco and Roger (2001). Internal consistency alphas for flexibility-focus (α=0.83) and stability-focus (α=0.81) were acceptable. Further, a CFA modelling both scales as separate latent factors provided an acceptable fit to the data. An example flexibility-focus item is “I easily adapt to change”. An example stability-focus item is “I take steps to clarify uncertain situations”.

Safety compliance. A short three-item measure of safety compliance was used (Casey & Krauss, 2013). Internal consistency alpha was acceptable (α=0.82). An example item reads “Appropriately report all safety incidents”.

Safety proactivity. A four-item measure of safety proactivity was used based on the scale of ‘initiating safety-related change’ developed by Hofmann et al (2003). Proactivity was measured on a six-point frequency scale (1=Never to 6=Always). Internal consistency alpha was acceptable (α=0.91). An example item reads “Try to improve safety procedures”.

Results and Discussion

Descriptive Statistics

Table 3.4 shows the means and standard deviations for all variables used in Study 2.

Table 3.4. Means and standard deviations for all variables used in Study 2.

Variable	**Mean**	**SD**
Leverage	3.51	0.87
Energize	3.67	0.83
Adapt	3.80	0.76
Defend	3.76	0.81
LEAD	3.73	0.70
Prevention-focus	4.41	0.52
Promotion-focus	3.75	0.68
Flexibility-focus	4.06	0.57
Stability-focus	4.15	0.52
Safety proactivity	3.71	0.95
Safety compliance	4.44	0.69

Measurement Model

CFAs were conducted to evaluate the measurement model. First, a one-factor model was run, which was a poor fit to the data; $\chi 2(252)=1970.63$, $p<.01$; RMSEA=0.08, $p<.01$; CFI=0.85; TLI=0.84; SRMR=0.05. A two-level factor structure with LEAD sub-dimensions and one overall LEAD superordinate factor provided the best fit to the data; $\chi 2(247)=987.35$, $p<.01$; RMSEA=0.05, $p=0.07$; CFI=0.94; TLI=0.93; SRMR=0.04. Table 3.5 shows the standardized factor loadings from the CFA.

Table 3.5. Results of Study 2 confirmatory factor analysis (standardized factor loadings are shown).

Survey Item	Leverage	Energize	Adapt	Defend
After problematic work, our team discusses what happened to prevent similar situations from happening again			0.69	
People on this team try to prepare for situations that are out of the ordinary			0.61	
When a health or safety incident happens, our direct leader thoroughly investigates the situation			0.73	
This team makes sure that information about health and safety incidents is communicated to everyone			0.75	
People on this team shares what it learns from health and safety incidents widely			0.81	
Within this team, people are encouraged to talk openly about their mistakes and errors			0.74	
Compliance with health and safety rules is enforced by our direct leader				0.77
Assessing and managing health and safety risks is an important work priority for this team				0.79
In this team, workers' safety performance is closely monitored and supervised				0.82
This team has a lot of specific steps that should be followed to make sure work is healthy and safe				0.72

This team is thoroughly trained in the specific health and safety rules and standards that apply to our work				0.71
In this team, safety violations are handled fairly				0.71
Our direct leader visits workers on this team to talk directly with them about health and safety		0.77		
Experienced workers on this team are encouraged to take control over health and safety in their job		0.72		
Workers on this team help each other to understand health and safety hazards and requirements		0.74		
Within this team there is a lot of two-way communication about health and safety between leaders and workers		0.84		
Our direct leader encourages the team to ask questions and clarify health and safety messages		0.84		
Our direct leader appreciates when workers take personal initiative when it comes to health and safety		0.74		
Our direct leader gives positive recognition when the team performs tasks safely	0.76			
Workers on this team are given opportunities to work in different areas to build health and safety skills	0.65			
This team is given experience in different types of work so we can do many tasks safely	0.64			

Within this team, people think ahead and plan how we will do our work safely and productively	0.69			
Our direct leader sets clear and specific health and safety goals	0.87			
Our direct leader focuses on the positive behaviors we need to show to achieve health and safety goals	0.88			

Correlation analysis

Pairwise correlations showed that the LEAD sub-dimensions and overall LEAD factor were significantly correlated with prevention/promotion focus, uncertainty management, safety compliance, and safety proactivity (see Table 3.6). Of note, the LEAD scales were positively related to self-regulation variables (as suggested by the theory proposed by Casey et al., 2017) as well as safety behaviours (proactivity and compliance). These results provide support for the LEAD scale's criterion validity.

Table 3.6. Correlation analyses for all variables used in Study 2.

Variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
(1) Leverage	1.00										
(2) Energize	0.78	1.00									
(3) Adapt	0.66	0.71	1.00								
(4) Defend	0.72	0.77	0.70	1.00							
(5) LEAD	0.89	0.92	0.85	0.90	1.00						
(6) Prevention-focus	0.18	0.17	0.19	0.24	0.22	1.00					
(7) Promotion-focus	0.21	0.16	0.16	0.21	0.21	0.43	1.00				
(8) Flexibility-focus	0.20	0.21	0.21	0.21	0.23	0.33	0.29	1.00			
(9) Stability-focus	0.15	0.15	0.15	0.19	0.18	0.45	0.36	0.37	1.00		
(10) Safety proactivity	0.31	0.31	0.27	0.31	0.34	0.26	0.23	0.23	0.22	1.00	
(11) Safety compliance	0.27	0.30	0.27	0.35	0.33	0.35	0.15	0.20	0.24	0.51	1.00

Note: All correlations are statistically-significant at the $p<.01$ level.

Study 1 established preliminary evidence of the LEAD scale's psychometric properties and criterion validity using cross-sectional data. Confirmatory analyses showed that a two-level hierarchical structure best fit the data, with all LEAD sub-dimensions loading onto a combined overall LEAD factor. LEAD scales and the overall second-order factor correlated significantly with all hypothesized outcome variables, supporting the utility of the scale in terms of its potential to predict safety behaviour.

Study 3

The objective of this study was to evaluate the psychometric properties of a new shorter version of the LEAD scale incorporating the findings from Study 2. A new shorter version of the LEAD scale was an important objective outlined by the Government sponsor of the research program at the outset of this research. Also, a shorter survey tool may increase its practical utility and reduce sources of response error induced by survey fatigue. A new sample was used for Study 3 to provide a more robust replication of our findings from Study 2.

Method

Participants

Participants 2,216 workers who again participated in a larger project to develop and trial a LEAD toolkit, representing 22 different companies. Close to half of the sample reported working in the same industry for 10 years or more (48%, 560). 41% (473) were workers without supervisory responsibilities.

Procedure

A similar procedure to Study 1 was undertaken for this study. We broadcast a message to the SLAW database requesting participation the scale development in exchange for an organizational report and debriefing session. 58 companies initially expressed interest in participating, which converted into 20 that followed through to data-collection. The average response rate across all companies was 43%, ranging from 11% to 83%.

To reduce the LEAD scale further, the Stanton et al. (2002) procedure was used, drawing on standardized loadings from the Study 2 CFA, corrected-item total correlations, research team ratings, and correlations with proximal outcome variables of interest

(regulatory focus and uncertainty management). A total of 12 items were retained through this scale reduction process.

Measures

LEAD. A shortened 12-item version of the LEAD scale was used in this study, with three items per LEAD sub-dimension retained. Respondents indicated their agreement to each statement using a 5-point Likert scale (1=Strongly disagree to 5=Strongly agree). Overall, internal consistency estimates were acceptable; combined scale α=0.95, leverage α=0.83, energize α=0.92, adapt α=0.84, and defend α=0.83. Items are shown in Table 7.

Safety compliance. A 15-item scale developed by Hu and colleagues (2018) was used to measure safety compliance. Hu's et al. (2018) scale measures 'deep' compliance (paying close attention to risk and how to apply procedures effectively. Respondents indicated how true each statement was in relation to their safety compliance behaviours using a 5-point Likert scale (1=Not at all true to 5=Very true). The scale internal consistency alpha was acceptable: deep α=0.92.

Safety proactivity. The same safety proactivity measure used in Study 2 was used again for this study. Internal consistency alpha was acceptable (α=0.89). An example item reads "Try to improve safety procedures".

Results and Discussion

Descriptive Statistics

Table 3.7 shows the descriptive statistics for variables used in this study.

Table 3.7. Means and standard deviations for all variables in Study 3.

Variable	**Mean**	**SD**
Leverage	3.74	0.86
Energize	3.72	0.94
Adapt	3.97	0.82
Defend	3.92	0.83
LEAD	3.83	0.78
Safety proactivity	4.50	0.98
Deep compliance	4.33	0.67

Measurement Model

A CFA revealed that a two-level factor solution was the best fit to the data, with one overall superordinate LEAD factor and four LEAD sub-dimensions; $\chi 2(50)=230.65$, $p<.01$; RMSEA=0.06; CFI=0.97; TLI=0.96; SRMR=0.03. Alternative models were also run, including a one-factor model ($\chi 2$ (54)=513.87, $p<.01$; RMSEA=0.09, $p<.01$; CFI=0.93; TLI=0.91; SRMR=0.04) and a two-factor model ($\chi 2(53)=398.74$, $p<.01$; RMSEA=0.08, $p<.01$; CFI=0.94; TLI=0.93; SRMR=0.04); however, both exhibited inferior fit statistics. This replication of the factor structure from Study 2 supports the LEAD scale's construct validity.

Table 3.8. Results of Study 3 exploratory factor analysis (standardized factor loadings are shown).

Survey Item	**Leverage**	**Energize**	**Adapt**	**Defend**
After a problem at work, this team discusses what happened to prevent similar situations from happening again			0.80	
This team shares information about health and safety incidents and how to prevent them			0.82	
Within this team, people are encouraged to talk openly about their mistakes and errors			0.77	
Managing health and safety risks is an important priority for this team				0.77
Our manager closely monitors high risk work and enforces safe work methods				0.84
This team is thoroughly trained in our health and safety duties and obligations				0.74
Our manager talks to people in this team about their health and safety concerns		0.88		
Our manager helps workers to develop new health and safety skills		0.89		
Within this team, our manager regularly consults with workers about health and safety matters		0.90		
Our manager gives positive recognition when this team achieves high safety performance	0.83			

Workers in this team help each other to complete routine work quickly and safely	0.66			
Our manager sets clear and specific health and safety goals for this team	0.86			

Correlation analysis

Correlations between LEAD dimensions and overall scale revealed significant and meaningful relationships with deep and surface compliance, and safety proactivity behaviour. These correlations added further evidence of support to our research hypotheses. Table 3.9 shows the pairwise correlations between all variables included in Study 3. Specifically, the LEAD scales and the overall measure were significantly related to both safety proactivity (replicating the results from Study 2) and deep compliance. The latter result extends the utility of the LEAD scale to include more nuanced and contemporary constructs related to safety performance, such as thorough and meaningful consideration of safety procedures and activities.

Table 3.9. Correlations between all variables used in Study 3.

	1	2	3	4	5	6	7
(1) Leverage	1.00						
(2) Energize	0.81	1.00					
(3) Adapt	0.71	0.71	1.00				
(4) Defend	0.78	0.81	0.73	1.00			
(5) LEAD	0.91	0.92	0.87	0.92	1.00		
(6) Safety proactivity	0.28	0.32	0.22	0.27	0.30	1.00	
(7) Deep compliance	0.34	0.33	0.29	0.33	0.36	0.39	1.00

Note: All correlations are statistically-significant at the $p<.01$ level.

Study 4

The objective of this study was to replicate the factors structure identified in Study 3, and as a cross-validation of the results obtained in Study 2 using a distinct sample of respondents.

Method

Participants

Participants were 497 workers drawn from survey panel data (employed persons) across a representative sample of Australian industries. Over half of the sample were employed full-time (59%, 295) and just under one-third were employed part-time (29%,

146). The remainder were employed on a casual basis. Respondents worked an average of 32.14 hours per week (SD=12.79). Close to half (47%, 236) reported being employed as a worker without supervisory responsibilities. All Australian industries were represented, with the highest being: Education and Training (52, 10%), Health Care and Social Assistance (51, 10%), Retail Trade (50, 10%), and Other Services (50, 10%). The lowest industries were: Electricity, Gas, Water, and Waste Services (4, 1%) and Rental, Hiring, and Real Estate Services (9, 2%).

Procedure

Participants were recruited using a professional survey panel company located in Australia. The sample was reimbursed a small monetary reward ($5.00AUD) for participating fully in the survey. The sample was recruited to inform industry benchmarking data that was being used in a larger safety culture diagnostic and improvement project initiated by Workplace Health & Safety Queensland. Participants completed the survey online using the Qualtrics system. Participant anonymity was maintained by assigning them a deidentified code.

Analytical strategy

Given the sample size, one complete sample was used for all analyses. We proceeded straight to CFA to verify the two-level factor structure, then undertook structural modelling. Mplus v5.2 (Muthen & Muthen, 1998-2008) was used to conduct all analyses. The full maximum likelihood estimator with robust standard errors was used.

Measures

LEAD. The same 12-item scale used in Study 3 was again used in Study 4, with some minor adjustments to the wording of some items. These small item changes were used based on feedback from survey respondents and the organizations that participated in Study 3, and were designed to improve the overall performance of the LEAD scale. The Appendix shows the final LEAD scale items.

Regulatory focus. A shortened version of the regulatory focus at work scale (Wallace et al., 2009) was used in this study. We used three items each for prevention and promotion focus, using the standardized factor loadings reported by Wallace and colleagues (2009) to select items with the highest loadings. The Appendix shows the final regulatory focus scales.

Uncertainty management. A revised version of the uncertainty management scale was used in this study. We changed the response scale from an agreement format to the same frequency format used by the regulatory focus scales. The Appendix shows the final uncertainty management scales.

Safety compliance. A shortened version of Hu's et al. (2018) deep compliance scale was used in this study. The items were provided by Hu (personal communication, 2018) based on confirmatory factor analysis results. The Appendix shows the final deep compliance scale.

Safety proactivity. The same scales for safety proactivity (initiating safety-related change and safety voice) that were used in Study 3 were used in Study 4. The Appendix shows the final safety proactivity scales.

Safety incidents. Retrospective involvement in safety incidents and incident reporting was assessed using three open-text items. Participants were asked to specify how many incidents they had experienced at work over the past three months. The three questions covered near-misses (incidents that could have caused harm or loss), minor injuries that did not require medical attention, and the number of reportable incidents that weren't formally reported to the organization.

Results and Discussion

Descriptive analyses

Table 3.10 shows the means and standard deviations for all variables included in the analyses. Table 3.11 shows the pairwise correlations between all study variables. Of note, LEAD combined scale scores were significantly and negatively associated with employees' experiences of near-miss safety events. LEAD dimensions and the overall combined scores were also associated with the different types of safety behaviour.

Table 3.10. Means and standard deviations for all variables in Study 4.

Variable	**Mean**	**SD**
Leverage	3.74	0.86
Energize	3.72	0.94
Adapt	3.97	0.82
Defend	3.92	0.83
LEAD	3.83	0.78
Safety proactivity	4.50	0.98
Deep compliance	4.33	0.67

Table 3.11. Correlations between variables used in Study 4.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
(1) Leverage	1.00													
(2) Energise	0.82	1.00												
(3) Adapt	0.69	0.69	1.00											
(4) Defend	0.70	0.71	0.74	1.00										
(5) LEAD	0.90	0.91	0.87	0.88	1.00									
(6) Prevention-focus	0.15	0.12	0.30	0.17	0.21	1.00								
(7) Promotion-focus	0.16	0.15	0.18	0.16	0.18	0.53	1.00							
(8) Flexibility-focus	0.19	0.21	0.17	0.17	0.21	0.33	0.47	1.00						
(9) Stability-focus	0.23	0.20	0.30	0.26	0.27	0.58	0.58	0.63	1.00					
(10) Initiating safety change	0.40	0.45	0.35	0.39	0.45	0.12	0.26	0.48	0.36	1.00				
(11) Safety voice	0.41	0.45	0.36	0.40	0.46	0.03	0.22	0.43	0.31	0.85	1.00			
(12) Deep compliance	0.24	0.26	0.28	0.27	0.29	0.40	0.34	0.40	0.52	0.43	0.34	1.00		
(13) Near misses	*-0.08*	-0.10	*-0.08*	*-0.06*	-0.09	-0.14	*-0.04*	*-0.05*	-0.12	*0.00*	*0.02*	*-0.07*	1.00	
(14) Medical treatment cases	-0.10	*-0.08*	*-0.07*	*-0.02*	*-0.08*	-0.14	*-0.02*	*-0.02*	*-0.05*	0.09	0.10	*-0.02*	0.26	1.00
(15) Minor injuries	*-0.04*	*0.00*	*0.01*	*0.01*	*-0.01*	*-0.08*	*0.03*	*0.01*	*-0.04*	*0.07*	*0.07*	*-0.03*	0.20	0.59

Note: Italicized correlations were <u>not</u> statistically-significant at a $p<.05$ level.

A CFA was conducted to replicate the factor structure (LEAD sub-dimensions with overall LEAD superordinate factor); an excellent solution was obtained; $\chi2(48)=150.64$, $p<.01$; RMSEA=0.05, p=0.02; CFI=0.96; TLI=0.95; SRMR=0.03. Alternative models were also run but these exhibited less favourable fit statistics: one-factor model – $\chi2(54)=277.40$, $p<.01$; RMSEA=0.08, $p<.01$; CFI=0.94; TLI=0.92; SRMR=0.04; four-factor model – $\chi2\ (50)=196.46$, $p<.01$; RMSEA=0.07, $p<.05$; CFI=0.94; TLI=0.93; SRMR=0.04. The repeated verification of the LEAD factor structure provides compelling evidence of construct validity.

Overall Discussion

We developed and contributed evidence towards the validation of a new measure of safety practices to assess four team-centric dimensions, derived from the theoretical propositions put forward by Casey and colleagues (2017). The study is the first empirical investigation of a framework to articulate specific pathways between safety practices demonstrated by supervisors and co-workers, self-regulatory states, and safety behaviour. Based on theoretical development by Casey et al. (2017), the framework we tested here indicates that teams can use a range of different control strategies to achieve safety objectives. The safety practices were expected to be related to each self-regulatory orientation, which in turn, were expected to be associated with safety compliance and safety proactivity. We found support for all our hypotheses.

Study 1 showed that the theoretical propositions advanced by Casey and colleagues (2017) could be operationalized and summarized into an assortment of safety leadership practices. These ‘themes’ were then used to inform the development of a pool of survey items. Study 2 used a large and diverse sample to then test these preliminary items, and provided some emerging evidence for the scale’s internal consistency reliability and construct validity. Study 3 built on this work by using a new sample and providing a replication of the scale’s construct validity. A shorter, 12-item LEAD scale was successfully evaluated in this study. Finally, Study 4 concentrated on evaluating discriminant and criterion validity by including a range of outcome variables including regulatory focus, safety compliance, and proactive safety behaviours. The program of studies provides a robust and comprehensive set of studies that together, chart the journey from scale concept through to evaluation and validation using multiple distinct samples drawn from a diverse range of companies and industry contexts.

To our knowledge, this study is the first systematic and empirical attempt to integrate self-regulation theories and safety leadership practices. We outline the theoretical implications of our results below. We then explore some practical implications of the results and identify limitations of study that should be addressed in future research investigating more dynamic approaches to managing safety in workplaces.

The results of our CFAs showed that the four dimensions of the safety leadership are distinct and load onto an overarching LEAD factor, with the same factor structure replicated across studies and multiple companies from a variety of industries. Our studies provide initial evidence that the LEAD dimensions do form separate factors, although are best operationalized by one overall LEAD factor. These factors are highly correlated because people's perceptions of safety leadership practices are affected by their perception of the overall value that the organization places on safety. It may also be the case that teams with high scores on one dimension are also more likely to demonstrate other dimensions' practices – an 'all or nothing' approach. Our research identified high-intercorrelations between the safety leadership dimensions, which we believe represents the need for an overall LEAD factor. In practical terms, it may be difficult to explore the differentiated prediction of safety outcomes at the LEAD sub-dimension level using the current survey tool and cross-sectional methodology. A more appropriate design would be to conduct a series of experiments that expose participants to each control strategy, and measure the differential impact on self-regulation and safety performance. Such experiments might be conducted by assigning participants randomly to one of four experimental conditions that represent the four dimensions of the LEAD model. The participants could then be exposed to one of the control strategies (i.e., Leverage, Energize, Adapt, and Defend) and the effects on self-regulation measured pre-post to evaluate the causal effects of the control strategies on self-regulatory state. A neutral 'control' condition could be added as a comparison point. This is a recommended avenue for future research to more thoroughly test the theoretical framework outlined by Casey and colleagues (2017).

Theoretical implications

An advantage of our framework is the focus on 'bundles' of safety leadership practices rather than homogenous dimensions. In strategic human resources management, it has been shown that it is useful to conceptualize groups of aligned practices that exert synergistic and augmenting effects on organizational performance

(Gooderham, Parry & Ringdal, 2008; Subramony, 2009). Similarly, we propose that the LEAD model represents bundles of safety leadership practices that together, may exert synergistic effects on safety behaviour over and above what each practice might contribute individually. Theoretically, this is a testable proposition as one could design an experiment whereby singular practices within each LEAD dimension are compared against bundles shown in combination or simultaneously. Also in-line with strategic human resources management, the LEAD model represents an opportunity to create a 'strong situation' in which contextual factors such as safety leadership overpower (and compensate for shortfalls) in person-level phenomenon such as personality and natural levels of motivation. The consistent establishment and 'pairing' of safety leadership practices with different work situations (e.g., use of Energize in conditions of change and uncertainty) may help to establish such strong situations that guide workers in the most appropriate behaviours to use.

Regulatory focus provides a theoretical scaffold that should assist other scholars operating in the safety science domain to utilize psychological linkages between perceptions of safety management practices and individual worker performance. From a theoretical perspective, we add complementary evidence to the growing base of theoretical development work being undertaken in safety-related disciplines around proactivity (e.g., Curcuruto, Mearns & Mariani, 016) and promotion/prevention foci (e.g., Beus & Taylor, 2017; Wallace & Chen, 2006). Regarding the proactivity literature, researchers have long touted the benefits of safety-critical organizations fostering safety initiative, citizenship, and other proactive behaviours. Such behaviours build organizational capability to monitor, anticipate, respond, and learn from unexpected threats and opportunities (e.g., Hollnagel, 2013). These capabilities enable organizations to create safer work processes, revise safety management approaches and strategies, and use resources to counter or benefit from disruptions (Weick & Sutcliffe, 2011). From a motivational perspective, proactive role orientations and behaviours may be elicited through 'reason to' motivations (Parker et al., 2010); in other words, subjective value states directed towards an organization. Safety leadership may contribute to such 'reason to' motivation through theoretical mechanisms like social exchange and internalized motivation. Promotion/flexibility-inducing safety practices are likely to enhance these effects through providing opportunities for workforce autonomy and involvement (Griffin & Curcuruto, 2016). Thus, further theoretical integrations that consider multiple psychological

mechanisms through which different types of safety practices influence behaviour, in a holistic fashion, are warranted.

We believe that regulatory focus adds another layer to the safety management field, specifically by providing workers with more detailed and nuanced information over what types of behaviour are rewarded and valued by the organization (i.e., behaviours that promote the presence of safety in addition to behaviours that prevent the absence of safety). In addition to direct effects on behaviours, implicit identification and clarification of such behaviours through social learning and interaction is likely to induce a particular regulatory focus that will enable operators to achieve the desired safety goal/outcome in the most effective way. Consequently, our work has theoretical implications for the field of safety climate. Traditionally, safety climate has been cast or operationalized primarily in ways that encourage a prevention focus (Wallace & Chen, 2006). Indeed, if one inspects the wording of various safety climate scales, there is a predominance of 'Safety-I' thinking such as 'following rules', 'monitoring compliance', and 'disciplining violations'. Such an approach would likely foster prevention-focus given the emphasis on security and obligation. In contrast, operationalizing at least some dimensions of safety climate in a promotion-focused manner (e.g., 'rewarding high safety performance', 'communicating a safety vision', 'growing safety skills') would add an interesting theoretical perspective on the safety climate construct, and potentially extend its practical utility by empowering organizations to identify deficient aspects of their climates and working to improve these elements.

The ideas advanced by our manuscript may also take safety climate theory into a more dynamic realm, whereby the dynamic nature of safety climate (Griffin & Curcuruto, 2016) is explored in greater depth. Theoretically, this dynamic nature of safety climate is underspecified and has tended to focus on safety climate coherency of 'strength' rather than the content domain or dimensions of safety climate (the level of safety climate dimensions fluctuating over time). Current theory suggests that greater consistency in espousals versus enactments of safety leadership practices should result in higher levels and greater strength of safety climate (Zohar, 2010). With the LEAD model, it becomes relevant to explore how various demonstrations of safety leadership may contribute to different configurations of safety climate over time, and whether these configurations are mutually exclusive or compatible. Further theoretical and empirical work is recommended to explore these ideas in greater detail.

Practical implications

The study provides some practical insights for teams seeking to understand safety practices and their links to safety outcomes via self-regulatory states. The framework studied here (the 'LEAD' model) provide a useful heuristic for team leaders and supervisors to identify the most appropriate safety practices given the work situation or desired goals, and use specific safety management and general leadership practices to induce a corresponding psychological state in workers that should optimize safety and other important outcomes such as efficiency and team morale (as a result of greater 'regulatory fit'; Higgins, 1997). Workers at the front line might benefit from awareness of practices to emphasize in different work situations. It may also provide a more credible and engaging approach to communicating safety concepts to workers given the notion of 'safety dilemmas' or trade-offs and corresponding strategies that seek to maintain health and safety through complementary, rather than antagonistic, management practices.

We think a more dynamic framework such as the LEAD model can help supervisors and co-workers to consider the breadth of their safety practices, particularly those that focus on encouraging a promotion-focus/flexibility-focus combination and proactivity. The framework encourages a more holistic approach to health and safety management that draws together many separate lines of theory and practice into one integrated framework. The framework encourages investment in traditional safety management practices associated with prevention of the absence of safety (e.g., monitoring and enforcing compliance standards, prioritizing risk management tools and processes), and also seeking ways to operationalize additional practices such as those associated with promotion of the presence of safety. It is possible that such practices may result in additional workforce outcomes outside the health and safety domain, such as affective commitment and proactive, self-starting behaviours like organizational citizenship through the effect of such practices on workers.

Post-hoc exploratory analyses at the industry level identified that participating organizations tended to exhibit stronger and more positive results for the prevention-related dimensions, and less positive and less positive results for the promotion-related dimensions. These results suggest that compliance-driven and top-down control based methods are apparent in measures of safety leadership. Less prevalent were perceptions that are likely to induce a promotion-focused way of framing health and safety, potentially leading to less frequent demonstrations of safety proactivity among workforces particularly in situations where changes and routine low-risk work are being undertaken.

Our LEAD model and survey tool could be particularly effective at enhancing these deficiencies if used as a team-leader/supervisor level data gathering and feedback tool in a manner similar to the intervention described and evaluated by Zohar and colleagues (2003; 2014). Specifically, this survey could be used as a 'pulse' measure that diagnoses deficiencies in safety practices proactively and provide useful monitoring feedback for frontline leaders and co-workers together.

In addition, the Casey et al (2017) framework and concepts could be embedded into team huddles and 'pre-starts' to a) identify the nature of upcoming work tasks, b) proactively identify and encourage specific practices to manage safety, and c) surface typically intangible pressures that could induce competing self-regulatory states and identify misalignment between production and safety systems (e.g., where high risk work is being undertaken but production-related pressures and practices are inducing a conflicting promotion-focused self-regulatory state). Our future program of work will include developing and trialling these types of interventions.

Strengths, limitations, and future research directions

A strength of this study is the size and diversity of the organizations participating in this research. Studies 2 and 3 had over 50 companies participating across a range of industrial settings. However, as with all cross-sectional research this study is limited in the causal inferences that can be drawn from the reported findings. Also, we made exclusive use of self-reported measures, which may introduce additional bias such as positively-inflated ratings. Nevertheless, we employed a stringent data processing/cleansing procedure and also argue that self-report is the most appropriate method for the majority of perceptual and attitudinal variables included in this study (Conway & Lance, 2010). An extension includes testing Casey's et al (2017) theoretical propositions in longitudinal and experimental designs. Specifically, there is opportunity to evaluate whether (a) specific safety practices can be used in a dynamic fashion, and (b) alignment of specific safety practices dimensions with specific work contexts results in optimal team performance. Such research would best be conducted using an experiential sampling technique or similar repeated measures approach.

One significant limitation concepts the operationalization of the uncertainty management construct in Study 2. Specifically, the measurement scale and item wording used may have tapped into a trait-like construct rather than an induced state-like construct.

However, we corrected this deficiency in Study 4 so that the measure more accurately reflects a state-based construct.

A final limitation is that participation in the study was voluntary and done in exchange for a free safety diagnostic report. This approach may have biased the sample of companies towards those more positive on their scores, reducing the total variation in predictors and outcomes at the between-group level. However, this was addressed in Study 4 with the use of an online survey panel where no report or feedback was given.

One way to improve and clarify the relationships between the safety practices dimensions and safety performance outcomes is by using a more comprehensive taxonomy of safety behaviours. It is possible that the LEAD safety practices scales will be related to specific safety behaviours via the different combinations of self-regulation foci. For example, leverage may predict team communication safety behaviours such as passing on safety messages and coordinating work operations with colleagues via the inducement of promotion-focus and stability-focus.

Also important is future research that establishes the potential for the Casey et al (2017) safety practices dimensions to be improved through team-level interventions, and the concomitant impact on performance and team culture. An intervention targeting team leader/supervisor safety leadership and focusses on specific practices that can be implemented in response to specific operating conditions would be appropriate (e.g., Toolbox Talks, pre-start meetings, safety leadership training). Given the dearth of evidence-based safety culture, climate, and leadership interventions in published literature (Lee et al., 2018), such research would advance the field significantly.

Conclusions

Overall, the Casey et al (2017) framework takes safety management in new theoretical and practical directions. The safety practices dimensions were positively associated with safety compliance and proactivity, as well as to all of the hypothesized intermediatory variables (regulatory-focus and uncertainty management). Our findings that promotion, prevention, flexibility, and stability foci were consistently related to safety behaviour confirms our central proposition. Namely, that self-regulation presents an opportunity to exert nuanced and strategic influence over safety-critical systems, provided the specific combinations of self-regulation states can be directly induced by system operators and leaders in response to or anticipation of different environmental conditions. This integration of safety practices with systems thinking demonstrates the potential of

cross-disciplinary frameworks to advance safety management and performance in the future. Further, through providing a validated and evidence-based ‘LEAD toolkit’ freely to industry, it is possible that further gains in safety performance will be made through equipping organizations with an innovative, practical, and evidence-based safety management framework that concentrates on practices that can be implemented by supervisors and co-workers.

Chapter 4: Improving safety culture through leadership practices: A case study describing the implementation and evaluation of an evidence-based practitioner toolkit based on the LEAD model

Abstract

Safety culture has been described as one of the most thoroughly researched yet poorly understood concepts in safety science (Reason, 2000). Indeed, a plethora of models and frameworks exist, which makes it difficult for practitioners to know where to begin (Vu & Di Cieri, 2015). Rather than tackle the safety culture debate directly, the LEAD framework sidesteps these conceptual issues and focusses instead on the tangible practices that should ultimately contribute to a shared pattern of beliefs and assumptions around safety culture. A feature of the LEAD model is its dynamic and situational approach: specific LEAD practices and strategies are emphasized in different operating conditions when working toward achieving optimum health and safety performance. This approach is in line with contemporary scholars who have suggested that rather than attempt to 'manage culture', organizations should instead 'manage culturally' through a focus on systems, leadership, and team work (Borys, 2014). This paper describes the theoretical and practical underpinnings of the LEAD safety culture model, and describes the results of an applied study conducted with six organizational units at a major university campus in Queensland where the LEAD toolkit was implemented. We found evidence that the implementation was successful, with some measured changes in leadership perceptions and safety behavior. Implications for future leadership interventions are described, with a focus on practical considerations.

Keywords

Safety leadership, safety culture, training, intervention

Much has been said and done in the name of safety culture. It has been hailed by some as an evolutionary step forward in understanding and explaining the causes of accidents in organizations (Hudson, 2007). Others treat safety culture with skepticism and have labelled it a 'container' concept that essentially displaces blame from operators to groups of people in organizations (Guldenmund, 2010). Regardless, safety culture has been firmly established as a core concept in safety science (Dekker, 2019) and represents the culmination of ground-breaking sociological ideas and thinking that originated in the 1970s (Turner, 1979).

Since the 2000s, safety culture research and practice has been divided into two camps: the interpretivist, which treats culture as something the organization *is* or *does*; and the functionalist, which treats culture as something the organization *has* (Reiman & Rollenhagen, 2014). The interpretivist view offers rich descriptions of culture, but few answers about what to practically do about it. The functionalist view offers plenty of suggestions for action, but forces cultural homogeneity, which in itself may actually increase risk through stifling discrepant and diverse points of view.

A critique of the functionalist paradigm suggested that instead of 'managing culture', practitioners should instead 'manage culturally' through the design and implementation of systems, structures, and practices (Borys, 2014; Hopkins, 2019). Similarly, Edwards and colleagues (2015) showed how insights into cultural beliefs regarding safety can be used to design more effective organizational structures and systems. Essentially, the broader organizational social context is taken into account so that implementations of safety initiatives support rather than conflict with existing beliefs. This represents an interesting new direction for safety culture research, and essentially sidesteps many of the problems that both the functionalist and interpretivist perspectives suffer from. On the one hand, functionalist methods argue that there is a desirable end state for a safety culture, which can be established 'if only everyone thought and acted in the same way'. On the other hand, the interpretivist perspective is descriptive and proposes that culture shouldn't be evaluated or judged; it simply 'is'. One view is overly prescriptive and constraining, and the other view is overly emergent and impractical. A middle ground could be to focus instead on encouraging underlying practices that over time, gradually shape and contribute to the safety culture (Casey et al., 2019; Hopkins, 2019). In other words, managing safety with culture in mind rather than attempting to change the culture itself.

Leaders are widely described as exerting a strong influence over the types of attitudes, beliefs, norms, and ultimately, behaviors that get adopted by people within

organizations and become ingrained into ‘the way things are done around here’. Schein (2010) proposes that leaders shape and mold culture through practices such as directing attention, measuring and monitoring work, rewarding good performance, role modelling, and imposing their own views and beliefs onto followers. Others have found that safety leadership training can improve perceptions of safety climate and outcomes such as safety behaviors and injury rates (Mullen & Kelloway, 2009). Thus, leaders are a natural focal point for safety culture improvement initiatives.

The LEAD model, first outlined by Casey and colleagues (2017), positions safety as a ‘control problem’, whereby superior safety performance can be achieved through aligning bundles of safety practices with specific work situations. A measurement tool was then developed and validated by Casey et al. (2019), and this current study takes the research program an additional step by evaluating an intervention ‘toolkit’ that was implemented across a cohort of six organizational units within a tertiary education institution setting. The toolkit was developed through a tripartite relationship between academia, government, and industry, and is freely available for use on the Safety Leadership at Work website. The main objective of this paper is to provide evidence that the toolkit is an effective means to improve safety performance through developing safety leadership capabilities at worker, supervisor, and management levels. This toolkit presents a practical way of improving safety culture by focusing on bundles of leadership practices and the corresponding self-regulatory states that they activate.

Introduction

Despite the hundreds of safety culture studies published in peer-reviewed journals (Vu & Di Cieri, 2015), very few have captured evidence of intervention impact. Definitional problems plague safety culture research, with anything from attitudes and beliefs (Choudhry et al., 2007) to perceptions (Zohar, 1980; Zohar, 2010) to safety management systems and structures (Guldenmund, 2010) to behaviors (Cooper, 2000) targeted for improvement. An evaluation of a government-funded incentive scheme designed to improve safety culture revealed mixed evidence of success: out of 17 companies, eight showed positive improvements in injury rates following implementation (Hale et al., 2010). Factors that predicted intervention success included: the number of initiatives conducted, level of support from senior management, workforce motivation and engagement, and quality of communication between stakeholders. These findings suggest that safety culture

change might best be achieved if a combination of top-down and bottom-up strategies are used (DeJoy, 2005).

Safety climate is commonly positioned as the measurable aspect of safety culture – a momentary snapshot of the culture at a point in time (Griffin & Curcuruto, 2016). Theoretically, improvements in safety climate should flow through into underlying changes to the safety culture as perceptions of safety value and priority start to influence core assumptions and beliefs through cognitive dissonance (Das et al., 2008), intrinsic motivation (Zohar et al., 2015), and self-regulation (Casey et al., 2017).

A recent systematic review of safety climate interventions found that 47% of studies within scope involved safety leadership improvement activities (Lee et al., 2019). These studies were able to achieve measurable improvements in safety climate through leadership-centric activities. Leadership impacts safety climate, and eventually, culture, because implemented practices serve as situational cues regarding the importance and priority attached to safety (Griffin & Curcuruto, 2016). Leaders also contribute directly to the formation of safety climate by drawing attention to specific practices and policies, facilitating sense-making about safety (Zohar & Luria, 2003), and creating strong behavior-outcome expectancies regarding safety performance (Zohar, 2010).

Taken together, the reviewed literature suggests that it is possible to change safety culture through safety climate, and that the dominant approach taken to date concerns the targeted improvement of leadership practices.

The LEAD model

The LEAD model is based on the premise that safety is a control problem. This means that safety capacity is increased when work processes operate as predicted, and variability is either exploited or suppressed to achieve successful work. Incidents occur when work processes are ‘out of control’, or where variability is outside tolerable limits and the system is unable to cope. In practical terms, this logic follows the thinking of Rasmussen (1997) who described safety at the ‘sharp end’ as being influenced by successive layers of top-down and hierarchical control mechanisms. Legislators implement laws and regulations to control organizations; organizations implement policies and procedures to control supervisors; supervisors exert monitoring and compliance-based activities to control workers; and ultimately, workers directly control the hazardous energies that are required to do work.

Top-down control is effortful and fraught with difficulty. As evidenced by the diminishing returns achieved by top-down techniques such as bureaucracy (Dekker, 2014), alternative means of control must be established if safety performance is to improve. A top-down approach results in a control system that is ultimately just as complex as the work processes it has to monitor and constrain, requires costly resources and effort to maintain, and is only as successful as the foresight of the organization is to anticipate every eventuality – threat, disturbances, and opportunities alike. Alternative means to exert control are therefore required.

Control over safety critical systems, according to Rasmussen (1997) and other scholars (Mitropoulos & Cupido, 2009) is not synonymous with implementation of constraints and compliance against prescribed standards. Granted, safety control can be established using such methods, but it is a strategy with diminishing returns. Paradoxically, control over safety can be achieved by empowering workers in ways that increase flexibility and uncertainty (rather than reduce it). This line of thinking follows from fundamental theories in human psychology, such as self-determination theory, whereby satisfaction of the fundamental human needs of autonomy, belonging, and competence increases internalized or intrinsic motivation (Ryan & Deci, 2000). Put simply, ‘screwing things down’ when it comes to safety may be appropriate in some situations (e.g., high risk work), and less appropriate in other situations (e.g., implementation of new initiatives or where creativity and innovation are required). Human psychology suggests that where lasting and fundamental buy-in and engagement are required, empowering approaches are preferable, and in situations where workers just ‘need to get on with it’, an approach based on externalized motivators is probably the best strategy.

Scholars have long been working to establish psychological links between practices and safety performance. Up to now, the dominant model has been Griffin and Neal’s (2000) framework that links safety leadership through to safety climate and behavior via knowledge and motivation; when people know more about safety, and care more about safety, they are more likely to show safety compliance and participation. However, this model is not nuanced enough to inform specific management strategy and practices when safety is treated as a control problem. Recent work by scholars such as Wallace and Chen (2006) and Beus and Taylor (2018) have explored the role of regulatory focus, a type of motivational state that influences goal striving behaviors, in predicting more nuanced demonstrations of safety performance.

Regulatory focus at work is an established construct (Wallace and Johnson, 2009) derived from regulatory focus theory (Higgins, 1997) that posits people are differentially motivated by the way goals are framed. If a goal is framed in terms of security and danger, corresponding behaviors will emphasize duties, obligations, and avoidance of losses (e.g., compliance with safety procedures). If a goal is framed in terms of growth and achievement, corresponding behaviors will emphasize proactivity and energetic striving to achieve successful 'hits' (e.g., raising ideas to improve safety).

In addition, Casey et al (2017) proposed an additional self-regulation construct called 'uncertainty management'. This variable is best represented by two constructs; flexibility-focus and stability-focus. When the work situation emphasizes psychologically-safe opportunities to become involved in decision-making and a sense of control and autonomy, people are more likely to embrace change and take measured risks. When the work situation emphasizes dangerous conditions or high risk, people are more likely to embrace stability and stick to 'tried and true' methods like work methods statements. Such self-regulation constructs mirror similar management concepts like 'exploitation/exploration', which typically apply at the organizational level.

The LEAD model suggests that there are four different operating conditions that workers are confronted with: high risk work, routine work, changing conditions, and mistakes/incidents (Casey et al., 2017; Casey et al., 2019). To maintain control and hence achieve safe work outcomes, a corresponding control strategy (in the form of bundles of practices implemented by workers and leaders) is required. For instance, in high risk situations (e.g., working at heights) where hazards are dangerous but well-known, a valid control strategy is to standardize work processes (e.g., using safe work methods statements or procedures) and emphasize prevention (e.g., draw attention to hazards and foster a sense of unease and vigilance). By contrast, in situations where there are opportunities to innovate and develop, a corresponding control strategy could be to encourage flexibility (e.g., consultation and participative decision-making) and promotion of success (e.g., in-depth training and coaching, establishment of a compelling vision). Each of the LEAD control strategies are described briefly below.

Leverage is the strategy for routine, everyday work where risk is low. Leverage induces a promotion- and stability-focus through practices that create a sense of achievement and certainty about the work environment. Leverage is comprised of three bundles of practices: recognition of good safety performance, clarity of tasks and safety goals, and coordination.

Energize is the strategy for changing conditions, where new initiatives are being implemented. Energize induces a promotion- and flexibility-focus through practices that create a sense of involvement, autonomy, and competence. Energize is comprised of three types of practices: inspiration to achieve, empowerment, and growth (i.e., employee training and coaching).

Adapt is the strategy for when mistakes or errors are being made, and the emphasis is on recovery and learning. Adapt induces a prevention- and flexibility-focus through practices that highlight the risk involved in the situation but encourage open discussion and learning. Adapt has three bundles of practices: reflection on practice, resilience to unexpected emergencies, and voice (speaking up about safety concerns).

And finally, *defend* is the strategy for high risk work, where tasks are dangerous and compliance with thorough work processes and standards is advantageous to control risk. Defend induces a prevention- and stability-focus through practices that emphasize the danger of tasks and the importance of complying with pre-specified safe work methods. Defend has three bundles of practices: enhancing unease and vigilance within a team, driving accountability in a fair and just way, and monitoring or taking an active interest in workers' safety performance and work practices.

Defend is a strategy that many organizations have invested in heavily and is best described as a 'Safety-I' approach (Hollnagel et al., 2015). Safety-I consists of practices and techniques that aim to reduce the number of negative outcomes to as low a level as possible, and does so through strategies that emphasize compliance and adherence to strict standards of work. Although Safety-I has been criticized heavily (Dekker, 2017), it is responsible for dramatic improvements in safety over the past 100 years (Dekker, 2019) and so should form the backbone of an organization's safety management strategy.

Adapt is a strategy that is founded in high reliability organizing (HRO) theory. HRO theory advocates for the establishment of cultural principles that drive organizational 'mindfulness' or keen sensitivity to risk, chronic unease, and effective error avoidance and management (Weick & Sutcliffe, 2006). HROs include organizations such as nuclear power plants, aircraft carriers, and potentially some hospital environments (Cook & Rasmussen, 2005). In these settings, the potential for catastrophe is huge, yet the organizations persist and indeed thrive in high tempo environments. In these conditions, leaders in HROs listen and encourage speaking up regardless of rank or status, foster reflection and learning, and a commitment to resilience (Weick & Sutcliffe, 2001).

Energize and leverage would best be described as strategies that incorporate principles from ‘Safety-II’. Safety-II is a complementary perspective to Safety-I, and states that safety capacity is an emergent property defined as the capacity to succeed under varying conditions (Hollnagel et al., 2015). According to Safety-II, organizations should instead aim to increase the number of things that ‘go right’ through developing positive capacities. Consequently, there is an emphasis placed on understanding variability rather than quashing it, workforce involvement, and development of expertise. In sum, Safety-II advocates for strategies that encourage workers to strive *toward* safety; achieving something rather than avoiding something.

In this study, we outline the development and evaluation of a LEAD toolkit designed to be independently administered by organizations. The toolkit was developed by the Office of Industrial Relations, a government regulator of health and safety in Queensland, Australia, a cohort of eight organizations from a wide range of industries, and a consortium of universities. Thus, in this paper we focus on both the process and the outcomes of the toolkit development for two reasons: 1) to establish the LEAD toolkit as an evidence-based intervention package, and 2) to foster scholarly learning and encourage further tripartite collaborations between academia, industry, and government. In the sections that follow we initially outline the development and content underpinning the toolkit, followed by a presentation of evaluation data. Then we move into a discussion of our reflections and learnings throughout the process, as well as implications for LEAD toolkit implementation by industry.

The LEAD toolkit is a measurement and training resource designed for industry, consisting of a validated survey for efficient data gathering, and an intervention package. The latter includes three LEAD safety leadership workshops targeted to managers, direct supervisors, and workers.

Method

Participants

The toolkit development and evaluation were possible due to the joint efforts of government, academia, and industry. This study includes data from the evaluation of the toolkit in six organizational units from an Australian tertiary education institution. The diversity of functions and hazard profiles represented by these units was valuable for the study, given that the toolkit was designed for general application across multiple industries.

A total of 714 survey responses were received before and after the training. At Time 1 (Baseline), 385 worker and supervisor responses were received. At Time 2 (Follow-up), 329 responses were received. The survey response rates for each time point by organizational unit are summarized in Table 4.1. The strategies to promote survey participation included: a) initial presentations to all staff to raise awareness about the project and highlighting the importance of response rates, b) the distribution of survey links and reminders by the area's leadership team, and c) regular progress monitoring information supplied to each organizational unit by the research team.

Table 4.1. Survey response rates by time point and organizational unit.

Unit	**Baseline Participation Rate**	**Follow-up Participation Rate**
Org Unit 1	22%	26%
Org Unit 2	33%	33%
Org Unit 3	46%	25%
Org Unit 4	39%	13%
Org Unit 5	86%	67%
Org Unit 6	44%	49%

The workshops included 220 people across all the organizational units; which represented between 10% and 43% of the total population within each organizational unit (see Table 4.2).

Table 4.2. Workshop participation per organizational unit.

Organizational Unit	**Participation**
Org Unit 1	20%
Org Unit 2	15%
Org Unit 3	30%
Org Unit 4	10%
Org Unit 5	27%
Org Unit 6	43%

Measures

The LEAD measures developed and tested by Casey and colleagues (2019) were used in this study. For brevity, only basic details are summarized here, and readers are referred to the Casey et al. (2019) paper for the full instruments.

Safety control strategies (LEAD). A total of 12 items were used to measure safety practices, with three items per LEAD safety control strategy. Internal consistency alphas for each subscale were acceptable: Leverage α=0.86, Energize α=0.88, Adapt α=0.85, and Defend α=0.87. All items were answered according to a 5-point Likert scale, ranging from 1=Strongly disagree to 5=Strongly agree. See Table 4.3 for an overview of the measures.

Safety improvement behavior. A total of three items were used to measure the frequency of safety improvement behavior. Participants were asked to self-report their behavior with respect to offering safety improvement suggestions. Internal consistency reliability was acceptable; α=0.90. A sample item reads: “Make suggestions to improve the health and safety of work”. All items were answered according to a 5-point Likert scale, ranging from 1=Never to 5=Always.

Safety voice behavior. A total of three items were used to measure the frequency of safety voice behavior. Participants were asked to self-report their behavior with respect to speaking up about safety issues. Internal consistency reliability was acceptable; α=0.92. A sample item reads: “Express my opinions on health and safety matters even if others disagree”. All items were answered according to a 5-point Likert scale, ranging from 1=Never to 5=Always.

The workshops were evaluated using an organizationally-endorsed form; which consisted of nine questions: five ‘reaction’-style statements that were rated on a 5-point Likert agreement scale (ranging from 1=Strongly disagree to 5=Strongly agree) and three open-ended questions (i.e., what will be applied on return to the workplace, workshop strengths, and workshop improvements).

To enable pairing of individuals measured before and after comparisons, survey participants were presented with the option to answer four additional questions that combined to create a unique deidentified code. Another important question that allowed analysis, yet preserved the anonymity of participants, was the inclusion of a binary variable in the follow-up survey that classified respondents into those who attended a LEAD workshop versus those who didn’t.

Table 4.3. LEAD safety control strategies survey items (Casey et al. 2019).

Variable	Items
Leverage	Our supervisor works with people on this team to set clear health and safety performance goals
	People in this team are recognized when they achieve what is expected around health and safety
	In this team, our priority during work is to keep each other informed about what is happening
Energize	Our supervisor inspires us to think about how health and safety changes could benefit us
	This team looks favorably on people who use their personal initiative around health and safety
	This team is supported to grow new health and safety skills so we can make our work environment safer
Adapt	Our team reflects on problems with work to prevent the same things from happening again
	As a team, we expect each other to speak up when we notice something is unsafe
	Our supervisor expects this team to confront unexpected problems and minimize their impact
Defend	People in this team expect each other to clearly identify all the risks to health and safety
	Our supervisor reacts strongly when people fail to uphold an important health and safety responsibility
	When work is critical, this team's compliance with rules and standards is closely monitored

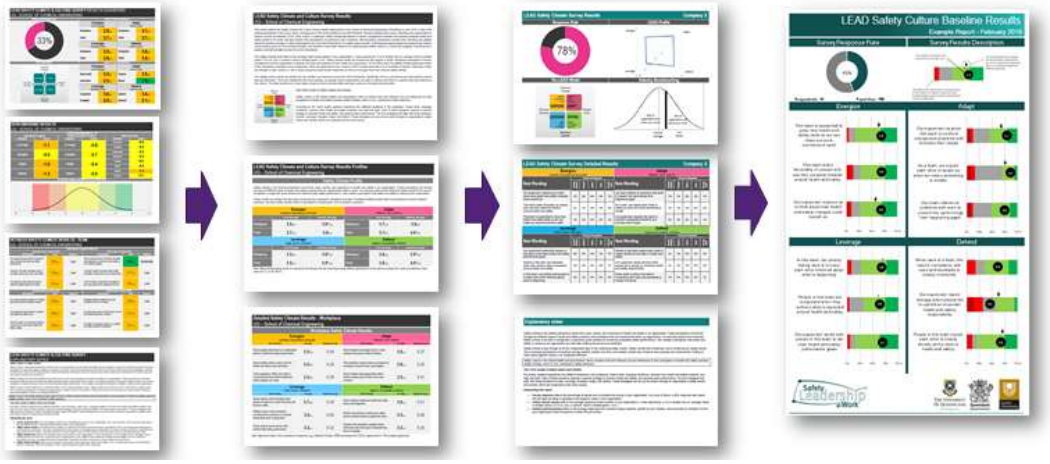
Intervention development

As described by Casey et al (2019), the core component of the LEAD toolkit is an organizational diagnostic survey that includes 12 questions measuring the four LEAD quadrants. Workers report their perceptions of safety leadership practices of their team and direct supervisor, and the data are summarized by a report ‘dashboard’ (developed manually by the research team). Figure 4.1 below shows a page from the reporting dashboard. Overall, the LEAD toolkit includes four components. The four components

include: a diagnostic survey, a management action planning workshop, a supervisors' workshop, and a workers' workshop. The next section outlines our process to develop the toolkit.

First, a design 'sprint' (Knapp, 2016) was held that involved the core research team and government stakeholders. The session was facilitated by the first author. During this session, participants defined and reached consensus on the core objectives and goals of the LEAD toolkit. An open brainstorming session was also held where participants described components and features of the toolkit independently. Common ideas were identified and prioritized using a sticker-based voting system. Specifically, participants indicated features they particularly liked with a sticker, and the features with the highest count were prioritized for consideration. Specific training content was also brainstormed and drafted as part of the design sprint.

Figure 4.1. LEAD dashboard report example, showing the evolution of designs over time.



Following the sprint, draft training content was identified from existing safety leadership, general leadership, and organizational behavior literatures. A steering committee was established at each organization and a series of brainstorming sessions held to identify 'must haves' for the toolkit. Early versions of the toolkit materials were piloted with the steering committees and feedback incorporated. The workshops started with a brief description of the concept of safety culture and its link with safety performance, followed by a description LEAD Safety Culture Model and a description of the workshop dynamic. After this, participants are invited to do a "walk-around the model", which consists of: a) a brief conceptual description of each subcomponent of each quadrant; b) an introduction to a well-known organizational behavior tool associated to the item; c) an

activity where participants reflect on application the described tool to a health, safety or wellness example relevant to each participant's organizational unit; and d) one-on-one sharing of reflections from the exercise.

Concurrently, the diagnostic survey was designed in close consultation with the steering committees. Draft versions of the results report and questionnaire were shared with the group, and feedback incorporated. A final report and survey instrument were developed that adequately balanced the need for comprehensiveness with practicality and simplicity of communication. Data were presented as a series of stacked bar charts and overlaid line graphs, which communicated three pieces of information: the spread or distribution of responses to each question, the average result for each question, and the statistical-significance of any differences between the organization's average and the results obtained from a sample of 600 respondents drawn from Australian industry (see Casey et al., 2019 for details). The overall response rate and qualitative comments to the question 'Please describe any concerns or ideas to improve health and safety in your workplace' were also added to the results report to assist in action planning.

The management action planning workshops consisted of a two-hour session facilitated by the research team. The session began with a 15- to 20-minute overview of the LEAD model, followed by a description of the action planning process and overall toolkit implementation model. Management was given the survey results and asked to identify parts that resonated in terms of strengths or opportunity areas. These areas were then written down into a template planning document, and specific goals and actions assigned through group discussion. The facilitators erred on the side of caution, stepping back from the role of subject matter expert and instead providing general advice and process observations to prompt discussion. This approach was used to maximize the managers' ownership over the action planning outputs.

After the action planning workshops, the training modules were implemented. Sessions were held for each organizational unit, with blanket invitations issued to employees and postgraduate students. Attendance to these workshops was voluntary, and consequently the participation rates varied widely across the sessions. The sessions were designed to maximize learning through allocating most of the time to activities and discussion. Sessions were fast-paced and dynamic, resulting in continuous participant engagement. Time management played a fundamental role towards ensuring that all the content, activities and discussion were completed satisfactorily. Facilitators were therefore

required to keep very close monitoring of the time, and clearly communicate to participants the time allocated for each activity

After each workshop, feedback was obtained from participants and key themes incorporated into revisions to content and delivery. Iteratively, the program quality improved over time as feedback was actioned and content tweaked to address identified weaknesses and build on elements identified as strengths.

Intervention evaluation strategy

Our evaluation results are divided into two sections: feedback from post-session forms completed by participants at the conclusion of the two-hour training event, and statistical analyses involving matched pairs (pre-post analysis) and comparisons at 'post' follow-up between training participants and non-participants. Our goal with these analyses is to provide a triangulated story of training impact drawing on multiple sources of information, considered suitable for the in-situ experimental design.

Results

Workshops feedback analysis

The Likert-scale data collected after each session was processed and presented as average (see Table 4.4). Apparent is the incremental improvement in session quality as feedback was integrated into each workshop.

Table 4.4. Workshop feedback results.

	I am likely to apply this learning in my work	This workshop met the set objectives	The learning activities were effective	The learning materials were useful	The time allocated to each activity was adequate	I would recommend this training to others
Session 1	4.3	3.8	3.8	4.2	3.4	4.0
Session 2	4.0	3.7	3.6	3.7	3.3	3.1
Session 3	4.2	3.9	3.9	4.0	2.5	3.7
Session 4	4.0	4.0	3.7	4.0	3.3	3.7
Session 5	4.2	3.9	4.1	3.9	4.0	3.9
Session 6	4.3	3.9	4.1	3.9	4.3	4.0
Session 7	4.5	4.3	4.5	4.2	4.0	4.3
Session 8	4.1	4.1	3.9	3.9	3.7	4.2
Session 9	4.5	4.5	4.5	4.5	4.0	4.5
Session 10	4.6	4.4	4.0	4.1	4.4	4.1
Session 11	4.2	4.4	3.7	3.6	3.9	3.5
Session 12	4.1	3.7	3.8	4.0	3.9	3.8
Session 13	4.1	3.9	3.9	4.3	3.8	3.6
Session 14	4.1	4.1	4.2	4.1	4.1	4.1
Session 15	4.1	4.4	4.4	4.4	4.1	4.1
Session 16	5.0	4.7	4.7	4.7	4.7	5.0
Session 17	4.5	4.5	4.4	4.4	4.3	4.5
Overall	4.3	4.1	4.1	4.1	3.9	4.0

The feedback was generally positive, with participants agreeing that they are likely to apply the learning at their work (4.3 in a 5 point agreement scale), that the learning activities were effective (4.1 in a 5 point agreement scale), that the learning materials were useful (4.1 in a 5 point agreement scale), that the time allocated to each activity was adequate (3.9 in a 5 point agreement scale) and that they would recommend this training to others (4.0 in a 5 point agreement scale).

In the free-text fields, participants indicated that the strengths of the workshops were the discussions, having knowledgeable and engaging facilitators, useful activities,

quality of materials, content quality, the delivery structure, that the instructions were clear and easy to follow, that the sessions were thought provoking, well-organized and provided participants with applicable skills.

Pre-post analyses

Means and standard deviations for each study variable are summarized in Table 4.5 below. Across the safety behavior variables (safety voice and safety improvements) before and after the training (using unmatched data and aggregating across all organizational units), there were statistically significant differences for the safety behavior variables only.

Table 4.5. Means and standard deviations for each variable, by time point, and t-test results.

	Time 1			Time 2			t-value	p-value
	n	Mean	Var	n	Mean	Var		
Leverage	297	3.76	0.81	247	3.88	0.68	-1.60	0.11
Energize	297	3.75	0.83	247	3.82	0.72	-1.01	0.31
Adapt	297	4.04	0.69	247	4.12	0.50	-1.13	0.26
Defend	297	3.81	0.73	247	3.92	0.56	-1.60	0.11
Improv.	297	3.50	1.09	247	3.64	0.80	-2.12	0.03
Voice	297	3.34	3.31	247	3.58	0.90	-2.65	0.01

Approximately 10% of the participants answered all the four optional survey questions that allowed the creation of a four-letter code for paired analysis. A series of matched pairs t-tests were undertaken to evaluate whether there were any significant changes in the focal variables, drawing on the 27 matched cases. These tests revealed statistically-significant differences for individuals on some of the study variables. Specifically, the test of change in Leverage was non-significant; $t(26)=1.11$, $p=0.28$. The test for Energize was also non-significant; $t(26)=-1.13$, $p=0.27$. However, the tests for Adapt and Defend were statistically-significant; $t(26)=-2.82$, $p<.01$ (Adapt), and $t(26)=-2.10$, $p<.05$ (Defend). Neither safety behavior variables changed at a statistically-significant level; $t(26)=-0.10$, $p=0.94$ (improvements) and $t(26)=-0.51$, $p=0.61$ (voice).

Workshop participant vs. non-participant analyses

Within the follow-up survey, we included a binary variable that classified respondents into those who had attended any of the LEAD workshop versus those who hadn't. This categorization allowed the comparison of intervention recipients against those who may only have received indirect effects of the workshop. A series of independent t-tests were conducted to evaluate whether these two groups differed (training participants versus non-participants).

Meaningful and statistically-significant effects were found for all study variables: workers who participated in the training had higher and significantly more positive scores on the survey measures than those who did not participate. Table 4.6 below summarizes the results of our statistical testing.

Table 4.6. Results of comparisons between training participants and non-participants.

	Yes (Participated)			No (Did not participate)			t-value	p-value
	n	Mean	Var	n	Mean	Var		
Leverage	127	4.10	0.46	193	3.83	0.78	2.86	<.01
Energize	127	4.07	0.58	193	3.76	0.71	3.34	<.01
Adapt	127	4.32	0.30	193	4.05	0.55	3.48	<.01
Defend	127	4.08	0.48	193	3.88	0.63	2.39	<.05
Improv.	127	3.97	0.53	193	3.49	0.84	5.03	<.01
Voice	127	3.97	0.63	193	3.41	0.96	5.41	<.01

Organizational unit analysis

Where sample size permitted, we conducted intra-organizational unit analyses to identify patterns of change within the participating units. Three organizational units could be analyzed in this manner.

For Organisational Unit One, there were statistically-significant improvements for the Energize safety control strategy ($t[106]=-2.11$, $p<.05$) and one of the safety behaviour variables, making safety-related improvement suggestions ($t[105]=-2.00$, $p<.05$) see Table 4.7). Our comparisons also revealed that these improvements (within the unit) were apparent across all participants (on average), independently of their attendance at the workshop.

Table 4.7. The intervention's effect on the mean indexes for Organizational Unit One.

	Time 1			Time 2			t-value	p-value
	n	Mean	SD	n	Mean	SD		
Leverage	47	3.90	0.80	61	4.15	0.90	-1.48	0.14
Energize	47	3.78	0.90	61	4.14	0.88	-2.11	<.05
Adapt	47	4.21	0.62	61	4.32	0.76	-0.81	0.42
Defend	47	3.91	0.77	61	4.17	0.81	-1.72	0.09
Improv.	46	3.65	0.13	61	3.97	0.71	-2.00	<.05
Voice	46	3.63	0.95	61	3.86	0.79	-1.38	0.17

For the Organisational Unit Two, no statistically-significantly differences were noted for the before and after t-test comparisons (using unmatched data; see Table 4.8). However, when we analysed the differences between trained and untrained (measured post-implementation), we found that both safety improvement behaviours ($t[78]=2.89$, $p<.01$) and safety voice behaviours ($t[78]=2.52$, $p<.05$) were higher in the trained than the untrained group.

Table 4.8. Workshop participation effect on the mean indexes for Organizational Unit Two.

	Time 1			Time 2			t-value	p-value
	n	Mean	SD	n	Mean	SD		
Leverage	108	3.93	0.86	83	3.98	0.62	-0.43	0.67
Energize	108	3.99	0.81	83	3.99	0.66	-0.03	0.98
Adapt	108	4.22	0.78	82	4.21	0.56	0.17	0.87
Defend	108	3.96	0.79	82	4.01	0.60	-0.44	0.66
Improv.	108	3.55	0.92	81	3.55	0.89	0.02	0.99
Voice	108	3.39	0.98	81	3.63	0.95	-1.74	0.08

The before vs after comparisons (unmatched) for Organisational Unit Three revealed there were no statistically-significant differences (see Table 4.9) between the October 2018 and the June 2019 results, except for a decrease in the Energize index ($t[139]=1.99$, $p<.05$) and self-reported safety voice behaviours ($t[137]=2.36$, $p<.05$). Additional analyses revealed that there were statistically-significant differences between

the before and after data for people that did not attend the workshops for the Leverage (p-value=0.03), Energize (p-value=0.00), Adapt (p-value=0.02), Defend (p-value=0.01) and Proactive (p-value=0.01) indexes; specifically, all these indexes worsened from Time 1 to Time 2. Interestingly, there were mainly no statistically-significant differences between the before and after data for people who did attend the workshops (i.e., participants' ratings of the LEAD safety control strategies and their self-reported safety behaviour remained stable over time). Overall, the trained group's perceptions and ratings were consistently higher and more positive than the untrained group's ratings. However, the trained group's self-ratings of safety improvement behaviours were significantly higher than the ratings of the untrained group at Time 2; $t(72)=2.08$, $p<.05$.

Table 4.9. Workshop participation effect on the mean indexes for Organizational Unit Three.

	Time 1			Time 2			t-value	p-value
	n	Mean	SD	n	Mean	SD		
Leverage	67	3.84	0.87	75	3.61	0.83	1.56	0.12
Energize	67	3.81	0.92	75	3.50	0.90	1.99	<.05
Adapt	67	4.10	0.78	75	3.92	0.71	1.37	0.17
Defend	67	4.00	0.85	75	3.73	0.77	1.92	0.06
Improv.	65	3.90	0.83	75	3.69	0.85	1.50	0.14
Voice	64	3.88	1.01	75	3.46	1.06	2.36	<.05

Discussion

The objective of this study was to describe the evaluation of a practitioner-focused toolkit designed to improve safety culture through specific bundles of safety practices. These practices are positioned as control strategies that represent optimal ways of resolving the safety control problem depending on the specific operating conditions experienced. Following development and validation of the diagnostic survey component by Casey and colleagues (2019), this intervention study is the next logical step in a program of research that commenced with the theoretical underpinnings explicated by Casey et al. (2017).

Participant feedback from all workshops and training sessions was generally positive. The upwards trend in average feedback received over time represents the

iterative and flexible nature of our development strategy. Specifically, we incorporated feedback between each implementation. This approach paid off in terms of developing a superior toolkit product that received consistently high feedback from participants.

Our triangulated analysis of the pre-post survey data suggested that the training influenced participants' perceptions of safety as well as their self-reported safety behavior. Specifically, we found significant changes in perceptions of targeted safety practices for the small matched sample of training participants. We also found that there were meaningful differences between the trained and untrained groups at the follow-up survey, with perceptions of safety and frequency of self-reported safety behavior being higher and more frequent in the trained group versus the untrained group.

Our additional analyses of intra-organizational unit results found some interesting results worthy of further exploration and commentary. In particular, the results obtained for Organizational Unit Three suggest that the LEAD training intervention may have a 'protective' effect in terms of workers' perceptions of safety practices. At the time of the LEAD implementation, Unit Three was undergoing a large-scale organizational change. Change, particularly when implemented sub-optimally, can be a source of anxiety and dissatisfaction from affected employees (Vakola & Nikolaou, 2005). Participation in the LEAD training sessions, which include some topics related to change management and self-regulation, may not only improve safety practices generally, but also help to inoculate employees to other stressful organizational events like restructures and downsizing.

Overall, the results of this study demonstrate the use of different evaluation techniques when confronted with practical restrictions and difficulties with employing more rigorous experimental designs.

Practical implications

This study reinforces the central role played by leadership in influencing safety climate perceptions, and flowing through to safety behavior. Ever since the original conceptualization of safety climate (Zohar, 1980) and subsequent refinement through the addition of group level safety climate (Zohar & Luria, 2005), leadership practices have been a major contributor to safety climate perceptions. Just as Zohar and Polachek (2014) found that a simple intervention involving providing feedback to supervisors on the safety content of their communications was enough to improve safety climate, we have found evidence that a series of short two-hour workshops was enough to bolster safety perceptions and improve (albeit, self-reported) safety behavior.

This intervention paves the way for shorter and more focused safety interventions, which are likely to be more important in the modern workplace where costs of training are high, and workers' available time is short. In our workshop, we stepped leaders through such activities as forming a safety vision, identifying two-three short-term goals associated with it, and identifying ways to improve communication and coordination with their teams. This approach shifted the focus away from didactic classroom-based learning and towards bursts of 'microlearning'; short three- to five-minute mini-lectures that are supplemented by eight-10 minutes of application and workbook activity. Discussion was used extensively throughout the workshop, which may have contributed to sense-making and reformulation of safety climate perceptions.

This study also supports the use of a multi-level approach when tackling safety climate improvement. We used a combination of an organization-wide survey, leadership training, and general workforce training to achieve the outcomes described here. As safety climate perceptions are informed by structural components like safety policies and procedures, improving one aspect like leadership while leaving the systems-components untouched is likely to attenuate improvements. Interestingly, one of the organizational units that participated in the project went through a restructure at the time of the training program. Our analysis showed that participation in the training may have 'inoculated' training participants from this stressful and potentially negative experience; in particular, those that were trained had stable safety climate and behavior results whereas the non-trained experienced significant decline in perceptions and behavior. Thus, safety training may have the additional benefit of boosting morale and ability to cope with change, particularly where it includes self-regulation skills and leadership skills.

Reflections

This toolkit development process was a rich source of professional learning. Following the project, we collated our experiences and reflections thereof, and provide these as a source of learning for other scholars and practitioners who seek to use the LEAD toolkit or develop their own safety culture improvement interventions in the future. Within the management workshops, participants varied greatly in their ability to generate meaningful actions. Participants often referred back to the facilitators for specific ideas and suggestions, which were gently reflected onto the group for discussion and debate. Managers 'don't know what they don't know'; hence, an accompanying training session or resource describing example actions and practices to improve safety culture may have

been advantageous. In organizations with less corporate knowledge and experience, the action planning component may be particularly difficult without such resources.

Partnerships between academia, industry, and government are powerful mechanisms to advance knowledge and practice. Each party brings with it a unique array of strengths that overcome and counter each other's weaknesses. Government has a long arm to reach and influence industry that academia typically lacks. Academia can invest the time and resources required to develop innovations that are firmly evidence-based that industry cannot afford to do. And industry can act as a robust test bed for interventions to be implemented under 'rough and ready' field conditions that take research out of the laboratory and into the field, something that government and academia can often fail to do effectively.

Finally, our findings highlight the difficulty of achieving meaningful and sustainable change in large organizations where multiple initiatives and changes may be underway. At the Organizational Unit level, we found quite different patterns of results that would have otherwise been masked if we had concentrated our analyses on the overall aggregated sample. One of the Units showed signs of dramatic safety culture change, however, unfortunately a different version of the survey was used at baseline so pre-post comparisons were impossible. This Unit empowered their Safety Committee to take charge of the LEAD implementation, and numerous gains like additional training, investment in safety infrastructure, and improved safety behavior were observed. On the other hand, Organizational Unit Three showed signs of decline over time, at least when analyzed at the aggregate Unit level. It wasn't until we examined differences between trained and untrained that it became apparent there were differences between the groups. These results suggest that implementing change in large and complex organizations should adopt a tailored approach, which considers factors like timing, concurrent initiatives, and overall change readiness. On the other hand, the results indicate that safety training (in the form presented by the LEAD toolkit) may protect employees from negative reactions and responses to organizational changes like downsizing/restructuring. On reflection, more nuanced qualitative research with each participating Unit would have been useful to explore these hypotheses in more detail.

Limitations

There are numerous variables and processes that may be affecting the results, which are difficult to measure and evaluate in practice. Some reassurance should be

gleaned from the fact that other organizations that participated in the project reported perceived benefits from using the toolkit. Similar evaluation approaches to the one used in this study could shed some light about the effect of the toolkit in other organizations as it becomes more widely disseminated.

We also note the positive intervention feedback data as a sign that the 'dose' administered to the participants was strong and consistent, suggesting a more powerful effect on the focal variables than extraneous initiatives and factors underway.

One criticism that could be levelled at this study involved our comparisons between trained and untrained participants, along with the voluntary nature of the study. It may be such that differences between trained and untrained reflect preexisting differences in safety perceptions and behaviors instead of evidence that the toolkit has had an effect. However, the fact that we observed some degree of change in the matched pairs over time suggests that the training at least had some measure of impact, particularly on perceptions of Defend and Adapt perceptions.

Given perceptions of safety practices are likely to converge or approach homogeneity at the team level (LeBreton & Senter, 2008), it is desirable to examine the data using a group-level/nested modelling technique such as multi-level modelling. However, collecting team data may jeopardize the anonymity of survey participants, especially in small teams, and we encountered some resistance from Unit leaders when we initially presented a proposal to explore team-level patterns using a suitable identifier. Nevertheless, future research should explore and if necessary, control for the multilevel nature of data such as these.

Conclusions and Future Research

This study demonstrated the practical utility of the LEAD toolkit. The findings suggest that it is possible to improve both perceptions of safety practices and the frequency of safety behavior with a readily-implemented practical toolkit based on the LEAD model. These evaluation data bolster the evidence supporting the LEAD toolkit and should provide organizations with some level of confidence that the intervention materials are evidence-based and effective if the recommended process is followed. Further, we outlined a number of reflections on our experiences and learnings that should inform further intervention work in this area. In one sense, the program of research commenced by the first author has reached a logical conclusion, given the progression from theory, to measurement, to intervention. In another sense, there is still much work to be done to

explore nuances of the LEAD model, such as evaluating propositions like 1) are the proposed control strategies the optimal way to manage safety in each hypothesized work condition, 2) is it possible to dynamically influence workers' self-regulation through purposeful manipulation of leadership practices on short time-scales (i.e., intra-day), and 3) are there alternative ways to measure the LEAD control strategies that overcome the limitations of survey-based methods (e.g., non-response bias, halo bias, social desirability bias).

Chapter 5: General Discussion

This programme of research traced an arc from theory through to practice. I conducted a comprehensive series of investigations that established the LEAD model and associated measures and resources as an evidence-based toolkit that can benefit industry. Findings from this program of research demonstrated that the LEAD survey tool is a valid and reliable measure, with replicated results across multiple organizational and industry settings. The intervention study highlighted the potential for short and innovative workshops to produce some degree of change in safety practices over time. In this section I present an integrated discussion concerning the findings and implications of each contribution, as well as an in-depth consideration of programme limitations and future research directions. A reflection section concludes this thesis.

Theoretical implications

From a theoretical perspective, the first contribution contained in Chapter 2 (Casey et al., 2017) advanced the safety climate and culture literatures considerably. Up until now, the conceptualization of safety climate has largely ignored the motivational pathways through which climate exerts effects over behaviour. Beginning with Craig Wallace's work (Wallace & Chen, 2006), which was the first to demonstrate the effects of safety climate on regulatory focus, and safety performance, scholars have thereafter expanded understanding of the ways in which social forces shape behaviour via self-regulatory states. For example, Beus and colleagues (2019) recently explored the effects of paradoxical organizational climates on commitment and productivity. Similarly to the ideas advanced by Casey and colleagues (2017), Beus et al. operationalized climate measures in terms of their effects on self-regulation (i.e., a prevention climate and a promotion climate). Regarding the LEAD model, and the underpinning theoretical ideas, different constellations of LEAD control strategies should convey unique and measurable self-regulatory states, which then lead to purposeful elicitation of specific safety behaviours. This is an important theoretical contribution that remains to be tested in future research.

I also contributed a new construct which I termed 'uncertainty management'. This construct leverages the work of Grote (2015), who argued that uncertainty has a complex relationship with workplace safety. Uncertainty management is another self-regulatory construct that influences the tactics and strategies people use to cope with uncertainty in their environment. There are a number of testable hypotheses regarding the effects of

social and physical context on self-regulation. For instance, exposure to a high-risk environment in concert with practices that emphasize Defend should elicit a ‘stability-focussed’ state, leading to strategies that seek to maintain predictability and control over the workplace (e.g., using safety procedures and established tools like risk assessment to create uncertainty).

In the series of studies summarised by Chapter 3 (Casey et al., 2019), we found that the relationships between LEAD dimensions and self-regulatory states were not as ‘clean’ as the theory would have predicted. For instance, the theory would suggest that Leverage would be more strongly related to promotion-focus and stability-focus than other regulatory constructs. However, the pattern of correlations across the LEAD measures and self-regulatory constructs were homogenous and undifferentiated. However, it is possible that this finding is due to measurement issues rather than incorrect theory. Response bias, and more specifically, common method bias, could be an explanation for these results. In addition, forcing a global rating of the LEAD practices (i.e., a rating that is averaged across a number of different work situations) would likely artificially inflate the intercorrelations as respondents would be making an overall assessment of each practice rather than a momentary report of current practices. Use of a diary-based or other longitudinal study would help to clarify these relationships.

Regarding the Chapter 4 intervention study, the finding that one of the Organizational Units appeared to be inoculated against negative effects of restructuring/downsizing due to the safety training raises some theoretical implications. Safety initiatives may contribute positively to personal factors like organisational commitment and job satisfaction through a process of social exchange. Employees participating in safety training may feel that the organisation cares about them and has facilitated their involvement in valuable training, cuing the need to reciprocate. Further, the job demands/resources model may also be applicable here. Being provided with safety training that includes general leadership and self-management skills may increase job resources and decrease the experience of job demands, or assist people to reframe hindrance stressors into more functional challenge stressors. An interesting line of future research would be to examine the differential effects of safety training on non-safety phenomena like job satisfaction and organisational commitment.

Practical implications

Practically, this study contributes to the improvement of safety performance across industry through supporting the dissemination and uptake of the LEAD toolkit. Safety is often criticised as a discipline with little theory or empirical evidence behind it (Dekker, 2019). This research programme provides an integrative and innovative assemblage of theories and ideas from leading safety scientists, and resolved them to a practical toolkit that industry can readily implement. Our user-centred and iterative design process ensured that the tools and resources are fit-for-purpose. The partnership between industry, academia, and government was powerful because it enabled the rapid and wide-reaching recruitment of organisations to participate in the programme, as well as a powerful reach to assist dissemination. The toolkit has been made available on the Workplace Health & Safety Qld website and to date, approximately 100 organisations have used the materials at various stages of development. One organisation from the meat processing industry, Teys Australia, was successful at winning the National Safety Council of Australia 2019 Pinnacle Safety Award for their LEAD implementation. This recognition strengthens the practical utility of the toolkit by generating media coverage and bolstering the reputation of the resources.

Another practical implication of this study is that worker safety behaviour can be improved through relatively short and 'punchy' safety interventions. In all, the training sessions and workshops only required about one day of combined investment (each roughly two hours long). Tailored and targeted activities and content were delivered to senior managers, supervisors, and workers through this implementation. Rather than force employees to participate in every tool and training, we instead developed an approach that was tailored to each level of the organisational hierarchy. Focussed and brief safety training interventions are likely to be required in the future, as resources become tighter and production requirements more intense. The evidence here suggests that even a short two-hour training session can be enough to improve safety behaviour and perceptions of safety practices in an organisation.

Given the toolkit implementation was unable to achieve consistent and holistic improvement in safety leadership perceptions among subordinates, the context of the project might be relevant when it comes to practical implications. First, the toolkit concentrated just on leadership perceptions. As safety is created and produced through the interaction of multiple subsystems (i.e., personnel, procedural, structural; Carayon et al., 2015), changing just one of these may be inadequate to achieve wholesale change

across an organisation. For instance, training people in safety leadership without reviewing existing safety management processes and policies may encourage entrenched practices. Second, some of the organisations going through the intervention process were also simultaneously experiencing large-scale organisational change (centralisation of corporate services and downsizing). Thus, any gains in safety leadership perceptions may have been tainted through negative morale and other affective reactions. Third, the organisations involved in this research were diverse in terms of their risk profiles and work types. Organisations ranged from largely office-bound personnel through to staff that routinely visit active mine sites. Developing a training program that is generic enough to function across these contexts, yet still have a consistent and measurable impact on subordinates' perceptions of safety leadership is a significant challenge, which this study suggests shouldn't be underestimated. Finally, the time lag between before and after measurement was only a few months, which may have been an inadequate timeframe to assess for flow-on effects to subordinates' perceptions of safety leadership.

Limitations

Across this programme of research, I was unfortunately not able to source a sample that would have permitted the multiple repeated measures and intensive diary-based data collection that would have enabled me to test the underlying theory of the LEAD model in more detail. This is a significant limitation because the intervention was designed from the premise that the theoretically-specified relationships between control strategies, motivational states, and safety behaviour are valid.

Most of the data reported here was collected using a cross-sectional survey design. Even for the longitudinal intervention study, I was only able to collect data from two time points, and at each point both the predictor and criterion variables were collected using the same survey instrument. Consequently, it is inappropriate to make causal inferences about the nature of any relationships discussed here. For instance, the scale validation would have been considerably enhanced (in particular, predictive validity) by using a longitudinal design that sourced data from different instruments/methods.

Regarding the intervention study, the deidentified code performed less effectively than was hoped, resulting in a small sample of matched pairs pre-post intervention. The fact that so few participants could be matched before and after the intervention means that the sample could be biased, or otherwise provide a conservative test of the intervention effects. A larger sample would not only have increased statistical power, but also

potentially shown markedly different results. In addition, practical limitations with data collection prevented me from sampling at multiple time points. Consequently, the timing of the follow-up data collection may have been too early to detect evidence of other significant changes. We were also not able to source a suitable control group, so again, causality inferences are not appropriate (i.e., the observed changes may be due to contextual effects rather than the intervention exposure).

Despite these limitations it is noteworthy that I was able to recruit a diverse and large sample to conduct the scale development process. Further, the use of a multi-organisation and diverse intervention sample likely provided a realistic and conservative evaluation environment for the toolkit. Taken together, the series of studies here chart the progression of a theoretically derived idea, through to a psychometrically-sound measurement tool, and finally, a field test of an intervention toolkit that is focussed on practical usability by industry. Scholars have long lamented the absence of intervention research in safety science (e.g., Hale et al., 2010; Lee et al., 2019), so this study makes a useful contribution to the existing literature.

Future Research Directions

The LEAD model, explicated by Casey and colleagues (2017, 2019), supports the proposition that optimal safety performance results from the implementation of specific bundles of practices ('control strategies') in response to the demands conveyed by different work situations. At its core, the LEAD model attempts to explain the linkages between behaviour and more distal influences like leadership and safety climate through combinations of self-regulatory foci.

LEAD profiles

Although the model is typically represented as a quadrant, with orthogonal axes, the reality is likely much more complex. For instance, research has shown that promotion and prevention are actually non-mutually exclusive; rather than being opposing ends on a continuum, it may be possible for an individual to be simultaneously high on promotion and prevention (Wallace & Chen, 2006). Previous research on the LEAD model has also identified moderate positive correlations between the underpinning self-regulatory foci (Casey et al., 2019). Further research is required to identify the effect of a 'balanced' LEAD profile, and the consequent combinations of self-regulatory foci, on safety behaviour. Also, other LEAD profiles that are less balanced, and potentially misaligned

with situational demands may produce unintended effects on safety behaviour and performance. Existing research from both the safety and management sciences support these research directions. In the general management literature, the seminal work of Delery & Doty (1996) includes a discussion on configural approaches to strategic human resource management. Their results showed that configural approaches to human resources practices explains deviations in financial performance, with some profiles of practices being more effective than others, depending on the market context. In safety science, Colley et al. (2013) investigated the competing values framework and workplace safety performance. They found that profiles with stronger 'human relations' emphasis tended to result in better safety performance. These results highlight that profile or configural research can provide more nuanced prediction of organisational performance.

Targeted elicitation of safety behaviours

Each LEAD strategy is proposed to solve the safety 'control problem' by inducing a specific self-regulation state and thereafter, encouraging targeted behaviours at the individual and team levels. As shown by Figure 5.1, the integration of various safety behaviour frameworks with the LEAD model shows the expected relationships between combinations of self-regulation and certain behaviours. This is a fertile area for future investigation because it would enable organisations to encourage particular behaviours among workers in response to safety strategy, opportunities, or anticipated threats.

I illustrate the relationships between self-regulation and safety behaviour through the following examples. When prevention-focus and flexibility is high, employees may be more likely to engage in activities such as whistleblowing – targeted action designed to initiate transformational change within a team or organisation (hence the high flexibility-focus) and highlight duties, obligations, and ethical resolution of perceived miscarriages of responsibility (as induced through the high prevention-focus). 'Deep' compliance, described as investing full cognitive resources in the task of using standardised procedures, rules, and protocols, is most likely when both prevention-focus and stability-focus are high. This outcome is driven by the sense of duty and obligation (creating conditions that are ripe for compliance, and also a deference to standardisation and well-established rules and procedures (the combination of prevention- and stability-focus).

Figure 5.1. Integration of safety behaviours within the LEAD model.

Relative frequency of LEAD control strategies

The deployment of each LEAD control strategy (i.e., Leverage, Energise, Adapt, or Defend) is driven by two fundamental variables: uncertainty and risk. In situations where risk is high, the choice of regulatory focus defaults to prevention, and either stability or flexibility. In situations where uncertainty is high, the choice of focus is flexibility. Environmental cues are likely different for each individual worker. One doesn't have to go too far to identify that risk doesn't exist 'out there' (environment), but rather 'in here' (the mind). The seminal works of Slovic (1987, 1992) identify that risk is socially-derived and other more recent work shows the emotionality of risk-related perceptions (Xia et al., 2017), which collectively erode the intuitive and often-practiced assumption that humans are calculative and rational risk assessors.

Accounting for these considerations, the LEAD model 'landscape' is likely configured differently for certain individuals, teams, and organisations based on shared and agreed understandings of what constitutes low and high risk, and the type of work undertaken, among other factors. Consequently, the performance space defined or bounded by each control strategy could be markedly different. Figure 5.2 shows an example mapping of the work performance space in light of the LEAD control strategies. The Leverage control strategy space is likely to be the dominant or most frequently-experienced one, both in terms of the type of work undertaken and the organisation's (or team/individual) tolerance thresholds for uncertainty and risk. Adapt is likely to be a rarely

encountered control strategy given the high safety levels of most industries and relatively low failure rates (e.g., aviation, manufacturing).

Given the LEAD model requires individuals and teams to make decisions about level of risk and uncertainty, as well as select the most appropriate control strategy to suit the current environmental conditions, further research would be valuable. Specifically, investigating the thresholds and signal processing limits that trigger a switch between LEAD control strategies based on environmental cues would develop new insights into the practical implementation of the LEAD model.

Figure 5.2. Mapping of LEAD control strategy spaces by uncertainty and risk levels.

LEAD and the resolution of paradox

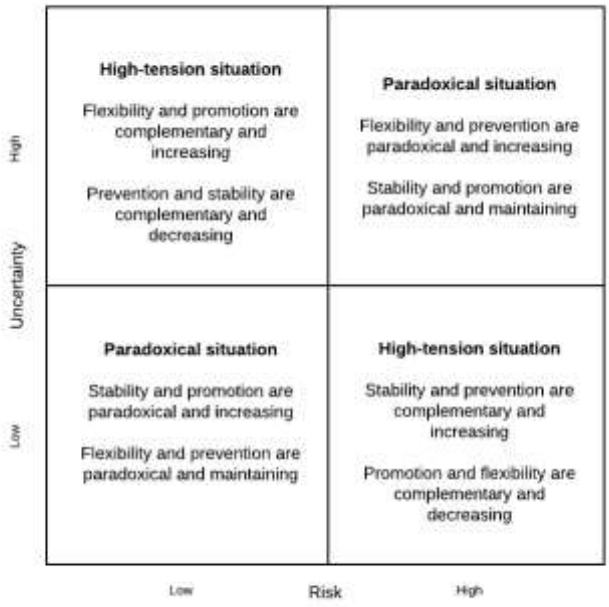
Each LEAD control strategy is proposed to optimise performance through inducing a specific self-regulatory state. This state is comprised of different combinations of promotion- and prevention-focus, and flexibility- and stability-focus. In some work situations, this combination is complementary or synergistic. For instance, when opportunities are being pursued and the Energise control strategy is used, the optimal configuration is flexibility and promotion (and high levels of both these foci are desired).

Promotion and flexibility are aligned because promotion-focus results in exploratory and growth-oriented behaviours, and flexibility-focus results in approach towards uncertainty. This is a high-tension situation because the exploratory and uncertainty approach effects of high promotion-flexibility foci is in direct competition with the compliance and certainty effects of high prevention-stability foci. For Energise to be fully

effective as a control strategy, flexibility-promotion foci should be maximised, whereas stability-prevention focus should be minimised.

Conversely, in routine work environments, a paradoxical situation results because the optimal configuration is stability-promotion foci, along with moderate levels of flexibility-prevention foci. Successful control over performance requires foci typically in competition to instead be mutually-reinforcing and existing simultaneously. In the case of routine work, the combination of promotion and stability foci ensures that behaviours are concentrated on achievement striving and effective work practices that maximise success. The moderate levels of prevention and flexibility foci act as attenuators – tempering the achievement striving in the face of emerging risks and permitting some acceptance of variability (e.g., work arounds, adaptive work patterns) to maintain overall stability and optimal efficient performance. Figure 5.3 provides a visual summary of these propositions.

Figure 5.3. Combinations of self-regulatory foci and corresponding tension or paradox situation.



These tensions and paradoxes between self-regulatory foci can be visually represented as vectors. As Figure 5.4 shows, each of the work situations (routine operations, opportunity pursuit, recovery and learning, and critical risks) are characterised by different levels of risk and uncertainty. These environmental cues determine the position and intensity of the regulatory foci vectors, as well as the direction of movement as levels of these cues fluctuate. By measuring levels of risk and uncertainty (albeit at

different levels), individuals, teams, and organisations should have real-time data regarding the most appropriate control strategy to deploy.

My general line of thinking here is that the dynamics of the LEAD model can be represented by vectors. These vectors can change their orientation around axes that represent increasing, decreasing, or maintenance of environmental conditions (i.e., uncertainty and risk). Each vector represents one of the self-regulatory states that a LEAD control strategy purports to induce (e.g., prevention, promotion). Because self-regulatory states are separate constructs rather than opposing poles on a continuum, they can co-exist, albeit in a state of paradoxical tension, such as creating stability through flexibility (Farjoun, 2010).

In Figure 5.4, cell a., the Leverage strategy is most appropriate due to decreasing risk and decreasing uncertainty – the work activities being undertaken are likely to be well-known and routine, where little can go wrong. Consequently, the optimal configuration of self-regulatory foci is promotion-stability, with moderate levels of prevention-flexibility. This is a paradoxical situation. Providing workers with clarity of goals and roles, and coupling this with recognition of effective work practices is likely to achieve the paradoxical self-regulation state. Clarity encourages a promotion-focus by highlighting goals and achievements that workers can strive towards. It also induces a stability-focus by helping to identify well-established processes and procedures that can be drawn on to increase efficiency. Recognition and reinforcement of effective work practices builds promotion-focus be satisfying needs of achievement, and encourages stability by cementing and grounding work practices.

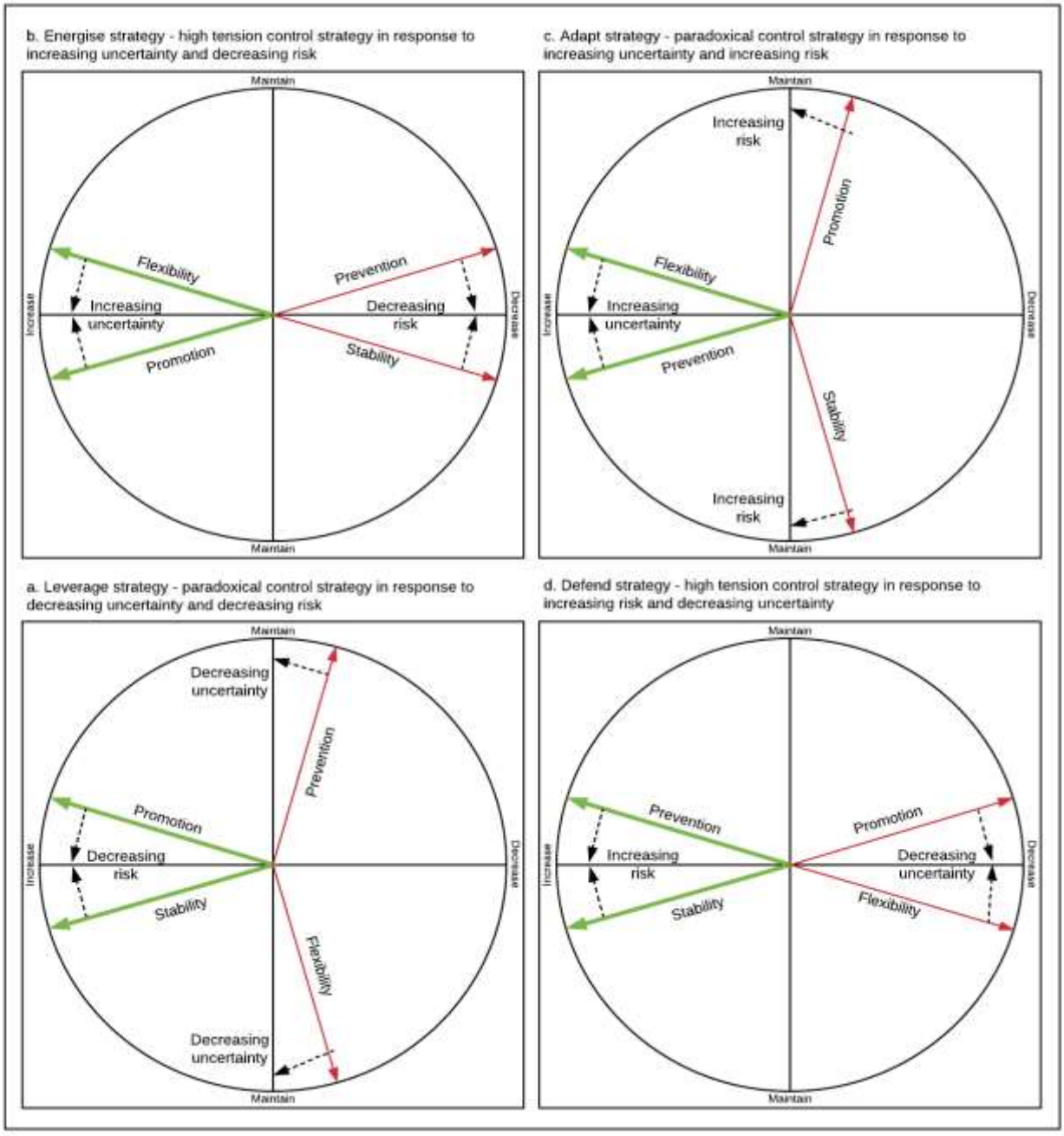
Cell b. is a high-tension situation as induced by the Energise strategy. Complementary combinations of flexibility-promotion (increasing) and prevention-stability (decreasing) establish control by promotion individual behaviours that generate and sustain exploratory change. Practices such as inspiration and empowerment induce the promotion-flexibility combination and decrease the prevention-stability combination.

Cell c. is another paradoxical situation, with the combinations of flexibility-prevention (increasing) and promotion-stability (maintaining). A flexibility-prevention focus, as induced by the Adapt control strategy, prime people to accept change but focus their efforts on incremental and prevention-oriented improvement (i.e., preventing the reoccurrence of failure). Practices such as reflection on past performance (e.g., after action reviews) and voicing concerns enable the coexistence of paradoxical foci (prevention-flexibility).

Finally, cell d. is a high-tension situation with the focus on prevention-stability in response to increasing risk and decreasing uncertainty in the environment. In other words, workers are confronted with high-risk hazards that they know well, and have effective means of identifying, assessing, and controlling such hazards. Promotion-flexibility focus is discouraged through practices such as detailed risk assessment and adherence to standardised safety procedures. Correspondingly, workers are more likely to engage in ‘deep compliance’ and achieve high safety performance.

From a future research perspective, exploration of how these paradoxical situations are experienced psychologically, and the effectiveness of various LEAD strategies are resolving such paradoxes, is warranted. Paradox will be an important concept into the future of health and safety, because employees in high-risk situations are likely to be presented with more frequent opportunities to either accept or resolve paradox (Hu et al., in press).

Figure 5.4. Combinations of environmental risk and uncertainty, and corresponding dynamics of self-regulatory foci.

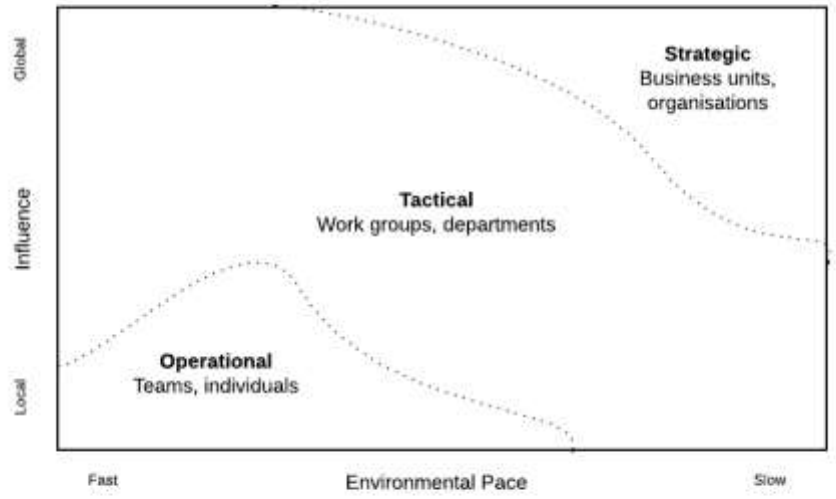


Levels of LEAD implementation: Operational, tactical, and strategic

Mostly, the LEAD model is positioned as a tactical (supervisory) and operational (worker-centric) phenomenon. At these levels of the organisation, the level of influence is local, and the environmental pace is fast. Correspondingly, the dynamism of the LEAD control strategy deployment and changes in environmental conditions is high. Teams may

cycle through many different iterations of LEAD control strategies throughout a working day as the nature of the work situation fluctuates. At the strategic level, senior managers experience a slower rate of environmental change and more global impact of decision-making. These patterns are summarised by Figure 5.5.

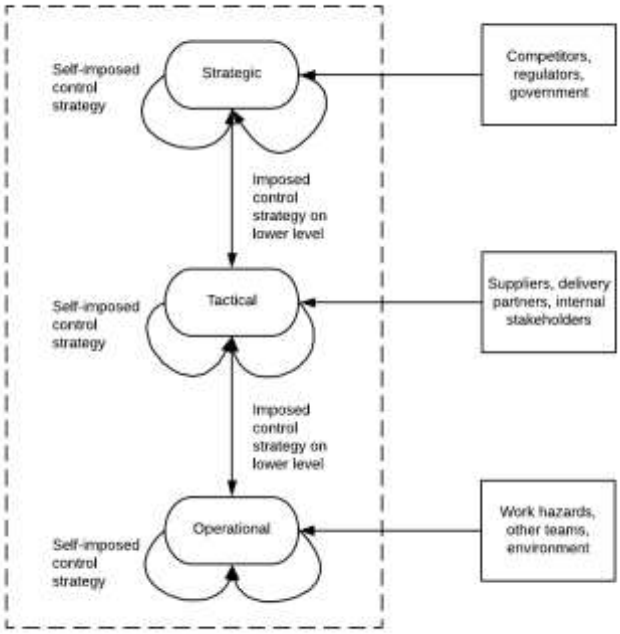
Figure 5.5. Different organisational levels and the relationships with influence and environmental pace.



Therefore, there exists the possibility of interactive effects between different layers if the LEAD model is implemented on a wholesale level across an organisation. Operational teams may deploy control strategies that are either aligned with or compete with tactical and organisational levels. Ensuring alignment of control strategies, and even misalignment in the case of strategic decision making that aims to change the status quo (to exert a macro or global influence over lower levels of the organisation) is important if the full effects of the LEAD model implementation are to be realised.

As shown by Figure 5.6, the layers of an organisation may exert markedly different effects on each subsequent layer through the self-regulatory context that each respective control strategy implementation generates. Adding to this complexity are the ‘self-imposed’ control strategies that operate within each level – all levels are comprised of teams, and certain leadership and co-worker practices will likely influence local conditions. The ‘net sum’ effect of all these interacting control strategies produce the ultimate effect on individuals’ self-regulatory foci and corresponding behavioural practices.

Figure 5.6. Implementation of LEAD control strategies at different organisational levels in response to environmental conditions.



Future research could possibly explore the different operationalisations of the LEAD model at different levels of an organisation. LEAD may apply quite differently to organisational strategists like senior managers, where the timescale and lag times associated with control strategy implementation (and their effects) will be much longer than in-the-moment control strategies implemented by teams at the operational level. Further, exploring the net sum of LEAD model effects across an entire organisation, where multiple and possibly competing control strategies could be deployed simultaneously, would add to the practical knowledge base around this framework.

Personal Reflection

Much has been said about the role of organisational culture in either contributing to (Tuner, 1978) or preventing (Weick, 1995) workplace accidents. From the first perspective, culture acts as a ‘blinker’, obfuscating or distorting important information about risk and creating organisational vulnerabilities. These vulnerabilities, known as ‘latent conditions’ or ‘resident pathogens’ (Reason, 1997) incubate and are triggered at the sharp end by unexpected interactions of variability or acts that cut through organisational defences. Consequently, culture is a process of ‘not seeing’. From the second perspective, culture acts as a positive capacity that an organisation should foster. The theory of high reliability

organising exemplifies this approach, with the five tenets of mindfulness; socio-cognitive processes that ensure risks are noticed and allocated the attention that is warranted by their significance. Thus, culture is also a process of ‘seeing more’ and ‘seeing differently’ (Barry & Meisiek, 2010). When an organisation knows more, through searching for what is not seen, directing attention in areas to see more, and critically questioning what is seen, safety is improved.

Critical to both perspectives on culture is the activity of sense-making. Sense-making is literally ‘making sense’ of ambiguity in organisations, through processes of interaction and interpretation. For example, following a situation or event within an organisation, people will cognitively ‘talk situations into being’, either through self-talk and interpretation, or through social interaction with others. The latter is particularly likely in organisations because humans are social beings, and we draw on relationships and interactions with others to help understand and control our environment.

Nevertheless, a lot of organisational sense-making is implicit and subconscious. People make decisions, send messages, and act (or not) on safety issues in ways that are often ignorant of the effect such activities have on employees’ sense-making, and their consequent behaviours. People can also contribute to a culture of ‘not seeing’ by poisoning the well of sense-making. For example, consider the accidental shooting down of an unarmed civilian airliner. An investigation of such a disaster may begin with a fundamental question ‘why did he/she shoot’ However, such a question drives sense-making in ways that lead straight back to the individual decision maker rather than casting light on hidden dangers lurking in other areas of the organisation. This is because ‘why did they shoot’ quickly leads to ‘why did they make the wrong decision’. Judgment is premature, sanctions are imposed, and learning is impaired. The organisational culture of ‘not seeing’ has been reinforced through the ‘success’ of the investigation conclusion – human error.

Consider another example closer to the reality of organisational life. A pocket risk assessment (JSA, Take 5 etcetera) is a staple tool in many high risk environments. Such risk assessments are conducted prior to a job commencing, and are a way of forcing workers to consider risk and implement controls. Yet, we know that these assessments are rarely completed as intended (Havinga et al., 2018). Stories abound of workers completing Take 5s en-masse at the end of the month to meet their quotas or developing rubrics to inform which boxes to tick so no further action is required. Non-compliance with risk assessments is usually met with disciplinary actions. This is dictated by a culture of not

seeing. In a culture of ‘seeing differently’, and ‘seeing more’, sense-making occurs differently. We ask questions like: Is a Take 5 the best method of focussing attention on risk? What else could we do instead? Is there a system change we can make to eliminate the hazard and negate the need for a Take 5 altogether?

Leaders (both formal and informal positions of authority) are well-placed to manage sense-making processes, and in so doing, contribute to more functional treatments of risk. Leaders can provide explicit cues or inputs into what constitutes a risk and how it should be dealt with. Leaders can contribute to a rich informational environment by encouraging ‘psychological safety’ or a willingness to speak up and voice concerns or ideas. And finally, leaders can draw attention to risks that may otherwise have gone unnoticed or underappreciated. Consequently, leaders are facilitators of sense-making, and by training their competencies to take conscious control of this process, contribute greatly to an organisation’s safety culture.

Altogether, a number of premises can be derived from the ideas described above:

- Risk is a social construction (it is subjective and what is deemed to be a risk is shaped through culture).
- Culture is a dynamic phenomenon that is constructed and modified over time, through processes of sense-making; hence, what is constituted as risk will also change over time.
- Culture is as a frame of reference or a ‘shared mental template’ that provides guidance to employees about how they should interpret and respond to risk (e.g., what constitutes a hazard, how should hazards be controlled, should incidents be reported).
- By influencing culture at all levels of an organisation, managers can change the way risk is perceived, assessed, and actioned.

Rather than attempting to change culture directly (largely a fruitless effort), it should be shaped or ‘nudged’ by increasing employees’ ‘cultural competence’ to engage in guided sense-making processes that enhance the informational environment.

By enhancing the informational environment and fostering critical thinking around safety, the culture becomes self-sustaining, and moves away from a prescriptive global template (e.g., all cultures should be homogenous) and towards a locally-relevant set of

boundary conditions (e.g., the ‘right’ culture will emerge if the initial conditions and maintenance activities are appropriately set).

What do these insights mean for the current research programme? The LEAD model neatly sidesteps the existential crisis of safety culture (and to some extent, safety climate) by concentrating on the antecedent practices that should create the cultural conditions that lead to an informational environment. The LEAD research programme even makes some small steps to unpacking the ‘black box’ of how social context influences behaviour, namely, via self-regulation. Yet, the LEAD research conducted here is largely normative and functional in nature.

Being steeped in a quantitative tradition, this research missed an opportunity to describe or interpret the cultural nuances that existed within the participating organisations. Throughout this research, and my exposure to alternative ideas and methodologies from sociology via the Safety Science Innovation Lab, I have discovered the futility of thinking that a safety culture can be engineered or created through purposeful interventions. I have even started to question the term ‘safety culture’ itself, preferring ‘a culture for safety’ instead to denote a dynamic, differentiated, and effect-based conceptualisation of organisational culture. I have found that it is less worthwhile to focus on what safety culture IS, but rather to focus on what safety culture DOES.

In addition, the studies here highlight the temptation plaguing industry for a panacea or quick fix when it comes to safety. Managers, consultants, and even regulators want a toolkit that has a readily-implemented ‘cookbook’ or recipe for how to create a safety culture. This research has made me realise more intently the pressure and blinkering that such demands place on both academics and practitioners. Rather than giving them what they want, perhaps we should instead be giving them what they don’t (want) to see? A window into the complexities, nuances, conflicts, and discrepancies that make up an organisational culture (for safety).

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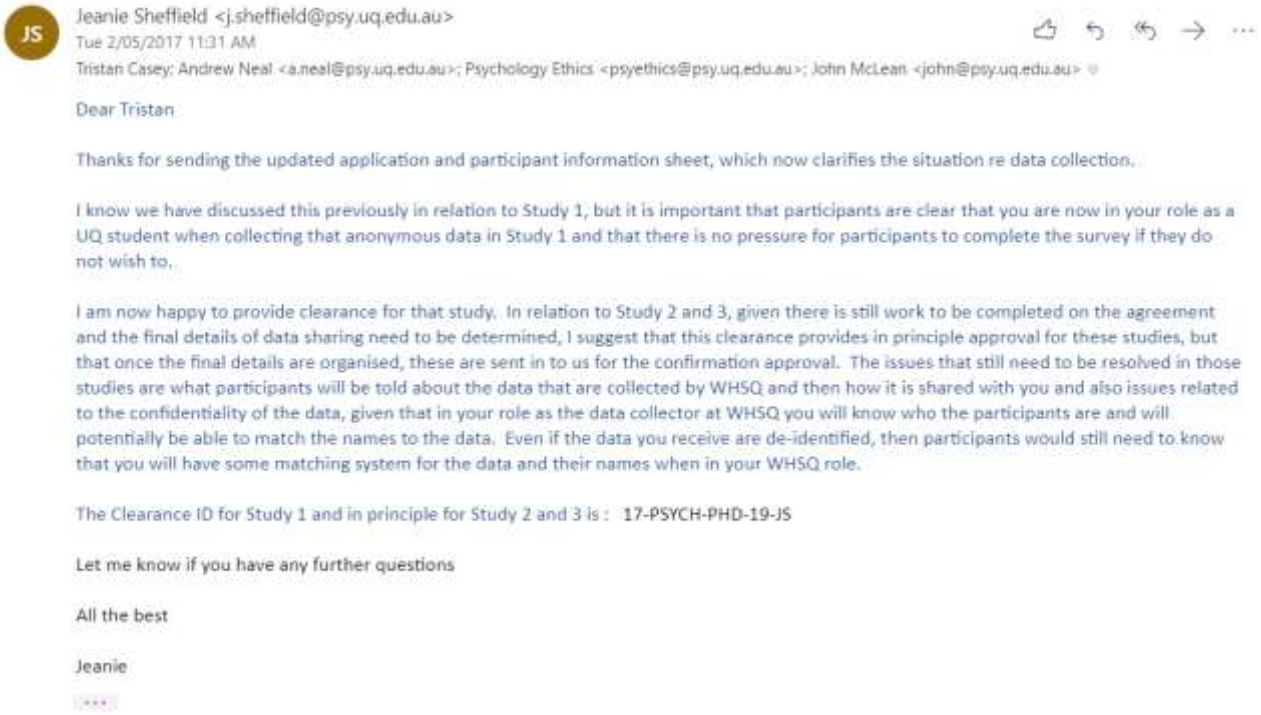
Appendix

Ethical Clearance Letters



Jeanie Sheffield <j.sheffield@psy.uq.edu.au>
Tue 2/05/2017 11:31 AM
Tristan Casey; Andrew Neal <a.neal@psy.uq.edu.au>; Psychology Ethics <psyethics@psy.uq.edu.au>; John McLean <john@psy.uq.edu.au>

Dear Tristan

Thanks for sending the updated application and participant information sheet, which now clarifies the situation re data collection.

I know we have discussed this previously in relation to Study 1, but it is important that participants are clear that you are now in your role as a UQ student when collecting that anonymous data in Study 1 and that there is no pressure for participants to complete the survey if they do not wish to.

I am now happy to provide clearance for that study. In relation to Study 2 and 3, given there is still work to be completed on the agreement and the final details of data sharing need to be determined, I suggest that this clearance provides in principle approval for these studies, but that once the final details are organised, these are sent in to us for the confirmation approval. The issues that still need to be resolved in those studies are what participants will be told about the data that are collected by WHSQ and then how it is shared with you and also issues related to the confidentiality of the data, given that in your role as the data collector at WHSQ you will know who the participants are and will potentially be able to match the names to the data. Even if the data you receive are de-identified, then participants would still need to know that you will have some matching system for the data and their names when in your WHSQ role.

The Clearance ID for Study 1 and in principle for Study 2 and 3 is : 17-PSYCH-PHD-19-JS

Let me know if you have any further questions

All the best

Jeanie

John McLean <john@psy.uq.edu.au>
Mon 3/04/2017 3:02 PM
Tristan Casey; Andrew Neal <a.neal@psy.uq.edu.au>; Psychology Ethics <psyethics@psy.uq.edu.au>

Casey Tristan Ethics applicatio...
87 KB

Hi Tristan,

Your PhD research ethics review application has now been reviewed and cleared.

Your clearance number is: 17-PSYCH-4-31-JMC

Best wishes with the (very interesting) research!

Kind regards,
John

Dr John P. McLean

Associate Professor
School of Psychology
University of Queensland
St Lucia, QLD 4067
AUSTRALIA
tel: 61 7 3365 6394 fax: 61 7 3365 4466 email: john@psy.uq.edu.au

I acknowledge the Aboriginal and Torres Strait Islander owners of the lands and waters on which I work, live, and play, and pay my respects to elders, past and present.

Subject Matter Expert Semi-Structured Interview Guide

- My background
- Scope of thesis project
- Confidentiality
- Time required

In developing a systems-model of safety in organisations, it has become apparent that social forces such as culture and climate could act as mechanisms for control over work operations. Culture and climate are arguably more effective ways of exerting control than top-down procedures and prescriptive rules because they are bottom-up and don't require effortful monitoring and enforcement. To help explicate the specific configurations of culture and climate that would enable such control to be effected, we've developed a model of four separate control strategies. These strategies are appropriate for operating contexts defined by two continuum, namely: flexibility-stability, and promotion-prevention focussed goals. The matrix below summarises the operating conditions and corresponding control problems.

	Promotion	Prevention
Flexibility	System is operating in an environment where change is being implemented while seeking to achieve promotion-focussed goals. Control achieved through motivating vision and purpose, and workforce empowerment.	System is attempting to recover from an incident and implement improvements to prevent reoccurrence. Control achieved through well-rehearsed emergency routines and learning practices.
Stability	System operates in routine conditions with a focus on promotion goals. Control achieved by planning, coordination, and recognising goal attainment.	System is operating in routine conditions with a focus on prevention goals. Control achieved by monitoring and correcting deviations, standardisation, and top-down supervision.

What I'd like us to do together is to review each of the four control strategies and hear your opinions on the specific organisational practices and cultural beliefs that you think apply to each one. There are no right or wrong answers, I am simply interested in your professional opinion.

At times, organisations operate in stable and routine environments where risks and hazards are predictable, and the focus is on preventing losses and harm. In this operating context, the control strategy constrains the variability of operations and exerts a force to push the system operating point away from the boundary of safe performance. The strategy exerts control by setting and enforcing safety standards, monitoring compliance, and correcting deviations.

1a) In your opinion, how prevalent is this control strategy across industry?
1b) What industries would be most likely to use this type of control strategy?
1c) What organisational practices do you think characterise this strategy?
1d) What cultural beliefs do you think characterise this strategy?

Alternatively, organisations can operate in a stable and routine environment where the focus is on promotion-focussed goals such as striving towards production goals. In this operating state, the control strategy aims to maintain a state of optimisation so the system is as close to the boundary of safe performance as possible, thus maximising production goals while maintaining safety. Control is maintained through coordination of operations, setting aspirational standards, monitoring performance, and recognising successful achievement of goals.

2a) In your opinion, how prevalent is this control strategy across industry?
2b) What industries would be most likely to use this type of control strategy?
2c) What organisational practices do you think characterise this strategy?
2d) What cultural beliefs do you think characterise this strategy?

Another operating state that organisations can experience is high flexibility and prevention. Such a state occurs when a hazard has been released and the organisation is attempting to recover and learn to prevent reoccurrence. The control strategy returns the system operating point back behind the safe performance boundary and strengthens the boundary

through improvement and learning. The control strategy exerts control through implementing emergency routines and making changes to systems and processes to reduce future risk.

3a) In your opinion, how prevalent is this control strategy across industry?
3b) What industries would be most likely to use this type of control strategy?
3c) What organisational practices do you think characterise this strategy?
3d) What cultural beliefs do you think characterise this strategy?

The final operating state is when flexibility is combined with promotion, such as when positive changes are being introduced like new technologies, changes in market forces, or people work in an environment in which the risks and hazards are dynamic or unpredictable. In this operating context, the control strategy highlights and clarifies performance boundaries, and coordinates system operating point movements. The strategy exerts control through developing a shared and motivating vision for safe production, inspiring collective purpose and ownership, encouraging operator autonomy, and involving operators in decision-making and initiatives.

4a) In your opinion, how prevalent is this control strategy across industry?
4b) What industries would be most likely to use this type of control strategy?
4c) What organisational practices do you think characterise this strategy?
4d) What cultural beliefs do you think characterise this strategy?

Thank you for your time and effort. Do you have any further comments or advice to offer for this research project?

Can you recommend a colleague in this field who may be a suitable candidate for participation in this research study?

- Next steps
- Providing participants with feedback/outcomes

Interview Summary of Themes

Organisational Practices

Leverage

Collaboration and support. Leaders engage with workers to conduct shared planning processes. Leaders seek input and information from workers at the sharp end. Leaders work alongside their staff to ensure visibility on work variability is maintained. Feedback is given on performance to assess progress towards goals, and support is given to ensure goals are met (“But it's something that would normally be like cooperative planning and that sort of idea.”).

Performance recognition. Organisations implement reward and recognition programs that acknowledge workers who show high safety performance. Regular discussion of positive performance indicators (progress towards goals) is conducted within workgroups (“They have award for the best hazard identification card or somebody who has come up with a smart idea for approving safety. They have these kinds of reward systems as well to focus the workforce minds on safety.”).

Integration. Safety is integrated within production and quality processes in such a way that there is little distinction between them. Practices such as safe work methods statements combine task steps with safety requirements. Attempts are made to consider safety at the design phase of equipment manufacture and work design (“Yeah, I suppose to be safe in that sort of context, you're probably wanting to build safety into how you do your work processes. So rather than safety being a sort of separate add on process”).

Qualification. Attempts are made to invest in people so that they develop skills across multiple domains. Training in conducted to qualify and requalify staff, ensuring that multiple skills are kept fresh and sharp. There is a general reliance on the competency of workers to achieve group goals (“Stronger reliance on individual and team competency.”).

Preparation. Multidisciplinary planning practices are the norm. Work planning is conducted well ahead of the job being started. Scheduling and workload modelling are specific practices used to anticipate variability and intensity of work. Buffering is undertaken to horde resources so as to cope with heavy workloads (“Scheduling stuff, being more aware that okay it's going to get busier at the end of the year so we need to have more staff.”).

Energise

Consultation. Efforts are made to interact with workers at all levels and ask for their ideas and concerns around upcoming changes before implementation. Consultation is considered an important practice and routinely carried out prior to large-scale workplace changes. There is an emphasis on listening to workers’ concerns (“Like consulting with staff about new premises, and showing them plans and things, and saying "This is what we're doing." If there's any feedback obviously we can take it to whoever's designing”).

Local autonomy. Workers are permitted to make certain decisions themselves in the absence of a supervisor’s or manager’s direction. There is a tendency to defer to local expertise over rank or hierarchy. Workers are permitted to stop work if the situation is unsafe (“I think that there are organisations trying to promote autonomy, local autonomy, and they're starting to understand the importance of that.”).

Involvement. Workers actively participate in safety decision-making throughout the business. There is an emphasis on workers adopting responsibility for managing risks in the workplace. Workgroups engage in collaborative activities to anticipate and understand risks (“really working with a very high level of participation, clearly a level of participatory ergonomics has become part of the company and it’s well-integrated into the company.”).

Informed. Communication is two-way and regular between leaders and workers. Workers receive routine feedback on current changes and concerns they have raised. Regular meetings ensure that all workers are informed about business activities and safety initiatives (“Give them the opportunity to ask questions about stuff.”).

Safety vision and priority. Leaders articulate a company strategy and vision for safety, which are translated down into specific team goals and targets. Safety is given high priority and widely seen as an important work priority (“It's not seen as an onerous extra thing that businesses have to do. It's just part of good business and everyone believes in it and hasn't got a problem with it having the same priority as all the other things they've got to do.”).

Adapt

After action review. Following a safety incident or near-miss, work groups meet and discuss what went wrong and how to avoid the same mistake in the future. There is an emphasis on learning from negative events and making changes to the work system to prevent reoccurrence (“When there has something gone pear-shaped, they do a proper review on what it was and the focus is on preventing it from reoccurring.”).

Temporary structures. During emergency situations, temporary organisational structures ensure that activities are centrally coordinated, but locally executed (“Centralise coordination, but decentralise operations.”).

Emergency routines. Organisations possess well-rehearsed emergency routines that enable workers to respond quickly and effectively to emergencies. Resources are invested to conduct realistic simulations and regular emergency drills to keep workers alert and prepared (“They are focused on the emergency routines. They do have emergency provisions in place.”).

Incident investigation. Following a safety incident, thorough investigation practices uncover causes of incidents and system conditions that may have combined and contributed to the outcome (“They would typically use relatively sophisticated incident investigation tools and then also try to come up with a solution to that practise.”).

Sharing information. Attempts are made to share lessons learned with other parts of the business and with external parties. There is a focus on providing such information with the

expectation that it will be reciprocated, resulting in greater collective learning and improvement to safety (“They are trying to share lessons learned across installations, so that if the other installations have similar problems or challenges, they should implement the same measures, for instance.”).

Defend

Enforcement. Sanctions are used to hold people to account on agreed safety standards. Safety is included in performance reviews to formalise requirements. Non-compliance with safety standards is punished (“Very, very strong dos and don'ts and regulations and how you go about doing things in a safe manner.”).

Risk management. Workers employ practices to identify hazards, assess risk, implement controls, and verify the effectiveness of controls (“Putting measures in place to mitigate those hazards.”).

Monitoring performance. Workers’ performance is monitored closely through supervision and technological solutions such as GPS tracking. Performance is constantly checked against safety standards for compliance (“In environments where there is direct supervision of employees, then there is a fair amount of supervisory monitoring and control in that context.”).

Standardisation. Prescriptive action rules are put in place to ensure that variability is constrained. Work procedures standardise the steps involved in completing tasks (“They need to have really strict guidance and rules to manage the production.”).

Safety competence. Training and induction are used to raise the safety knowledge and overall competence of workers, in particular around safety standards and standardised ways of working. Such training is repeated to create automatic responses to safety-critical situations (“I think they train people to do this. I think they have also things that people can automatically do since they go through learning this many, many, many times, for example, in the military.”).

Cultural Beliefs

Leverage

Incremental improvement. Participants described cultural beliefs that centred around the importance on continuous improvement through taking small and measured risks (“Rather, you have to be more cautious and things need to be better. Possibly structured, monitored.”). Fitting with this theme, codes included a future-focussed element along with the belief that improvements in safety are likely to cross over into other areas of the business, such as quality and productivity.

Consideration. To achieve the objective of remaining informed, participants described supporting beliefs such as being open to and seeking out the ideas of others, regardless of hierarchical level, as well as a willingness to engage in collaborative decision-making (“There are companies where leaders are more inclined to include workers in their decisions and consult with them before making a decision”). Overall, there is a desire to consider workers’ views and stay informed about performance at the sharp end of operations.

Optimising feedback. Conjoint optimisation of safety was seen to rely on a feedback system that is open to the suggestions of workers at all levels of the organisation and consists of a closed loop that ensures improvements are actioned and the results fed back to the source(s) (“…would be a feedback system which we typically find in safety management system and that incorporates feedback from staff and collaborating with staff and taking staff feedback serious and then implementing consequences from the staff feedback”).

Energise

Workers-as-experts. According to the participants, control is achieved when workers at the sharp end are recognised as experts in their craft (“Particularly when they recognise that the experts are the ones that do the job every day”). Such expertise must

be tapped into through the belief that workers are valued sources of information (“People would think that the managers of the business actually think those people are important, want them to be more than just churning out stuff, and like it when they give their ideas and raise issues”).

Distributed power. In safe organisations, participants described a cultural belief of ‘giving away’ of ‘giving up’ power to workers (“But we're talking here about power. Ultimately, we're talking about power. Managers are not keen to give away power”). Instead of being seen as a threat or problem to control, workers are instead given power through support to have their opinions heard and ideas implemented.

Growth orientation. Supporting the change-focussed nature of the Energise control strategy, participants described cultural beliefs that concentrated on themes of flexibility, growth, and exploration. There was a common perception that safe organisations have a culture that supports invention and change (“understanding that what's been done until now might not be the thing to do in the future, that invention is good”).

Adapt

Chronic unease. Participants provided statements that were best summarised as ‘chronic unease’. This theme was supported by codes including a perpetual anxiety about things going wrong or safety incidents occurring (“I don't feel safe 100% of the time.”) and a consequent focus on ensuring contingencies are in place to deal with these anticipated negative events (“Look. That could happen to us and have we got things in place.”).

Learning. Under the Adapt control strategy, learning is proposed to underpin preventative changes to the work system to avoid future reoccurrence of incidents. This concept was apparent within the data, as participants described the importance of cultural beliefs that support reflection and learning (“Most important is to be open. To have an open attitude towards not being afraid of- not stigmatising when someone has done anything wrong, or some people or some crew.). The importance of respecting and

encouraging a diversity of views, maintaining an openness to others' ideas and suggestions, and being tolerant of mistakes were core aspects of this theme.

Self-critical. Accompanying the theme relating to learning was a theme around self-criticality. Participants indicated that safe and successful organisations continually strive to better themselves and are 'willing to admit that they don't know everything'. Such organisations are willing to turn their attention towards their internal processes and practices with the goal of questioning their efficacy ("They question themselves as an organisation more frequently.").

Defend

Accountability. There was some agreement among participants that the Defend control strategy is underpinned by a belief around accountability. Participants reported that this strategy is supported by aspects including not only setting agreed standards and expectations, but that all workers are aware of these and accept responsibility for their actions. There is a clear belief that people will be held accountable for their safety performance ("We pull people up at the line").

By the book. According to some participants, the Defend control strategy includes a cultural belief around there being a 'right way' to do things, and that there is a professional pride among workers in following this 'one' or 'correct' way. There was also an aspect in the data relating to the belief that following this right way of doing safety is likely to reduce risk ("I would expect to see a belief that actually obeying the rules and following policies and procedures would reduce that risk.").

Certainty. There was evidence of a cultural belief around a preference for certainty and reducing/removing ambiguity. Participants' statements included elements such as behavioural homogeneity ("That it's good that everyone behave in the same manner."), that certain types of work can be deconstructed into constituent components and understood ("I would say decomposed rather than deconstructed, but absolutely, and in

very literal ways.”), and that the future is predictable (“I think it's a belief that things are predictable.”).

LEAD Scale - Preliminary Item Pool

Listed below are a number of survey statements. Please review each one and provide feedback on clarity and simplicity. Please evaluate each item for its suitability across a range of industries and both medium and large business sizes. Rewrite any statements that you feel are unclear or difficult to understand. If you feel a statement is clear and understandable, please leave the feedback section blank.

After unsuccessful work, this organisation spends time reviewing what happened to improve how things are done.
Feedback:
When work doesn't go as planned this organisation takes the time to reflect to identify improvements.
Feedback:
After something goes wrong, this organisation brings people together to discuss what happened so similar situations can be prevented in the future.
Feedback:
During emergencies, this organisation creates a central point of communication and coordination to guide people's actions.
Feedback:
When emergencies happen, this organisation gives people direction but allows them to improvise as needed.
Feedback:
During emergencies, this organisation allows people to make necessary adjustments and changes within the boundaries of the response plan.
Feedback:
This organisation spends time practising a range of emergency situations so people are well-prepared.

Feedback:
In this organisation, we regularly take the time to rehearse different emergency situations.
Feedback:

This organisation has clear and realistic plans in place to help workers deal with emergencies.
Feedback:
This organisation thoroughly investigates safety incidents and near misses so specific causes are identified.
Feedback:
After a safety incident or near miss, considerable time is invested to understand what happened.
Feedback:
When a safety incident or near miss happens, this organisation investigates what happened so it knows how and why the situation occurred.
Feedback:
Lessons and learnings from safety incidents are shared widely across this organisation.
Feedback:
This organisation makes sure that information about safety incidents and near misses is communicated to everyone.
Feedback:
This organisation shares what it learns from safety incidents and near misses with everyone.
Feedback:

This organisation has safety rules that are enforced consistently.
Feedback:
Compliance with safety rules is enforced by leaders at this company.
Feedback:
Compliance with safety rules is part of how this organisation measures our work performance.
Feedback:
Prior to work starting, this organisation makes sure workers assess risks and put controls in place.
Feedback:
Risk management is an important work priority for everyone at this organisation.
Feedback:
After risks have been identified, people here verify that controls are in place and appropriate.
Feedback:
At this organisation, workers' safety performance is closely monitored and supervised.
Feedback:
Leaders at this organisation spend a lot of time closely watching how work is done to make sure it is safe.
Feedback:
Workers' performance is closely monitored to check it is in line with how work should be done.
Feedback:
This organisation has detailed standards and procedures that tell us how to do work safely.

Feedback:
Around here, there are thorough procedures for how things should be done safely.
Feedback:
This organisation spends time describing how work should be done so safety is maintained.
Feedback:
Training and onboarding for safety is an extensive process at this organisation.
Feedback:
This organisation invests a lot of resources teaching people about safety risks and how to manage them.
Feedback:
People here are trained so well in safety that the necessary skills are often automatic and well-learned.
Feedback:
Leaders at this organisation consult closely with workers at all levels to hear their safety ideas and concerns
Feedback:
At this organisation, leaders often visit places where work is done to consult directly with people about safety.
Feedback:
Leaders at this organisation act in ways that make it clear they value consultation with workers about safety matters.
Feedback:
Leaders here respect the safety expertise of workers who have been doing the job for a long time.
Feedback:

Experts in this organisation are given the freedom to make their own decisions about safety, regardless of their rank or seniority.
Feedback:
In this organisation, if you have expertise in a work area you are allowed to make your own decisions about how safety is done.
Feedback:
Workers at this organisation are involved in making decisions around how work is planned and done.
Feedback:
Leaders around here involve workers in major decisions and activities around safety.
Feedback:
Workers here are routinely encouraged to get involved in helping to understand safety requirements.
Feedback:
At this organisation there is a lot of two-way communication with leaders about safety.
Feedback:
Leaders here take the time to communicate safety messages and encourage people to ask questions or clarify.
Feedback:
Before the job starts, leaders at this organisation take time to have a conversation with workers about safety requirements and concerns.
Feedback:
Throughout work activities, there are times when teams come together to discuss safety problems or issues.
Feedback:

Leaders at this organisation encourage workers to plan together and collaborate during work activities so safety can be maintained.
Feedback:
As work happens, people routinely work together and support each other to talk through safety issues and challenges.
Feedback:
Leaders regularly reward or recognise workers who perform safely on the job (e.g., rewarding hazard identifications and control actions).
Feedback:
Workers here are given recognition by leaders when work is done safely and efficiently.
Feedback:
Workers here know when they have shown good safety performance because it is recognised and rewarded.
Feedback:
At this organisation, safety and work activities are integrated and not seen as separate parts of the job.
Feedback:
Around here, safety is just the way that work is done because it is a core part of all work procedures and activities.
Feedback:
Safety is not seen as a separate or add-on part of work activities at this organisation.
Feedback:
This organisation invests resources to make sure people are competent at their work and multi-skilled.
Feedback:

People's competence to perform work is checked at regular time periods (e.g., annually).
Feedback:
Workers are given training and experience to make sure they know how to perform many different tasks competently.
Feedback:
This organisation spends time planning how work will be done so hazards and inefficiencies are managed before the job starts.
Feedback:
At this organisation, we plan ahead and think about how our workload might create safety risks before we start a job.
Feedback:
This organisation tries to buffer against safety risks by putting extra resources in place in case they are needed.
Feedback:
You can never be too careful because a safety incident or accident could happen when you least expect it.
Feedback:
Incidents and accidents can happen to the safest workplaces, so it's best to be prepared for anything.
Feedback:
It is important to maintain a level of fear or anxiety that things could go wrong otherwise we might be unprepared for an incident.
Feedback:
People need to be open to different perspectives and ideas to learn effectively.
Feedback:

When people make mistakes, the focus should be on how we can learn and improve rather than blaming or shaming.
Feedback:
Different or unorthodox ways of thinking is a useful way to identify improvements to how things are done.
Feedback:
It is better that people question themselves and admit they don't know everything than to think everything is predictable and under control.
Feedback:
We can never rest easy because there is always something to learn and improve.
Feedback:
Being critical and questioning how things are done is an important quality to encourage.
Feedback:
People need to be clear about their role and the company's expectations to perform well.
Feedback:
It's important that people are pulled up on their performance when they cross the line.
Feedback:
Accepting your personal responsibilities and accountabilities will get you far.
Feedback:
There is a 'right way' and a 'wrong way' to do things in an organisation.
Feedback:
Following rules and standards is a useful way of staying out of trouble and reducing risk.

Feedback:
There is a sense of professional pride in doing things 'by the book'.
Feedback:
Work activities can be taken apart and broken into pieces so they can be fully understood.
Feedback:
Things are at their best when work is predictable, routine, and certain.
Feedback:
It's important that people think and behave in similar ways so that work is predictable.
Feedback:
People at the frontline are the reason why an organisation is successful.
Feedback:
People with influence in an organisation are the ones that do the work everyday.
Feedback:
It's important to respect and value the expertise of people who work in frontline operations.
Feedback:
Power and influence is something that should be shared and distributed across an organisation.
Feedback:
Organisations where leaders and workers have a similar level of influence are more effective than those with a strong hierarchy.
Feedback:

People shouldn't be afraid of giving away their power or influence to others with more expertise.
Feedback:
Without change and flexibility an organisation is likely to fail.
Feedback:
Growth is important for an organisation to survive and flourish.
Feedback:
Being open to growth means that an organisation is better equipped to handle threats and opportunities.
Feedback:
Investment in well thought-out safety improvements is likely to also result in better efficiency and quality.
Feedback:
It is wise to take small and measured risks when improving safety so unintended problems are avoided.
Feedback:
Thinking about the future and how to make small improvements makes an organisation more effective.
Feedback:
Considering a range of perspectives and viewpoints is essential for work to be done safely and efficiently.
Feedback:
Getting multiple people involved in planning usually results in more effective work on the job.
Feedback:

Considering people's viewpoints and involving them as much as possible leads to safer and more productive work.
Feedback:
It is critical that people are kept informed and in the loop when concerns or suggestions are raised.
Feedback:
Giving feedback on what people have raised as ideas or concerns is important to keep them engaged.
Feedback:
Listening to and valuing people makes sure the organisation's work is efficient and safe.
Feedback: