REDUCING WORKPLACE SAFETY INCIDENTS: BRIDGING THE GAP BETWEEN SAFETY CULTURE THEORY AND PRACTICE

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Keywords

Construction industry; mining industry; safety culture; safety climate; safety motivation; safety behaviour; safety performance; safety leaders; organisational culture; leadership; values; workplace incidents; stage of change; barriers; facilitators
Abstract

The aim of the current research program was to explore safety culture in one of Australia’s largest construction and mining companies, with a view to understanding how theory and practice can be integrated to improve safety culture and related outcomes within the construction and mining industry. The research undertaken within this PhD comprised three studies that explored safety culture in a large and diverse construction and mining company, investigated factors that influence the relationship between safety culture and safety behaviour, and examined differences in perceptions of safety culture across the organisation. Together, the research program has generated important insights into how safety culture is understood theoretically versus how it is applied in practice, and resulted in a number of recommendations that can guide the development of future safety culture interventions in the construction and mining industry.

Workplace safety incidents are a significant global issue, and in particular, the construction and mining industry is over-represented in workplace injury and death statistics. At the time this research program project commenced, the Australian construction industry recorded 40 fatalities in 2008–9, the highest number of fatalities across all industries (Safe Work Australia, 2010). The economic and social costs of workplace safety incidents have been tackled by industry and academia on several fronts in the past, including legislative and compliance-based responses, and a focus on engineering controls and management systems. Following several major disasters in the nuclear, oil, and mining sectors, safety culture has been identified as a critical concept for organisations in reducing workplace safety incidents. Whilst its importance is not questioned, the safety culture field remains fragmented on a number of conceptual and practical issues, to the extent that despite over thirty years of research, agreement has not been reached on a definition for the concept, an integrative theoretical model or the relationship between it and safety performance. It is in this context that the current research program was conducted.

The research program was informed by a review of safety culture and climate literature, and used a number of established theories and models from the organisational psychology discipline to develop a guiding theoretical framework. By
drawing on these established models, the research design had a strong foundation for application in a new context. The theoretical framework guiding the research incorporated concepts of safety culture, climate and safety behaviour and provided a comprehensive perspective on the role of safety culture and related outcomes in the construction and mining organisation.

Study One comprised theoretically driven exploratory research undertaken with a panel of experts (safety leaders) within the target organisation. A modified Delphi method, including qualitative interview data and quantitative survey data, was used to gain insight into 41 safety leaders’ perceptions and understandings of safety culture within the organisation. In-depth, semi-structured interviews were conducted, followed by a quantitative perception survey with the same sample. Participants included Senior Executives, Corporate Managers, Project Managers, Safety Managers and Site Supervisors. The study found that leaders’ definitions and descriptions of safety culture were primarily action-oriented and some confusion was evident due to the implicit nature of culture in organisations. Leadership was identified as a key factor for positive safety culture in the organisation, and there was an emphasis on leaders demonstrating commitment to safety, and being visible to the project-based workforce. Barriers to a positive safety culture were also identified, including challenges of managing a transient subcontractor workforce, pace of change, and reporting requirements. The survey data provided a quantitative confirmation of the key interview themes through a ranking process with the safety leaders. As such, the findings highlighted that safety culture is a complex construct, which is difficult to define, even for safety leaders with considerable experience and exposure in the organisation. Findings on the key factors indicated consistency with the current literature regarding the importance of management commitment to safety; however the perceptions of barriers to safety culture offered a new understanding as to how safety culture operates in practice.

Study Two was informed by the findings of Study One and the review of the existing literature. It involved a quantitative exploration of safety culture perceptions and related safety behaviour, with a cross-section of the organisation. The sample included 2,957 employees from various organisational levels and divisions. Analyses explored the relationship between safety climate, safety motivation, leadership, stage of change, and safety behaviours (compliance, participation and non-compliance).
Safety climate, safety motivation and leadership were all significant predictors of variance in safety behaviours, and safety motivation and supportive leadership were significant partial mediators of the climate–behaviour relationship. The results suggest that current focus on safety climate and safety motivation is warranted in safety culture research, and that these factors can explain a notable amount of variance in self-reported safety behaviours.

Group differences were also explored in this study by comparing organisational divisions and workforce levels on key measures. The results illustrate that frontline workers and supervisors are distinct from middle and senior managers in their perceptions of safety climate and personal safety motivation. Middle and senior management have higher perceptions of climate and report higher personal safety values. Additionally, the results suggest some differences in climate and motivation perceptions across different functional areas in the organisation. In contrast, the facilitators and barriers to safety culture were perceived similarly across the safety leader and workforce samples in Studies One and Two, which is an important leverage point for future safety interventions in the organisation.

Study Three was designed to further explore a key finding from Study Two relating to safety motivation. The importance of safety motivation in explaining safety behaviour was established in Study Two; however, the underlying mechanisms of motivation were not explained in the survey data. Semi-structured group interviews were conducted with 29 frontline workers and supervisors, to explore how safety values were internalised and transformed into safe behaviours. Motivation was examined through the framework of Valence–Instrumentality–Expectancy (VIE) theory (Vroom, 1964), which demonstrated utility in understanding the drivers of workers’ safe behaviour. Important organisational implications around reward systems and supervisory discretion were identified from the results. Findings indicate that workers do not always receive rewards that are valued when they meet safety performance expectations. Further, a consistent link between valued rewards and safety performance needs to be clearly articulated both at the organisational level and, critically, through the frontline supervisors. The results of this study indicate that the workers in this organisation understand the level of safety performance required of them, and they know what they are expected to do in order to meet those requirements. However, as long as the outcomes for safety
performance are not valued, or are inconsistent provided, or if outcomes for other performance metrics are more valued, or more consistently provided, the worker may experience conflicting motivations to perform safely.

Overall, this thesis presents findings from three studies investigating safety culture and related outcomes in a large and diverse construction and mining organisation. The findings from these studies highlight a number of theoretical and practical implications for safety culture theory and practice. The research program aimed to translate these research findings into applied recommendations for improving safety culture and related outcomes within the industry. The recommendations arising from the research addresses issues such as: the approach that needs to be taken in safety culture research within the industry; the importance of gaining a foundational understanding of safety culture meaning amongst leaders; the relevance of considering the barriers and facilitators to safety culture development and maintenance in order to contextualise safety culture findings; the significance of encouraging the internalisation of organisational safety values to personal safety motivation for employees; and the need to support supervisors around their safety leadership in order to realise improved safety outcomes for the individual, organisation and industry.
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<th>Definition</th>
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<tr>
<td>α</td>
<td>Alpha coefficient representing a measure of internal reliability across items in a measurement scale</td>
</tr>
<tr>
<td>ACSNI</td>
<td>Advisory Committee for Safety in Nuclear Installations</td>
</tr>
<tr>
<td>Adj $R^2$</td>
<td>Adjusted r-squared (estimate of the population value of r-squared)</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of variance</td>
</tr>
<tr>
<td>B</td>
<td>Regression coefficient</td>
</tr>
<tr>
<td>β</td>
<td>Beta (standardised regression coefficient)</td>
</tr>
<tr>
<td>BBS</td>
<td>Behavioural based safety</td>
</tr>
<tr>
<td>Δ$R^2$</td>
<td>R-squared change (unique contribution in model step)</td>
</tr>
<tr>
<td>DV</td>
<td>Dependent variable</td>
</tr>
<tr>
<td>HRO</td>
<td>High reliability organisation</td>
</tr>
<tr>
<td>HSE</td>
<td>Health and Safety Executive</td>
</tr>
<tr>
<td>IAEA</td>
<td>International Atomic Energy Agency</td>
</tr>
<tr>
<td>IV</td>
<td>Independent variable</td>
</tr>
<tr>
<td>M</td>
<td>Mean</td>
</tr>
<tr>
<td>N</td>
<td>Total sample for the study</td>
</tr>
<tr>
<td>n</td>
<td>Sub-sample for a specific analysis</td>
</tr>
<tr>
<td>OHS</td>
<td>Occupational Health and Safety</td>
</tr>
<tr>
<td>p</td>
<td>The value of p (or probability level)</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal protective equipment</td>
</tr>
<tr>
<td>r</td>
<td>Pearson product-moment correlation</td>
</tr>
<tr>
<td>SD</td>
<td>Standard deviation (from the mean)</td>
</tr>
<tr>
<td>$sr^2$</td>
<td>Squared semi-partial coefficient (unique contribution of predictor in model variance controlling for additional variables)</td>
</tr>
<tr>
<td>VIE</td>
<td>Valence–Instrumentality–Expectancy (motivation theory)</td>
</tr>
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### Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
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<tr>
<td>Incident</td>
<td>A workplace event resulting in injury or harm to an employee or member of the public, or damage to property (replaces the term ‘accident’ in older literature).</td>
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<tr>
<td>Safety behaviour</td>
<td>Behaviour that contributes to workplace safety and reduces the likelihood of incidents. For this research, safety behaviour is considered to be comprised of safety compliance and safety participation.</td>
</tr>
<tr>
<td>Safety climate</td>
<td>Workers’ perceptions of the value and importance of safety within the organisation, typically reflected in policies, procedures and practices.</td>
</tr>
<tr>
<td>Safety culture</td>
<td>Shared values and beliefs that interact with an organisation’s structures and control systems to produce behavioural norms around safety.</td>
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<tr>
<td>Safety leaders</td>
<td>Managers who identify safety as an important part of their role responsibilities.</td>
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<tr>
<td>Safety motivation</td>
<td>An individual’s willingness to expend effort to act safely as well as the value an individual places on being safe.</td>
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<tr>
<td>Senior management</td>
<td>For the current organisation, senior management was defined as consisting of the Managing Director and all divisional General Managers.</td>
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Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: QUT Verified Signature

Date: 3 February 2015
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Chapter 1: Introduction

This chapter provides an introduction to the thesis. First, a background to workplace safety is provided, including a brief overview of the safety culture concept and how it has been applied to reduce incidents. Next, the rationale and scope of the research program are presented, followed by the research aims and objectives. Finally, an outline of the thesis chapters is provided.

1.1 BACKGROUND TO WORKPLACE SAFETY

It is estimated that 640,700 persons suffer a work related injury each year in Australia (Australian Bureau of Statistics, 2010), and the economic cost of work related injuries in Australia is estimated to be approximately $60.6 billion each year (Safe Work Australia, 2013). In addition to the economic costs, work related injuries also have social and business impacts, such as loss of goodwill and business reputation, as well as considerable impact on the individual’s networks at work, at home, and in the broader community (Safe Work Australia, 2012a).

The economic and social costs of workplace incidents are being addressed by industry on several fronts. Legislating and enforcing minimum safety standards is important; however, this approach is not fully sufficient for facilitating the safety performance desired by many organisations. Many different approaches have been taken to improve workplace safety and reduce the number and severity of incidents. These approaches include legislative and policy responses, behaviour-based safety initiatives, and safety culture change programs. Increasingly, safety culture improvement approaches are being implemented by organisations across a variety of industries. This “third age” (Johnson, 2007) of safety research suggests that safety culture is now broadly acknowledged as a significant concept in workplace health and safety approaches. Significantly, despite over thirty years of research into safety culture, there is currently a lack of adequate models providing an integrated view of safety culture, climate, and related constructs, and more importantly, how to link such concepts with subsequent operational risk management and safety performance (Cooper, 2000; Guldenmund, 2000).
The safety culture field is home to a number of different disciplines, and remains conceptually fragmented and confused—to the extent that there remains no universally accepted definition (Zohar, 2010). Glendon (2003) describes the concept of safety culture as problematic, with definitions often blurred and inconsistently applied. Perhaps the most cited definition adopted considers safety culture “the product of individual and group values, attitudes, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation’s health and safety management” (Advisory Committee for Safety in Nuclear Installations [ACSNI], 1993). It is common for researchers to make their own adaptations to this definition, based on their theoretical position or industry context. In a review of safety culture theory and research between 1980 and 2000, Guldenmund (2000) cited at least 18 different definitions of the safety culture / safety climate construct, highlighting the fragmented nature of the field. Cooper (2000) suggested that the broadness of safety culture definitions to date has contributed to the inconsistent operationalisation of the concept, and a heavy reliance on safety climate as a surrogate measure for safety culture. Despite this, whichever definition is employed, scholars agree that safety culture is an important concept in modern approaches to improving safety performance outcomes (Guldenmund; Zohar, 2010).

Researchers of workplace culture tend to take one of two approaches: interpretive or functionalist (Glendon, Clarke & McKenna, 2006). Interpretive approaches view culture as an emergent property that is a complex outcome of all employees, not just senior managers, and that culture cannot be ‘engineered’ quickly, but evolves through organisational learning over time (e.g., Cox & Cheyne, 2000). In contrast, functionalist approaches view culture as something that can be deliberately manipulated by management to support corporate interests, and is largely top-down driven (e.g., Hopkins, 1995; Reason, 2000). Both approaches have considerable support in the literature, and many now take an integrated approach (Glendon & Stanton, 2000). For example, a functionalist approach to culture would be reflected in thorough risk management processes, whereas an interpretive approach may focus on developing a shared vision and identity for organisational members. Furthermore, some researchers view safety culture as a desired state which is rarely attained (absolutist position; e.g., Reason, 1997), whereas others view safety culture as a
continuum whereby organisations are placed according to the extent to which safety is a part of their core business and practices (relativist position; e.g., Hudson, 2007).

The current research program takes an integrated approach to examining safety culture, adopting both an interpretive understanding of safety culture as a relativist concept (i.e., all organisations have a safety culture, but differ in their maturity and effectiveness) and a functionalist view of culture change (i.e., that it is driven by the leaders of the organisation and can be deliberately improved through targeted interventions). This approach is aligned with the applied research context of this program, and reflects a balance of theoretical and practical perspectives in safety culture research and industry application.

Several models of safety culture have been proposed, and many of these will be discussed in Chapter 2 as part of the review of the literature. There have been more recent attempts to synthesise several models within the safety field (Guldenmund, 2000; Neal, Griffin & Hart, 2000; Zohar, 2010), however, it is still generally accepted that the field remains fragmented and misunderstood (Guldenmund, 2010). Whilst a large body of research has investigated the relationship between safety culture and performance in various forms, a criticism of the safety culture literature is that many models do not adequately articulate the relationship between dimensions of safety culture and safety performance or outcomes. In particular, it remains uncertain how such concepts interact to influence the risk of workplace incidents (Robson et al., 2007; Walker & Tait, 2004).

With regard to the content of safety culture, this research program takes an approach from organisational culture theorists (Guldenmund, 2000; Schein, 1992), where culture is described as having three distinct layers, namely, basic assumptions (core); espoused values (middle); and artefacts (outer layer). Each layer differs in its visibility to outsiders and its consciousness with members, with the outer layers being easier to identify and measure in research. Guldenmund suggests a causal pathway between the layers, using the more common terms of safety culture, safety climate and safety behaviour. This causal pathway considers the combination of individuals’ safety perceptions (safety climate) a consequence of the basic assumptions of the organisation’s members (safety culture). The evaluative responses to the safety climate are then revealed in the organisation’s artefacts. A more in-depth discussion of organisational culture and safety culture models is provided in
the review of the literature in Chapter 2. The middle layer of this cultural model, espoused values, is predominantly where researchers operate, as these values are relatively explicit and conscious (Guldenmund), and can be measured using common research techniques such as self-administered questionnaires.

Safety climate is often confused with safety culture, as they are somewhat different though related concepts. Safety culture is the shared values and beliefs that interact with an organisation’s structures and control systems to produce behavioural norms. Whereas safety climate refers to the workers’ perceptions of the value and importance of safety within the organisation, typically reflected in policies, procedures and practices (Huang et al., 2013). Further discussion of safety culture and climate definitions is provided in Chapter 2.

The measurement of espoused values or attitudes towards safety has been conducted under the umbrella term of ‘safety climate’. The distinction between safety culture and safety climate has been discussed extensively in the literature, where safety climate has been viewed as an antecedent, an element or a manifestation of safety culture (Guldenmund, 2007). There is also disagreement on whether safety climate is an individual or organisational concept (Cooper, 2000; Dedobbeleer & Beland, 1991). That is, whether the safety climate is embodied in individual perceptions of safety, or only exists as a shared perception at the group or organisational level. The view adopted on this issue has important implications for construct measurement and interpretation. There is general agreement, however, that safety climate is a measure of perceptions about safety, and safety climate questionnaires are common in both academic and industry literature (Guldenmund; Hahn & Murphy, 2008). It is argued that these distinctions are largely a result of operationalisation, and research on both concepts is relevant to the broader understanding of safety culture (Dingsdag, Biggs & Sheahan, 2008; Guldenmund).

In addition to culture and climate distinctions, the factors that comprise safety climate are also frequently debated in the literature. Early empirical research on safety culture and climate focused on exploring its multi-dimensional nature (Brown & Holmes, 1986; Dedobbeleer & Beland, 1991; Zohar, 1980). In one of the earliest studies on safety climate, Zohar (1980) proposed an eight-factor model, which was later tested and refined to a three-factor model (Brown & Holmes, 1986). Interestingly, of those reviewed by Guldenmund (2000), the majority of studies were
exploratory, and those that were confirmatory did not support previous factor structures, further highlighting the disparity in safety climate descriptions. In a study with construction workers, two factors were found to provide the best fit: management’s commitment to safety, and worker’s involvement in safety (Dedobbeleer & Beland). Later studies on the role of safety leadership and management corroborate this result (Biggs, Sheahan & Dingsdag, 2005; Dingsdag, Biggs & Sheahan, 2008; Flin, Mearns, O’Connor, & Bryden, 2000; Zohar, 2010).

Whilst the academic literature has struggled to define, describe and measure safety culture, high-risk industries have been applying the safety culture concept to their safety practices for decades (Cox & Cheyne, 2000; International Atomic Energy Agency [IAEA], 1991). In Australia, the mining industry has adopted safety culture assessment tools and programs (Minerals Council of Australia, 1999), and more recently considerable work has been undertaken in the construction industry (Dingsdag, Biggs, Sheahan & Cipolla, 2006; Glendon & Litherland, 2001; Mohammed, 2002) and in the road safety field (Banks, Davey & Brownlow, 2006; Wills, Watson & Biggs, 2009). Safety culture is increasingly recognised as a useful concept for understanding and manipulating the processes through which organisational leaders influence frontline workers (Dingsdag et al., 2008).

From an industry perspective, questions remain regarding the gap between the operationalisation of the elements of safety culture and their link to safety outcomes, particularly at different levels within an organisation. Rather, the research literature has been occupied with reviews, meta-reviews, rebuttals and criticisms that have ranged from developing the most accurate definitions of such constructs as to how best to measure them (Glendon & Stanton, 2000; Zohar, 2010). In fact, it is argued that research efforts have historically remained preoccupied with ambiguous debates regarding conceptual distinctions and factor dimensions, rather than on more industry-relevant outcomes such as building integrative frameworks using multi-method approaches to understand the depth of culture and performance pathways, and to facilitate safety culture and climate research informing industry practices. There is a need to conduct further empirical research in this area, including the effective application of cultural theories to enhance industry safety performance.

Given the above, the field is being increasingly directed towards developing theoretical models to outline how safety culture is embedded as a whole within an
organisation’s practices, system structure and employee behaviours (Guldenmund, 2000, 2010). However, there remains specifically the need to integrate theory and practice, highlight organisational level differences, map the relationship between safety climate and safety behaviour, and translate research into applied solutions relevant to large organisations in the construction industry. Understanding the underlying mechanisms for safety culture perceptions and drivers for safety behaviour is critical to effecting change at the workforce frontline.

1.2 RATIONALE AND SCOPE OF THE RESEARCH

As outlined above, despite the considerable research over the last 30 years, the safety culture field remains fragmented and misunderstood. Whilst academia continues to debate theoretical issues such as the distinction between safety culture and climate, industry is developing and implementing safety culture change programs without solid theoretical or empirical foundation. This gap between theory and practice needs to be closed through empirical, applied research aimed at improving safety outcomes in industry.

The proposed research will address a number of significant deficits in safety culture research to date. Specifically, the research was undertaken with a large and complex international construction and mining organisation, with considerable influence in the Australasian industry. As discussed further in Chapter 3, the organisation operates as a primary and secondary contractor and is involved in many project alliances with other companies. The organisation belongs to a larger parent company and is viewed as a leader within the industry (see de Valence, 2014 for a compelling discussion on the influence and impact of the organisation and parent organisation within the construction and related industries). A mixed methods approach was adopted for the research program, benefiting from the richness of qualitative data and the breadth of perceptions reached in the quantitative survey. A strong theoretical framework, inclusive of safety culture, climate, outcomes and other predictive factors contributing to this relationship, also guided the research (see Chapter 3). This theoretical framework was balanced by the inclusion of industry-specific views on culture, as experienced by the organisation’s employees and managers. The conclusions of this research program contribute a unique perspective to both the academic literature on safety culture and industry practices.
It is important to recognise here the demarcation of scope for the research program. Whilst the ultimate aim of the research is to provide recommendations for the improvement of safety culture and related outcomes, the program does not include the specific development or implementation of a safety culture intervention. The goals of the research program are to explore safety culture as it manifested in this organisation, and empirically investigate the relationship between safety culture and safety performance, with a view to identifying mediating factors that can be the focus of future interventions in a holistic plan for workplace safety improvement. This approach is necessary for targeted and effective intervention efforts.

Also out of scope for the current research program is the formal testing of safety culture models or theories. The safety culture literature is replete with many definitions, models and frameworks that have been or are continuing to be tested in an empirical fashion. This research utilises a consolidated theoretical framework to inform the research design and methodology, rather than test the utility of any individual theory. A combination of safety culture models, safety climate and behaviour frameworks, and employee motivation and performance theories inform the research program.

Finally, the research program was restricted to one time-point for quantitative data collection, meaning the design of Study Two was cross-sectional in nature. Whilst this does limit the ability to determine causality between variables of interest, cross-sectional designs dominate the safety culture literature (Zohar, 2010), and can be very useful for examining the key variable of interest. Conducting an organisational-wide survey is a challenging process in a large, complex organisation, and conducting a follow up survey was considered by the industry partner to be too onerous on business operations.

1.3 RESEARCH AIM AND OBJECTIVES

The aim of this research program is to explore safety culture in a large Australasian construction and mining company, with a view to understanding how safety culture theory and practice can be integrated to improve safety outcomes within the industry.

The objectives of the research program are to:
1. Gain insight into how safety culture is understood in theory versus how it is applied in practice

2. Explore workforce differences in perceptions of safety culture across the organisation

3. Examine the relationship between safety culture and safety behaviour, and investigate additional factors that influence this relationship

4. Translate research findings into applied recommendations for improving safety culture and related outcomes within the industry.

The research program met these objectives through three empirical studies. Each study addresses one or more objectives, with specific research questions proposed in Chapter 2 after a review of the literature.

1.4 THESIS OUTLINE

This thesis has been structured around the three studies undertaken to address the research aim and objectives. The research design was based on an underlying theoretical framework derived from the research literature.

Chapter 2 reviews the literature relating to workplace safety incidents in the construction industry and cultural approaches to workplace safety. Theoretical models of safety culture and related constructs are reviewed, as well as the relationship between safety culture and safety performance. The chapter concludes with the key research questions for this program of research that were identified based on gaps and opportunities in the reviewed literature.

Chapter 3 describes the theoretical framework that guided the research program, and the subsequent research design to address current gaps in safety culture research. The methodology for each study is briefly described, as it relates to the overall research design. Also included are the benefits of applied research in this research context.

Chapter 4 describes Study One, which involved semi-structured interviews with organisational safety leaders. The study aimed to provide a foundation for the program of research by obtaining an in-depth understanding of how safety culture was understood by those in the organisation. An earlier version of Chapter 3 was published as a peer-reviewed article: Biggs, Banks, Davey and Freeman (2013)
“Safety leaders’ perceptions of safety culture in a large Australasian construction organisation”, *Safety Science*, 52, 3–12 (Note. Biggs is the maiden name of Sarah Jebb). The findings from this study partly informed the direction of investigation in Study Two.

Chapter 5 describes Study Two, which involved a quantitative survey of worker perceptions with a large cross-section of the organisation. The study utilised a safety climate – safety behaviour model to measure perceptions of how safety was valued in the organisation, how motivated workers were to behave safely, and a number of self-report measures of safety behaviour. The survey also measured related constructs around leadership and stages of change, as well as offering confirmatory findings around the factors and barriers to safety culture that were identified in Study One. Some findings from this study were published in the peer-reviewed proceedings of the international Occupational Safety in Transport (OSIT) conference, Gold Coast, September 2013: Biggs and Banks (2013) “A comparison of safety climate and safety outcomes between construction and resource functions in a large case study organisation”.

Chapter 6 describes Study Three, which further explored the influences on safety motivation from the perspective of frontline workers and supervisors. Semi-structured group interviews were conducted across three organisational project sites and utilised an established work motivation theory to understand what motivated workers to behave safely on the job, and what rewards and outcomes were in place for good safety performance versus other types of work performance.

Chapter 7 concludes the thesis by synthesising the results from the three studies and discussing them in terms of the key research questions and broader objectives. Implications of the findings for theory, research and practice are discussed. Recommendations for future research are offered in light of the strengths and limitations of the research, and recommendations for industry applications are presented.

1.5 CHAPTER SUMMARY

This chapter has briefly presented the background to the research problem, current approaches to the problem and a rationale for the current research program. Workplace safety incidents continue to be a concern for organisations and the
community more generally, and understanding the cultural aspects of safety is critical for improving safety behaviour and safety outcomes at the individual, organisational and industry levels. The current research program aims to explore safety culture in one of Australia’s largest construction and mining companies, with a view to understanding how safety culture theory and practice can be integrated to improve safety culture and related outcomes within the industry.

The following chapter describes the literature that led to the research aims and questions for this program of research. Theoretical understandings of safety culture and related constructs are reviewed, as well as current frameworks and approaches to measuring the relationship between safety culture and performance outcomes. The chapter also outlines the specific research questions designed to address gaps in the existing literature, which the remaining chapters will address by describing the studies and research findings from the program of research.
Chapter 2: Literature Review

This chapter reviews the literature relevant to the research program. First, a background to the review is provided, including its context for the research objectives, and an overview of the scope and search methodology. Next, the extent of workplace safety incidents and current approaches to workplace safety are described. The current understanding of safety culture is presented, including origins and definitions of organisational safety culture, followed by a review of the safety culture and safety climate debate, and a summary of the common models of safety culture and climate. The review then explores the evidence for differences in perceptions of safety culture, followed by an analysis of the relationship between safety culture and safety performance and the factors that influence this relationship. Following this review, the research questions for this program of research are presented as they relate to the previously identified gaps in knowledge.

2.1 BACKGROUND

The following literature review contributes to the research program by providing necessary background to understanding the theoretical history and current context of safety culture theory and research. The review directly contributes to the first research objective of gaining insight into how safety culture is understood in theory, including differences in perceptions of safety culture and the factors that influence the relationship between safety culture and safety behaviour. This will later be contrasted to how safety culture is understood and applied in practice in the organisation investigated.

The literature review is not intended to be a systematic literature review or meta-analysis, but instead is designed to provide the reader with relevant background through a synthesis of the current research literature relating to the program of research. The available literature on workplace safety and safety culture is vast and quite diverse; thus the review presents only the most pertinent information in the context of the current research.

In terms of the review method, literature searches were conducted using research domain-appropriate electronic databases, including ScienceDirect,
PsycINFO, and EBSCO. Keywords in the literature searches included combinations of the following: safe* culture; safe* climate; safe* behaviour; workplace safety; and workplace injuries/incidents/accidents. In addition, manual searches were conducted of well-known occupational-safety and organisational psychology journals including, Safety Science, Journal of Safety Research, Journal of Applied Psychology and Accident Analysis and Prevention. Cited-reference searches on seminal studies and reference list searches on recent studies provided additional relevant papers for the review. Grey literature was not included in the literature searches, with the exception of influential research reports that have been subsequently cited in the academic literature.

2.2 WORKPLACE SAFETY INCIDENTS

Workplace safety incidents are a significant global issue and both industry and academia are constantly searching for preventative strategies. This section describes the size and nature of the issue, and begins with an overview of workplace incident statistics. Then, construction and mining industry statistics are presented and the unique nature of the construction industry discussed. Legislative and policy approaches to workplace safety are briefly examined, followed by an overview of industry approaches to the same.

2.2.1 Workplace incident statistics

Workplace incidents are recognised as a significant issue across the globe. The International Labor Organisation (ILO, 2013) reports that 321,000 people are fatally injured every year due to work-related incidents. For example, there were 172 workers fatally injured in the United Kingdom in 2011/12, equivalent to a rate of 0.6 fatalities per 100,000 workers (Health and Safety Executive [HSE], 2013). In addition, a further 233,000 reportable injuries occurred, a rate of 840 per 100,000 workers. In the United States, the Occupational Safety and Health Administration (OSHA, 2013) reports that 4,609 workers died on the job in 2011, and approximately 3 million further workers suffered a non-fatal occupational injury.

In Australia, the most recent statistics estimate that 640,700 persons suffer a work-related injury each year (Australian Bureau of Statistics, 2010). In addition to those suffering injuries in the 12 months from July 2010 to June 2011, a further 374 people were fatally injured as a result of work-related activities in Australia (Safe
Work Australia, 2013). These fatalities comprise those who were directly involved in carrying out work-related activity (220), those that were killed commuting to or from their workplace (110), and bystanders (44) who were fatally injured as a result of others carrying out work-related activities. The economic cost of work-related injuries in Australia is estimated to be approximately $60.63 billion each year, representing 4.8 per cent of gross domestic product (GDP; Safe Work Australia, 2013). Economic costs do not adequately represent the impact of work-related injuries; there are additional intangible costs to the organisation, for example, business reputation, as well as the effect on an individual’s work-mates, family and community.

2.2.2 Construction industry incidents

The most recent data on global construction fatalities suggests that at least 60,000 fatal incidents occur each year at construction sites worldwide, equivalent to one death every ten minutes (ILO, 2005). Furthermore, one out of every six fatal workplace incidents take place at a construction site, and this rate is increased in industrialised countries, where construction site fatalities account for 25–40% of all workplace fatalities. In the UK, the construction and agriculture industries had the highest rate of fatalities in the 2011–12 financial year, consistent with previous years, with 42 workers dying on the job in the construction industry (HSE, 2013). The rate of major non-fatal injuries was 172 per 100,000 employees. In the US, 798 construction and mining industry workers died in 2011, making it the most dangerous industry after the transportation industry. In addition, over 244,000 non-fatal incidents affected construction industry workers in the US in 2008 (Bureau of Labor Statistics, 2013).

In Australia, the construction industry is similarly over-represented in the occupational injury and death statistics. At the time of project commencement, the most recent data indicated that there were 40 fatalities recorded for 2008–09, which was the highest number of fatalities of all industries. This corresponds to a fatality rate of 5.9 fatalities per 100,000 employees in 2008–09, which was more than twice the rate of 2.3 for all industries (Safe Work Australia, 2010). Since then, the construction industry has recorded a reduction in fatalities, with 3.77 deaths per 100,000 workers in 2010–11, the lowest rate in the eight years of fatality reporting for this industry (Safe Work Australia, 2012a). During the 2010-11 financial year, the
mining industry also recorded its lowest fatality rate since 2002 with 3.41 deaths per 100,000 workers. While the seven fatalities in the 2010–11 financial year is similar to previous years, the industry has experienced over 100% growth in employment over the last eight years (Safe Work Australia, 2012a). Despite this decrease in fatalities in both industries in the last few years, both construction and mining remain hazardous industries for workers. In particular, the construction industry consistently accounts for a high proportion of fatalities compared to all industries, with the latest Safe Work Australia statistics putting it third, behind transport and agriculture industries.

2.2.3 Nature of the construction industry

Whilst the specific causes of workplace incidents in the construction industry vary, the nature of the work environment is an important factor in workplace safety incidents (Misnan & Mohammed, 2007). Construction industry workers are exposed to significant hazards and risks as part of their everyday work—such as working at height, working around mobile plant and live traffic, working with underground and above ground services. Many of these risks are well-identified and managed through project risk procedures. However, the reality of construction work is that these hazards are present in a dynamic and diverse environment where each job presents a unique combination of situation, person and task risk factors.

Construction work is project-based, with works lasting anywhere from a week to a few years, making the establishment and maintenance of work group identities difficult. The type of work is also varied, with construction work including commercial and residential buildings, roads and motorways, tunnels and bridges, railway lines, electrical, gas and water services, and work in open-cut mines. In addition, the construction industry operates in a contractor environment, where primary project contractors regularly employ subcontractors, often contributing up to 90% of the workforce on any given project (Biggs, Sheahan & Dingsdag, 2005). The high proportion of subcontractors means that the majority of the workforce is highly transient, with regular movement between construction companies, projects, and sites.

The transiency of the subcontractor workforce adds to the already dynamic work environment, and increases workers’ exposure to risk as they are required to work on different job tasks and with different work teams in changing project
environments (Hoffmeister et al., 2014). Taken together, it is clear that although the hazards may seem simple to identify, managing safety on a construction project is not a simple task, and the complexity of the work type and workforce presents a challenge to safety professionals and management. Specific workforce issues include: remote management difficulties (Biggs et al., 2005) contract versus traditional employment (McKeown & Hanley, 2009); engagement issues in the contracting workforce (Bayer, 2013), and working time variations (Townsend, Lingard, Bradley & Brown, 2012).

### 2.2.4 Legislative and policy responses to workplace safety incidents

The traditional response to workplace safety incidents has been to legislate minimum safety requirements for workplaces, and provide supporting guidelines and standards to facilitate compliance. In the UK, the Health and Safety Executive is the national independent overseer for work-related health, safety and illness and acts as an independent regulator to reduce work-related death and serious injury in workplaces (HSE, 2011). The HSE stipulates a number of regulations and standards in relation to health and safety and enforces these through inspections, investigations, penalties and prosecutions. They also provide a large amount of guidance material and resources for businesses in various industries, including the construction industry. Furthermore, the HSE is part of the UK Construction Industry Advisory Committee (CONIAC) that includes industry stakeholder membership, and currently has a number of campaigns relating to improving health and safety within the construction sector.

Similarly, in the US the Occupational Safety and Health Administration (OSHA) is the Federal agency that enforces health and safety laws (covered under the Occupation Health and Safety Act of 1970). OSHA provides a number of health and safety regulations and standards for industry generally, and also specific standards for the construction industry. The safety and health provisions for construction outline requirements for safety training, incident reporting, housekeeping, and for specific health and environmental controls. Enforcement of these regulations is undertaken through inspections and referral to the Department of Justice for criminal prosecutions.

In the European Union (EU), a number of directives are in place to ensure minimum standards in health and safety. Some of the recently introduced directives
specifically apply to construction sites. In a recent review, Martinez Aires, Gamez and Gibb (2010) examined the impact of these directives on construction industry incident rates. EU Directive 92/57/EEC sets out minimum safety and health requirements at temporary or mobile work sites, including the requirement to appoint safety coordinators, and the inclusion of safety and health plans and procedures during project preparation and execution stages. The Directive also stresses worker consultation and participation throughout the project stages. Martinez Aires et al.’s (2010) analysis included 15 European countries, and overall found that ten countries experienced a moderately lower workplace accident rate (around 10%) after the Directive’s enforcement. This highlights that whilst legislation has an important role in injury reduction; legislation may have a limited influence on some, and there may be many other contributing factors to workplace safety incidents, such as safety culture.

In Australia, the individual States and Territories legislate development and enforcement and govern workplace health and safety. State and Territory based safety authorities such as New South Wales’ WorkCover, Victoria’s WorkSafe and Workplace Health and Safety Queensland, provide health and safety standards and enforce these through inspections, investigations and prosecutions in association with relevant State courts. Recent attempts at harmonisation of legislation has resulted in the Commonwealth Work Health and Safety Act 2011, which is an overarching model to guide each State’s enactment of relevant state legislation (Safe Work Australia, 2013). In addition, the Australian Work Health and Safety Strategy 2012-2022 (Safe Work Australia, 2012b), identifies targets for improving health and safety across the country. Within the OHS strategy, the construction industry has been identified as a national priority for prevention activities.

Despite these national and international legislative efforts to enforce safety practices, there are concerns that compliance and deterrence based approaches to safety will not yield the desired safety outcomes (Haupt, 2003). Legislative approaches have been criticised as encouraging company executives to focus on ‘box-ticking’ and meeting minimum standards, rather than developing essential attitudes and behaviours that support good safety practices. Despite some improvements in recent years, the construction industry safety record highlights the limitations of a purely compliance-based approach (Hallowell, 2010). It is now
recognised that significant safety improvements may only be achieved by acknowledging the role of cultural factors such as organisational values, management attitudes to safety and workforce involvement in safety initiatives (Biggs, Sheahan & Dingsdag, 2005).

2.2.5 Industry approaches to workplace safety

Industry’s response to workplace safety incidents has naturally matured over time, and various programs purporting to improve safety culture are now reasonably common in large organisations. There are three major approaches to safety improvement in organisations: safety management systems (SMSs); behaviour based safety (BBS) approaches; and safety culture change programs. These approaches are not mutually exclusive, and in fact some argue that the most effective approach is to use a combination of all three (DeJoy, 2005). A brief overview of these approaches follows to provide a background to practical approaches to safety management applied in industry.

Safety management systems

The development of SMSs has been a large focus for organisations attempting to improve their safety performance. SMSs are structured processes for managing safety risk, often incorporated into electronic business systems. Guldenmund (2010) points to the need to integrate the current academic, analytical and pragmatic approaches and suggests that developments of safety management systems will provide a future focus and framework for people to give meaning and direction to their safety actions.

In particular, high risk industries understand the importance of effective systems to manage risk. The literature has examined the approaches of many such industries, and refers to them as High Reliability Organisations (HROs). HROs are defined by the hazardous conditions they operate within, whereby adverse events are rare, but have serious implications both for individuals and the organisation (Reason, 2000). Examples include nuclear power plants, air traffic control centres and military organisations. In particular, HROs are reported to meticulously report incidents, accidents and ‘near misses’ and encourage the view of ‘failures’ as learning opportunities. HROs are often cited as examples of organisations with effective safety culture (GAIN, 2004; Hudson, 2003; Reason, 2000; Weick, Sutcliffe &
Obstfeld, 1999). In an analysis of HROs, Weick et al. (1999) suggest that their effectiveness can be attributed to the creation of collective mindfulness, essentially keeping safety ‘top of mind’ by being wary of potential failures and structuring groups and systems to be resilient and flexible to hazards.

**Behaviour based safety**

Behaviour based approaches to safety had considerable popularity with industry until recently, largely due to the well-known DuPont program, ‘STOP’ (Safety Training Observation Program; DuPont, 1991). The behaviour based safety (BBS) approach relies on a concept known as cognitive dissonance, which describes a state of psychological tension in individuals, produced by simultaneously having two opposing cognitions (Vaughan & Hogg, 2011). This tension is thought to be quite uncomfortable and people are motivated to reduce it by changing or rejecting one of the cognitions. To give an example, a person might have two thoughts about safety procedures that do not align: 1. Safety procedures are important to keep me safe at work; versus, 2. Safety procedures are time-consuming and boring. In order to reduce cognitive dissonance, one of these thoughts will be rejected or changed to be more in line with the other. This makes taking an action much easier as the behaviour can follow from the attitude. BBS approaches have well-defined steps, including: defining the desired behaviour; setting performance goals for the behaviour; providing feedback and/or reinforcement when goals are met; and finally tracking individual and team results over time and publically displaying results for motivation (Dejoy, 2005).

In traditional attitude–behaviour models such as the Theory of Reasoned Action (TRA; Fishbein & Ajzen, 1975) and the Theory of Planned Behaviour (TPB; Ajzen, 1985), attitudes precede behaviours through behavioural intention. However, the BBS approach shortcuts this and attempts to influence behaviours first, and hopes that through cognitive dissonance, attitudes will change to be aligned with the dominant behaviours.

Critics of BBS highlight a number of weaknesses with the approach. First, it is considerably resource intensive. The approach relies on structured observations of behaviour by people who have been trained in the required process. Observations are also required on a regular basis, to ensure optimal behaviour from employees. Second, due to the ongoing monitoring required, the sustainability of a BBS
approach in a business environment is questionable. It may be effective for short-term changes in individual behaviour, but it does not address broader elements of long-term change, including the supporting systems and management structure (DeJoy, 2005). Third, there is a risk that focusing on ‘safe behaviours’ may underestimate the importance of unsafe behaviours, thus producing a ‘blind-spot’ for behaviours that are most likely to increase exposure to risk (Hopkins, 2006b). An example of this might be observation protocol emphasising the wearing of personal protective equipment (PPE) whilst underemphasising principles of separation between people and plant. In this scenario, the protocol ‘loses the forest for the trees’ in that the greatest safety risk (people being near large machinery) has not received as much attention as a lower risk control (PPE). Fourth, behaviour-based safety approaches usually focus on frontline workers, rather than at management level. In fact, management often take on the observer role. This is counter to the advice from safety culture research—that managers have an enormous influence on the attitudes and behaviours of workers, and a supportive manager is more effective than a behavioural monitor (Cooper, 2000). It also encourages a focus on the last line of defence in incident trajectories (i.e., an individuals’ risk exposure during a specific job task), which is often insufficient in preventing organisational incidents as it does not address the potential impact of latent conditions (Reason, 1997).

**Safety culture change programs**

Safety culture programs are the latest trend in industry approaches to safety management (Guldenmund, 2010). In contrast to BBS approaches, safety culture approaches focus on articulating safety values with a top-down approach involving organisational leaders in the first instance. Rather than focusing on individual behaviours specifically, safety culture aims to create a self-sustaining environment based on a comprehensive understanding of the causes of workplace safety performance or lack thereof (Dejoy, 2005). The concept of safety culture is of great interest to modern researchers, to the extent that well-known journals including *Work and Stress* (Cox & Flin, 1998) and *Safety Science* (Hale, 2000) have published exclusively themed issues on the topic.

In Australia, the mining industry has adopted safety culture assessment tools and programs in pursuit of their goal to achieve an “industry free of fatalities, injuries and disease” (Minerals Council of Australia, 1999, p.11). More recently,
considerable work has been undertaken in the road safety field (Wills, Watson & Biggs, 2006; 2009) and the construction industry (Dingsdag, Biggs & Sheahan, 2008; Glendon & Litherland, 2001; Mohammed, 2002) regarding cultural approaches to safety. Traditionally, the construction industry has been focused on lag indicators such as incident statistics and worker’s compensation claims (Mohamed, 2002). However, there is an increasing recognition within the Australian construction industry that safety culture is useful for understanding how organisational leaders influence frontline workers through their behaviour and actions (Dingsdag, Biggs & Sheahan, 2008). For example, the identification of key competencies for critical safety leadership positions has highlighted the importance of safety accountability in positive safety cultures in construction (Biggs et al., 2005). Additionally, it is posited that leadership style affects the level of concern for subordinate safety (Zohar, 2002), and that supervisory safety practices predict safety climate level and strength as moderated by leadership quality (Zohar & Luria, 2004).

Whilst it is widely recognised that safety culture develops over a long time, and in a complex manner, this is often not considered in the development of change programs (Guldenmund, 2010). Interventions aimed at changing or improving safety culture are often taken off the shelf from consulting companies with the expectation that they will have radical impact on safety performance metrics—without taking into account the time and continuous effort needed to make a change, and to maintain it over time through natural organisational development.

As Haupt (2003) suggests, an organisation’s readiness for change is dependent in part upon the degree to which the change differs from the existing dominant culture. In the case of attempted safety culture change, any culture which does not include safety as a core value is likely to struggle with adopting and integrating a new cultural framework. Furthermore, whilst the translatability of safety culture tools across industries is common but questionable (Zohar, 2010), the unique nature of the construction industry requires a customised and targeted approach to safety management and safety culture programs such as has been developed in the transportation industry for commercial truck drivers as solo operators (Huang et al., 2012). The dynamic workforce, diversity of projects and variation of risk exposure for workers means cultural change is a difficult and complex process in the industry. Effective safety management systems are not sufficient to prevent workplace safety
incidents, and the cultural markers of safety need to be clearly identified and understood to ensure organisational learning and improvement.

2.3 SAFETY CULTURE ORIGINS AND DEFINITIONS

This section discusses the organisational culture and climate constructs as relevant to the current state of safety culture research; the origin of safety culture as an accepted term in the safety field; and the definitional difficulties that continue to plague the growing safety culture literature.

2.3.1 Organisational culture and climate

Whilst the origins of safety culture are often considered from an industry perspective, conceptually its foundations are in the organisational culture paradigm, and safety culture is still viewed by many as a component of an organisation’s broader culture (Guldenmund, 2010). ‘Culture’ was a term originally associated with nationalities rather than organisations. National culture expresses shared beliefs, behaviours and social norms, as developed within a specifically defined population (Hofstede, 1991). It was not until the late 1970s and 1980s that culture was considered a valuable construct to understand the complex nature of an organisation. Similar to nations, organisations have their own history, shared learning and leadership, which shape members’ attitudes and behaviours (Schein, 1992). Organisational culture is a multidimensional construct that provides organisational members with a frame of reference for behaviours and practices within the organisation (Guldenmund, 2000).

Organisational culture is understood to develop over time, but once formed it remains relatively stable throughout an organisation’s existence. However, culture is also viewed as dynamic, and susceptible to change (Parker, Lawrie & Hudson, 2006). In fact, safety culture change programs aim to deliberately influence organisational culture. This apparent paradox is reflective of the interpretative and functionalist perspectives adopted in this field (see Chapter 1 for further information on these perspectives), and further muddies the waters in relation to both theoretical conceptualisations and practical measurement of organisational culture.

Schein (1992, p12) defines organisational culture as “a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and,
therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems.” This view highlights the functional nature of organisational culture and the reciprocal interplay between organisational members and their environment. Schein also emphasises the indoctrination of new members into the accepted normative framework for the organisation. This stability, over time and membership change, is one of several characteristics of organisation culture identified by Guldenmund (2000), who also proposes that culture can be characterised by its holistic and integrative qualities, suggesting that in this case, the whole is more than the sum of its parts. Guldenmund argues that organisational culture is a complex construct which is further complicated by the variety of ways it is revealed in organisational practices.

Schein’s (1992) model of organisational culture includes three distinct layers, namely: basic assumptions; espoused values; and artefacts. Each layer differs in its visibility to outsiders and its consciousness with members. Basic assumptions are the core layer of culture and comprise the organisation’s collective assumptions around the nature of: reality and truth; time; space; human nature; human activity and human relationships. These are not visible to outsiders, and have to be deciphered from the outer two layers. The middle layer, espoused values, is more explicit and is often communicated in organisational mission statements, spoken management values and employee attitudes about different cultural aspects (such as safety). Artefacts are the final layer in Schein’s model and are possibly most often associated with culture due to their high visibility. Artefacts include slogans and logos, organisational celebrations and rituals, reporting and organisational documents. Also included in this layer is individuals’ behaviour within the organisation – a reflection of the influence of all cultural layers. The body of safety culture literature has largely been driven by social and organisational psychology approaches to the concept (Guldenmund, 2000). Therefore it is not surprising that safety culture has traditionally been viewed as a component of an organisation’s broader culture as articulated by Schein (1992). The implications of Schein’s model will be discussed in further detail later in this review, however it is important to highlight here, as it provides the foundation for understanding safety culture research.

An important way in which organisational culture is revealed is through organisational climate. Glendon and Stanton (2000) view organisational climate as
the perceived quality of an organisation’s internal environment. Climate is usually considered a more superficial concept than culture, as it reflects an organisation’s current state, but not necessarily the enduring assumptions, values and beliefs that define the underlying culture. Organisational climate encompasses a wide range of individual evaluations about the work environment – including general dimensions such as leadership and communication, and also more specific dimensions such as the climate for safety (Neal, et al., 2000).

Despite its complexity, other scholars prefer to view culture more pragmatically. Reason (1997; p192) argues that Uttal’s (1983) definition of organisational culture is the most functional: “shared values (what is important) and beliefs (how things work) that interact with a company’s people, organisational structures and control systems to produce behavioural norms (the way we do things around here)”. The latter part of this description—the way we do things around here—has been widely adopted by industry as not only a way to talk about organisational culture, but also about how safety is managed within an organisational group (Parker et al., 2006).

2.3.2 Origins of safety culture

The nuclear industry was the first to recognise safety culture as a significant concept in workplace safety. Safety culture rose to the forefront of industry’s collective mind after the Chernobyl nuclear incident of 1986 and the subsequent reports by the International Nuclear Safety Advisory Group, published by the International Atomic Energy Authority (Flin et al., 2000; IAEA, 1991). Despite the concept of safety culture being presented prior to this (e.g., Zohar, 1980 discusses safety climate), the International Nuclear Safety Advisory Group reports were the first to define and elaborate the concept as it related to the nuclear industry (Reason, 1997). The events at Chernobyl highlighted the industry’s lack of understanding around the cultural aspects of safety, and its high reliance on engineering levels of controls for complex safety systems. Since then, poor safety culture has been recognised as a major cause of other large-scale incidents, (for example, the Piper Alpha offshore oil disaster in 1998), and is now considered a pivotal factor for the safety performance of organisations.

Safety culture soon became a term that was accepted in both ‘technical’ fields such as engineering, construction, oil and mining (Dedobbeleer & Beland, 1991; Flin
et al., 2000; Hopkins, 1995), as well as health fields (Hudson, 2003; Reason, 2000) and academia (e.g., Cooper, 2000). In particular, the academic literature has studied safety culture primarily from the social psychological and organisational psychological traditions, proposing a number of models relating to safety knowledge, attitudes, beliefs in individuals and groups, as well as exploring the relationships between organisational policies, management behaviours and individual safety behaviours (e.g., Guldenmund, 2000; Zohar, 2010).

### 2.3.3 Definitions of safety culture

Although research on safety culture has been active for more than thirty years, there is not unanimous agreement on a definition (Guldenmund, 2010). This has led to considerable conceptual confusion, which will be discussed in the overview of safety culture models and the safety culture and climate review. However definitions also have practical implications, as they are critical as to how safety culture initiatives are operationalised, and how anticipated outcomes are measured. Indeed, definitions are utilised in organisations both to describe the desired end-state, and to monitor progress towards it. The lack of clarity around the concept of safety culture makes the development and implementation of safety culture approaches all the more difficult (this is why several key researchers focus on the concept of ‘climate’—see section 2.3.4 for further discussion). Some commonly cited definitions are provided in Table 2.1.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uttal (1983)</td>
<td>Shared values and beliefs that interact with an organisation’s structures and control systems to produce behavioural norms</td>
</tr>
<tr>
<td>Cox and Cox (1991)</td>
<td>Safety cultures reflect the attitudes, beliefs, perceptions and values that employees share in relation to safety</td>
</tr>
<tr>
<td>IAEA (1991)</td>
<td>Safety culture is that assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance</td>
</tr>
<tr>
<td>Pidgeon (1991)</td>
<td>The set of beliefs, norms, attitudes, roles and social and technical practices that are concerned with minimising the exposure of employees, managers, customers and members of the public to conditions considered dangerous or injurious</td>
</tr>
<tr>
<td>ACSNI (1993)</td>
<td>The product of individual and group values, attitudes, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation’s health and safety management</td>
</tr>
<tr>
<td>Geller (1994)</td>
<td>In a total safety culture, everyone feels responsible for safety and pursues it on a daily basis</td>
</tr>
<tr>
<td>Reason (1997)</td>
<td>An ideal safety culture is the engine that continues to propel the system towards the goal of maximum safety health, regardless of the leadership’s personality or current commercial concerns</td>
</tr>
<tr>
<td>Cooper (2000)</td>
<td>That observable degree of effort by which all organisational members directs their attention and actions towards improving safety on a daily basis</td>
</tr>
<tr>
<td>Guldenmund (2000)</td>
<td>Those aspects of organisational culture which will impact on attitudes and behaviour related to increasing or decreasing risk</td>
</tr>
<tr>
<td>Hale (2000)</td>
<td>The attitudes, beliefs and perceptions shared by natural groups as defining norms and values, which determine how they act and react in relation to risks and risk control systems</td>
</tr>
<tr>
<td>Mohammed (2003)</td>
<td>A sub-facet of organisational culture, which affects workers’ attitudes and behaviour in relation to an organisation’s on-going safety performance</td>
</tr>
<tr>
<td>U.S. Department of Transportation (2011)</td>
<td>The shared values, actions, and norms that demonstrate a commitment to safety over competing goals and demands</td>
</tr>
</tbody>
</table>

Table 2.1

Commonly cited definitions of safety culture
The definition put forward by IAEA (1991, p.4) describes safety culture as “that assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive attention warranted by their significance”. In a report to the UK Health and Safety Commission, the ASCNI (1993, p23) defined the safety culture of an organisation in a more explicit manner as “...the product of individual and group values, attitudes, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation’s health and safety management”.

In reviewing the definitions listed, it is clear that many scholars understand safety culture to be intrinsically linked to organisational culture, and the definitions are understandably similar to organisational culture definitions (Cox & Cox, 1991, Guldenmund, 2000; Hale, 2000, Mohammed, 2002). Some definitions specify the priority placed on safety (IAEA, 1991; Reason, 1997) and others point to the daily effort required to maintain safety standards (Cooper, 2000; Geller, 1994).

In one of the few construction-specific culture definitions, Choudhry et al. (2007, p.1008) define construction safety culture based on the ACSNI’s (1993) definition: “The product of individual and group behaviours, attitudes, norms and values, perceptions and thoughts that determine the commitment to, and style and proficiency of, an organisation’s system and how its personnel act and react in terms of the company’s ongoing safety performance within construction site environments.”

The range of safety culture definitions has meant that the concept is not consistently operationalised, and many scholars rely solely on safety climate measures in culture research. That is, despite the acknowledged complexities of culture, safety climate is often the proxy measure of culture in published literature. As will be discussed later in this review, this may be due to the difficulty of directly measuring cultural aspects, as well as a preference for more quantitative data collection methods. However, the definitions also share similarities around emphasising values and culture impacting on behaviour. Industry is arguably most interested in the behavioural outcomes of culture, as these are more tangible and most accessible in day-to-day business operations. Despite this variation in conceptualisation and operationalisation, scholars agree that safety culture is an
essential concept in modern approaches to improving safety performance outcomes (Guldenmund, 2000; Zohar, 2010).

2.3.4 Safety culture and safety climate

The safety culture literature is divided on a number of conceptual issues, arguably the most significant of which is the distinction between safety culture and safety climate. Early research on the concept referred to safety climate (Zohar, 1980), as a term borrowed from the organisational climate paradigm used in management literature. More recent research has tended to focus on safety culture, at least in phrasing; however the theoretical and practical distinction is not always clear (Guldenmund, 2000; Hale, 2000). Commonly cited differences include:

1. Culture is a more holistic construct whereas climate is often seen as a manifestation or ‘slice’ of broader culture (Hale, 2000; Mearns & Flin, 1999).
2. Culture is thought to reflect a group level idea, whereas climate was traditionally viewed as an individual/perceptive measure (Zohar, 1980).
3. Climate has its origins in psychological traditions, whereas culture is more familiar in anthropological and sociological research (Guldenmund, 2000).
4. Culture and climate are measured differently—culture is often determined through qualitative research such as observations and interviews, whereas climate is commonly measured through quantitative questionnaires that measure individual’s perceptions and attitudes (Cooper, 2000).

Furthermore, Mearns and Flin (1999) distinguish between the two concepts by viewing safety climate as a snapshot of employee’s perceptions, attitudes and beliefs about safety, whereas safety culture is viewed as a stable trait that reflects fundamental values, norms, assumptions and expectations. This view is supported in other models of safety culture, discussed in section 2.4.

In addition to the culture versus climate debate, there are also variations in how safety climate is defined. Some common definitions of safety climate are provided in Table 2.2. Most definitions refer to perceptions; however some also include beliefs and attitudes (Brown & Holmes, 1986; Cooper & Philips, 1994; Coyle, Sleeman & Adams, 1995). Another difference relates to the level of measurement. Most definitions reflect a group level measurement with references to ‘molar’ or ‘shared’
perceptions (Zohar, 2000), whereas others refer to individual perceptions (Neal et al., 2000; Neal & Griffin, 2006).

Table 2.2

*Commonly cited definitions of safety climate*

<table>
<thead>
<tr>
<th>Reference</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zohar (1980)</td>
<td>A summary of molar perceptions that employees share about their work environments</td>
</tr>
<tr>
<td>Brown and Holmes (1986)</td>
<td>A set of perceptions and beliefs held by an individual and/or group about a particular entity</td>
</tr>
<tr>
<td>Dedobbeleer &amp; Beland (1991)</td>
<td>Molar perceptions people have of their work settings</td>
</tr>
<tr>
<td>Cooper and Philips (1994)</td>
<td>Safety climate is concerned with the shared perceptions and beliefs that workers hold regarding safety in their work place</td>
</tr>
<tr>
<td>Coyle et al. (1995)</td>
<td>The objective measurement of attitudes and perceptions toward occupational health and safety issues</td>
</tr>
<tr>
<td>Neal et al. (2000)</td>
<td>A specific form of organisational climate, which describes individual perceptions of the value of safety in the work environment</td>
</tr>
<tr>
<td>Zohar (2000)</td>
<td>Safety climate as a multi-level construct rests on the differentiation between respective sources of climate perceptions at the organisational and group levels of analysis</td>
</tr>
<tr>
<td>Mohamed (2002)</td>
<td>Workers’ perception of safety in the work environment</td>
</tr>
<tr>
<td>Neal and Griffin (2006)</td>
<td>Individual perceptions of policies, procedures, and practices relating to safety in the workplace</td>
</tr>
<tr>
<td>Hahn and Murphy (2008)</td>
<td>Shared perceptions of employees about the safety of their work environment</td>
</tr>
</tbody>
</table>

2.3.5 Safety climate dimensions

The multi-faceted nature of safety culture and climate has largely been investigated in the safety climate research stream, with a focus on categorising and defining the elements involved in safety climate perceptions. In particular, the exploration of safety climate dimensions or factors has been a major focus for many safety climate researchers. Since Zohar’s first paper in 1980, several studies have been published relating to safety climate questionnaires and the key factors that
comprise safety climate. Resulting dimensions from factor analyses have revealed anywhere from two (Dedobbeleer & Beland, 1991) to 28 (Lee & Harrison, 2000) factors. However, as will be discussed later, it is possible that these factors may be more similar than current comparisons suggest (Glendon & Litherland, 2001).

Zohar’s (1980) paper was one of the first studies that defined, measured, and tested safety climate. Operationalised as a specific type of organisational climate, a safety climate scale was developed to assess employee’s perceptions about the relative importance of safe behaviour as part of their work. The research found that the organisations studied had definable safety climates, that is, the safety climate scores were more similar within an organisation than between organisations. The results from a production industry sample of 20 workers from 20 factories supported safety climate as an organisational construct. Zohar (1980) proposed an eight-factor model, namely: (a) management attitudes towards safety; (b) importance and effectiveness of safety training; (c) level of risk at workplace; (d) effects of work pace on safety; (e) status of safety committee; (f) effects of safe conduct on social status; (g) effects of safety conduct on promotion; and (h) status of safety officer. Of these, it was found that two dimensions were most predictive of the level of safety climate: worker’s perceptions of management attitudes about safety and their perceptions regarding the relevance of safety in general production processes (Zohar, 1980).

The safety climate dimensions were later tested by Brown and Holmes (1986) and Dedobbeleer and Beland (1991), making this one of the few safety climate scales that has been subjected to confirmatory studies (Guldenmund, 2000). Brown and Holmes (1986) failed to confirm Zohar’s factor structure with an American production industry sample, and so conducted exploratory factor analysis on a refined scale and determined three factors, including: employee perceptions of management concern with their well-being; employee perception of management response to this concern, and employee physical risk perception.

In a subsequent study with construction industry workers, Dedobbeleer and Beland (1991) found two safety climate dimensions provided the best fit, namely: management commitment to safety and workers involvement in safety. Management commitment to safety was a dimension that reflected workers’ perceptions of management’s attitudes to safety, and management’s safety practices. In contrast to
the production workers’ studies, the construction workers viewed managers’ words and actions as a single dimension. This is an important finding which reflects the critical association of safety policy and safety practice in the construction environment. Management words and deeds were inseparable in worker judgements of management commitment to safety. Workers involvement in safety included workers’ physical risk perception, workers’ perceptions of control, and workers’ perception of safety responsibility. This industry difference may be important in understanding safety culture perceptions and influences on worker motivation to perform safety behaviours as it indicates that construction workers perceive safety as a joint responsibility between individuals and management.

In a slightly different approach, Guldenmund (2007) considers safety climate dimensions as management processes or attitude objects. The nine dimensions include: risks, hardware design and layout, maintenance, procedures, manpower planning, competence, commitment, communication, and monitoring and change. In a construction industry study, Mohamed (2002) proposed ten constructs: management commitment, communication, safety rules and procedures, supportive environment, supervisory environment, workers’ involvement, personal appreciation of risk, appraisal of work environment, work pressure and competence.

Guldenmund (2007) argues that safety climate research to date has two things in common. First, most analyses provide many different factors that are hard to replicate, and second, these analyses invariably point to an overarching higher order factor relating to higher management or organisational factors (for example, Griffin & Neal 2000). In fact, although Guldenmund presents nine factors in his paper on safety climate, he also acknowledges that these factors probably reflect an overarching evaluation of management’s consideration and management of safety. In a later publication, Guldenmund (2010) reports that the trend is now towards a one-dimensional scale known simply as ‘safety culture’. For example, Jiang, Yu, Li and Li (2009) conducted exploratory and confirmatory factor analyses on their chosen safety climate scale and found that a single factor model was the best fit. Similarly, O’Toole (2002) found that employees’ perceptions of management commitment to safety were most predictive of injuries over time. This likely reflects the recognition of a higher order safety climate factor relating to management commitment (c.f. Griffin & Neal, 2000). The single factor scale also reflects a functionalist
understanding of safety culture and safety climate, such that management’s approach to safety is the most critical aspect of an organisation’s culture and climate.

In recent Australian research, safety climate has been measured as a single factor, with other dimensions—including motivation, compliance and participation—re-conceptualised as determinants and components of safety behaviour (Griffin & Neal, 2000; Neal et al., 2000; Neal & Griffin, 2006). When viewing safety climate as a predictor of safety outcomes, it becomes relevant to consider the predictors of performance in regards to proximal influence. Neal et al.’s framework will be discussed in more detail in section 2.6.

2.3.6 Group differences in safety climate

Another perspective on safety climate suggests that the organisation-level is not the only level at which people can share climate perceptions (Zohar, 2000). Particularly in large or diverse organisations, it is possible that work groups or workforce levels may differ in their perceptions of how safety is valued and prioritised due to different working environments and management approaches. This multi-level understanding of safety climate has implications for both the conceptual and practical aspects of culture and climate.

A number of studies have identified differences in safety climate scores between sub-groups in organisations (Cox & Cheyne, 2000; Glendon & Litherland, 2001; Lee & Harrison, 2000; Zohar & Luria, 2005). In particular, Zohar and colleagues have been influential in pursuing the development and testing of a multi-level model of safety climate. The model recognises that safety policies, procedures and practices are implemented at different organisational levels and what is implemented at the workgroup level may vary according to supervisory execution.

In a recent Australian study, Lingard, Cooke and Blismas (2009) investigated the concept of group-level safety climate in a road administration organisation. Work groups of construction and maintenance crews were tested for within-group homogeneity and between-group variance to determine the existence of workgroup-level safety climates. Results were supportive, with findings indicating group-level safety climates do exist, and that this is a possible explanation for differing safety performance within areas of an organisation.
Different working environments can also impact on perceptions of safety climate. In their study in the mining industry, Cui, Fan, Fu and Zhu (2013) found a significant effect for hazardous environment on safety climate. Specifically, they found that higher perceptions of a hazardous environment (in the coal mining context this includes dust, gas, flood and fire) were related to higher safety climate perceptions, possibly because of a heightened awareness of safety issues by management. These results suggest that the immediate work environment can result in different safety climates. Large and diverse organisations within the construction industry are likely to have a variety of working environments across functional groups. Further research on organisational size and differentiation suggests that larger mines are safer than smaller mines, possibly due to greater availability of safety resources, and mines with less task diversity are safer than those with greater task diversity (Page, 2009). This argues strongly for the relevance of Zohar’s (2000) assertion that shared climate perceptions exist not only at organisational level but also at work group level. This multi-level understanding is important at both conceptual and practical considerations of culture and climate.

There is also evidence that safety climates may differ between different position types within an organisation. Morris et al. (1999) investigated differences in health climate perceptions amongst blue and white-collar workers, and found that blue-collar workers generally had a less positive view of the safety climate. Prussia, Brown & Willis (2003) found that when safety climate was positive, managers and workers had a similar view on the causes of safety incidents. However, when safety climate was poor, workers tended to attribute safety responsibility to managers, and vice-versa for managers’ attributions. The results from this study suggest that workers and managers exhibit group differences on perceptions of safety responsibility and blame when safety climate is poor. Taken together, the literature on group differences and safety climate indicate that further research is needed to examine the nature of workforce differences, particularly in large and diverse organisations. An organisation cannot be assumed to be homogenous just because senior management state shared safety values.

2.4 MODELS OF SAFETY CULTURE

It has been highlighted in this review that the safety culture literature suffers from ambiguity and confusion, and the various theoretical models are no exception.
Whilst safety climate has been reasonably well conceptualised, this has been largely detached from a broader safety culture perspective, such that theoretical development has been parallel rather than synergetic. Some models describe ‘components’ of culture, others attempt to explain the relationship between safety culture/climate and safety outcomes, and some models in the area describe the factors that interact to cause a workplace safety incident, and the role of culture in this interaction. This section provides an overview of the influential models in the safety culture and climate literature, including accident causation models, safety triad models, component models, and safety culture maturity or change models.

2.4.1 Accident causation models

As previously discussed, the investigation into the 1986 Chernobyl nuclear disaster resulted in safety culture becoming a legitimate causal explanation for safety failures. Despite its reactive beginning, safety culture was a concept that was designed to allow more proactive analysis, prior to incidents taking place. Accident causation models attempt to map the various factors that interact to create an organisational accident.

Reason’s safety pyramid model (1990). Reason’s model is a well-known accident causation model that represents the interaction of active failures (human errors, mistakes, procedural violations) and latent pathogens (existing system conditions arising from management decisions, e.g., understaffing) increasing the likelihood of incident. Whilst safety culture is not explicitly defined, Reason’s model implies a cultural influence through the latent condition pathways. That is, the overall safety culture is reflective of how safety is resourced and supported by management, and how it is operationalised in policies and procedures. This is described in more detail in Zohar’s (2010) extension of the model.

Zohar’s (2010) safety climate and safety pyramid model. Zohar (2010) has proposed a conceptual model linking organisational climate literature with safety management literature, drawing on Reason’s (1997) Safety Pyramid model. As shown in Figure 2.1, Zohar (2010) suggests that incorporating an organisational and safety climate ‘filter’ (represented in the grey boxes) in the model will allow it to be used in a preventative sense rather than just as an incident analysis tool.
Figure 2.1. Integration of safety climate and safety pyramid models (Adapted from Zohar, 2010)

The model provides a link between the safety management and safety culture/climate literatures by reconsidering latent pathogens as safety climate perceptions, particularly employee perceptions around espoused versus enacted priorities and policies. Safety climate can be measured periodically to provide a lead indicator of organisational safety, as opposed to just assessing the contributing factors once an incident has already taken place. What this model does not do however, is consider safety culture in its broadest sense, including core basic assumptions, nor how one might manipulate certain factors in an organisational change program. This model is clear in articulating the role of leadership, and has been utilised in safety interventions (Zohar, 2002).

The construction accident causality (ConAC) model. A further example of accident causation models is the construction-specific causation model published by the UK Health and Safety Executive (Haslam et al., 2003). The model was derived from research investigating construction accidents from the perspective of accident victims and supervisors. The model is not dissimilar from Zohar’s (2010) integrated
model, in that it considers proximal and distal factors in the accident trajectory. The model describes originating influences such as client requirements, the economic climate and the safety culture; shaping factors such as work schedules, individual attitudes/motivations and supervisory behaviour; and immediate accident circumstances including both worker and site factors. The model is comprehensive in its consideration of influences in construction accidents and could certainly be useful as a tool to analyse accidents.

2.4.2 Safety triad models

In contrast to accident causation models, safety triad models of safety culture focus on the interaction between the individual perceptive elements, behavioural elements and the environment in the management of safety. Safety triad models are generally based on Bandura’s (1986) Social Cognitive Theory (Bandura, 1986). Social Cognitive Theory extends earlier research on social learning and behaviour by considering environmental influence on individual behaviour, in addition to cognitions.

Geller’s (1994) total safety culture. Geller (1994) outlines ten principles for achieving what he refers to as a “Total Safety Culture”. The principles are designed to be applied in organisations aiming to achieve a culture where safety is pursued by all levels of employees on a daily basis, and focuses on the ‘human’ elements of the person–behaviour–environment triangle. Geller’s model describes three elements or domains that provide a foundation for the principles:

1. Person—knowledge, skills, abilities, intelligence, motives, personality;
2. Behaviour—complying coaching, recognising, communicating, demonstrating active caring; and
3. Environment—equipment, tools, machines, housekeeping, engineering.

The principles follow a psychological approach, and include statements around actively caring, and increasing self-esteem, belonging and empowerment in employees. Specifically, the principles state: 1. The culture, rather than regulatory bodies, should drive the safety process; 2. Behaviour-based and person-based factors determine success; 3. Focus on process, not outcomes; 4. Behaviour is directed by activators and motivated by consequences; 5. Focus on achieving success, not on avoiding failure; 6. Observation and feedback leads to safe behaviours; 7. Effective
feedback occurs via behaviour-based and person-based coaching; 8. Observing and coaching are key actively caring processes; 9. Self-esteem, belonging and empowerment increase actively caring for safety; and 10. Shift safety from a priority to a value.

Intervention domains or processes are then suggested based on the culmination of the principles, namely (Geller, 1994, p. 23): interpersonal observation and feedback; safety coaching for interpersonal feedback; incentives and rewards for process activities; using techniques to increase actively caring behaviours; and evaluating environment, behaviour and person factors. The last process suggests periodic assessment of each of the three domains, monitoring progress via audits, surveys, interviews and focus groups to provide a measure of overall safety performance. Whilst Geller’s (1994) model is highly translatable to practice, it does not provide conclusive empirical evidence for the principles, providing generally a superficial explanation of the theoretical reasoning behind them. For example in an extensive study of employer-based programs to motivate safety belt use, findings indicated that intrinsic motivation proved more effective than extrinsic rewards, extrinsic rewards required intermittent reiteration to be effective, and a no-reward condition utilising awareness and commitment discussions only provide the most effective in the medium and long term (Geller, Rodd, Kalsher, Streff, & Lehman, 1987).

Cooper’s (2000) reciprocal model of safety culture. Cooper’s reciprocal model (Figure 2) includes person, behaviour and situation factors, not dissimilar from Geller’s (1994) model. Cooper highlights the encompassing nature of the model, whereby it includes subjective internal psychological factors, observable safety-related behaviours and objective situational factors. It is also argued that the model promotes methodological triangulation (combining methodologies to cross-validate the results gained from each), a principle also encouraged by others in the field (e.g., Guldenmund, 2000). Methodological triangulation is argued to be critical for investigating multi-faceted constructs, as each method is necessarily limited in what it can reveal about each facet.
2.4.3 Component and layer models

Yet another perspective on safety culture includes describing the components and layers of culture, with the assumption that if the content of culture is understood, this allows for effective diagnosis and improvement of cultural aspects of safety.

Reason’s (1997) components of safety culture. In his book on managing the risks of organisational accidents, Reason (1997) provides a chapter on ‘engineering safety culture’. Reason tailors his message to a ‘safety professional’ audience rather than an academic one, and the resulting discussion outlines the four components of safety culture as applied primarily in high-risk industries:

- **Reporting culture**: An organisational climate in which people are prepared to report their errors and near-misses.
- **Just culture**: An atmosphere of trust in which people are encouraged (even rewarded) for providing essential safety-related information, but in which

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Figure 2.2. Reciprocal safety culture model. (Adapted from Cooper, 2000).

Choudhry et al.’s (2007) model of construction safety culture. Choudhry et al. (2007) offer a conceptual model of construction safety culture, which aims to integrate three related concepts—safety climate, behaviour-based safety, and the safety management system. In fact the model is essentially an extension of Cooper’s (2000) reciprocal model of safety culture, which has been extended to include construction-specific descriptions of each component (person, situation and behaviour). Adapting the language of the model for the industry facilitates effective translation of key concepts to project work tasks.
they are also clear about where the line must be drawn between acceptable and unacceptable behaviour.

- **Flexible culture**: A culture in which an organisation is able to reconfigure themselves in the face of high tempo operations of certain kinds of danger—often shifting from the conventional hierarchical mode to a flatter mode.

- **Learning culture**: An organisation that possesses the willingness and the competence to draw the right conclusions from its safety information system and implements major reforms based on this information.

Reason suggests that these four components interact to create an informed culture, which he equates to an advanced safety culture. The components provide a prescriptive model of the various elements of safety culture, and are often cited in the literature. For example, Hudson (2003) has built on Reason’s model by including further components around mindfulness and risk wariness. There has been to date, however, no published empirical research on the validity of the components, nor any evidence of their effective application in an organisational change intervention. Furthermore, Reason’s components are not commonly reflected in safety climate factor scales, and so represent quite a different view of safety culture.

**Guldenmund’s (2000) framework for safety culture.** Guldenmund (2000; 2010) extends Schein’s (1992) model of culture to a framework for safety culture. Table 2.3 displays the framework, which essentially outlines three layers of culture, their visibility in organisations, and safety-specific examples of manifestations.

Guldenmund (2000) shares Schein’s view that ‘true’ culture is the core layer, but as it is the hardest to decipher, many researchers rely on the middle and outer layers to investigate culture. In the discussion, it is also suggested that the levels can be explained in a causal pathway, where the combination of individuals’ safety attitudes (safety climate) can be considered a consequence of the basic assumptions of the organisation’s members (safety culture). The evaluative responses to the safety climate are then revealed in the organisation’s artefacts, including personal protective equipment, safety training and site safety posters.
Table 2.3

*Framework for safety culture. (Adapted from Guldenmund, 2010)*

<table>
<thead>
<tr>
<th>Layers of culture</th>
<th>Visibility</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Outer layer—artefacts</td>
<td>Visible, but often hard to comprehend in terms of an underlying culture</td>
<td>Slogans/logos, buildings, dress codes / personal protective equipment, posters/bulletins, reports (accident, incident, inspection), minutes, training manuals, job descriptions, procedures, celebrations, rituals</td>
</tr>
<tr>
<td>2. Middle layer—espoused values</td>
<td>(Relatively) explicit and conscious</td>
<td>All spoken statements/justifications, attitudes* (e.g., as determined through surveys), interviews and focus group data, ambitions/intentions, all perceptions.</td>
</tr>
<tr>
<td>3. Core layer—basic assumptions regarding:</td>
<td>Mainly implicit:</td>
<td>Have to be deciphered from artefacts and espoused values</td>
</tr>
<tr>
<td>1. The nature of reality and truth</td>
<td>- Obvious to members</td>
<td></td>
</tr>
<tr>
<td>2. The nature of time</td>
<td>- Invisible</td>
<td></td>
</tr>
<tr>
<td>3. The nature of space</td>
<td>- Pre-conscious</td>
<td></td>
</tr>
<tr>
<td>4. The nature of human nature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The nature of human activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The nature of human relationships</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Attitudes e.g., regarding safety measures, systems, people (self, colleagues, supervision, management) and risks (hazards, scenarios).

2.4.4 Safety culture change and maturity models

The final type of models in the safety culture literature reflects the element of individual and organisational change and maturity in relation to safety management. This approach is less focused on the content of culture or the mapping of culture to safety outcomes, but aims to describe how individuals and organisations travel through change stages in regards to their approach to safety and risk management.

Hudson’s (2003) evolution of safety cultures. Hudson (2003) also puts forward a model in which he describes a hierarchy of cultural sophistication
regarding safety. As shown in Figure 2.3, Hudson proposes that high levels of informedness and trust are critical to organisations reaching a mature safety culture where safety values are embedded in business philosophy and practices.

![Figure 2.3. The evolution of safety cultures. (Adapted from Hudson, 2003).](image)

The evolution model was based on Westrum’s (1996) three-level typology of an organisation’s culture—pathological, bureaucratic and generative cultures, and Reason’s (1997) proposed extension, including two extra levels—reactive and proactive. Hudson has also applied this model (re-named the “HSE culture ladder”, 2007) in the implementation of safety culture in a major multi-national petroleum company. Known as the “Hearts and Minds” project, Hudson used the HSE culture ladder as a consultation tool to gain support from senior management for the development of their safety culture, and to monitor progress over time. The model has considerable popularity in industry, with corporate language often reflecting rungs of the ladder (e.g., ‘we are still reactive’).

**2.4.5 Utility of current models**

It is clear that the theoretical development in the safety culture field has progressed significantly over the past 30 years. A number of thoughtful models have been proposed regarding the content of safety culture, and the interplay between perceptive elements, behavioural components, and environmental factors.
Developmental models are also influential in the field, recognising the individual and organisational change progression in relation to cultural maturity and readiness.

Some progression has occurred with theoretical development, with researchers extending and adapting models to different contexts, however, there are still many new contributions to the field. The safety culture literature is growing and diversifying rather than being distilled into a broadly accepted framework and approach to understanding and measurement. Currently there is still a gap between conceptual thinking and research methodologies. Perhaps this is not surprising given the definitional, epistemological and practical divergences in safety culture theory and research.

Each type of model has some utility for understanding aspects of safety culture, or a version of the relationship between safety climate and safety outcomes and individual, group or organisational levels. However, it is rare that a framework incorporates all of these facets, and it is even rarer that a methodological approach is defined for applying the framework in an industry setting. There is a need for further research that utilises complementary models to provide an encompassing scaffold for understanding and measuring safety culture and climate elements and relationships. Furthermore, safety culture and climate are not well integrated in existing models. There is a need for these concepts to be considered simultaneously in safety culture research for the divergent approaches to be integrated into a meaningful and holistic understanding of the concepts.

2.5 FACILITATORS AND BARRIERS TO SAFETY CULTURE

If safety culture is predictive of safety performance, then it is important to know not only how this pathway operates, but also what factors help or hinder the development of this predictive element. A notable gap in the current research literature is the exploration of the facilitators and barriers to safety culture development and maintenance in an industry context. Previous research has explored barriers to health intervention success (Banks & Davey, 2010; Hart, Watson & Tay, 2003), factors that help and hinder supervisor engagement in safety leadership (Conchie, Moon & Duncan, 2013), and more generally the job demands and resources affecting motivation, engagement and safety outcomes (Nahrgang, Morgeson & Hoffman, 2011).
In a study of food safety programs, Bas, Yuksel & Cavusoglu (2007) identified a number of barriers to implementation. Included in these were the safety system’s complexity, lack of employee motivation and complicated terminology. Research on barriers to the implementation of a health promotion initiative identified barriers around employee resistance to change, insufficient resources, managers’ lack of appreciation for the importance of health and safety initiatives and a prioritisation of production over safety (Whysall, Haslam & Haslam, 2006). Resistance to change and prioritisation of production over safety have also been identified in the automobile (Clarke, 2006) and health care industries (Blake et al., 2006).

Nahrgang et al. (2011) take a different approach and consider barriers and facilitators from an individual, job-specific perspective, in the form of job demand and resources. Job demands included risks and hazards, physical demands and complexity of work. Job resources included knowledge, social support and leadership. Following from Nahrgang et al.’s meta-analysis, Conchie et al. (2013) investigated safety leadership in the UK construction industry and identified a number of contextual factors that facilitated or inhibited supervisor engagement in leadership practices. Factors that hindered supervisors’ engagement in safety leadership included role overload, production pressure, subcontractor safety attitudes, inadequately skilled employees, and language barriers with foreign workers. In contrast, factors that were perceived as helpful resources included social support and role autonomy.

In a more recent empirical study on safety barriers, Banks and Davey (2010) identified a number of organisational characteristics perceived as barriers and facilitators to the implementation of occupational road safety initiatives. Perceived barriers included the prioritisation of production over safety and complacency towards risks. Perceived facilitators included management commitment and supportive systems for implementation. However, the focus of the study was on barriers and facilitators to road safety initiatives, rather than the development and maintenance of culture specifically. It is not known if these same characteristics are relevant in relation to safety culture in the construction and mining industry.
2.6 SAFETY CULTURE AND SAFETY PERFORMANCE

As discussed previously in section 2.4, many models of safety culture have been proposed, however, not many specifically define the pathway between safety culture and safety performance at both individual and organisational levels. Much of the safety culture literature assumes a relationship between cultural indicators and safety performance. However, the mechanisms by which safety culture and safety climate influence the safety behaviours of organisational members are not well integrated in the literature.

2.6.1 Safety behaviour, performance and outcomes

Many studies, including this program of research, begin their discussion of safety culture by describing the burden of workplace incidents, injuries and fatalities to the relevant country/industry/organisation. Safety culture is then proposed as a solution to this problem; however, outcome variables are often not clearly defined. For example, injury rates may be stated as the outcome of interest, but details around how injuries are reported and classified are not always provided. It is a similar case with the measurement of lost time injury free periods, which may be measured as time or rates. This further contributes to the fragmented nature of the field; without a consistent approach to defining predictor and outcomes variables, the antecedents and determinants are naturally mixed.

Christian, Bradley, Wallace & Burke (2009) note that safety performance is often considered in one of two ways: first, as an organisational metric for safety outcomes, such as incidents, injuries, and near misses; and second, as an individual metric related to safety behaviours of employees. These two understandings of performance are undoubtedly related, however, are conceptually distinct, particularly when considering antecedents and determinants of performance outcomes. Workplace safety incidents are comparatively rare events in organisations (Cooper & Phillips, 2004; Zohar, 2000), so are not always a useful metric for tracking the safety performance of an organisation. As explained in Reason’s safety pyramid model (see section 2.4.1), the resulting incident is a culmination of several factors over time to create the precise environment in which the incident occurs.

From an individual behaviour metric perspective, Neal et al. (2000) consider individual safety performance to be comprised of two components: safety
compliance and safety participation. Safety compliance refers to individuals’ adhering to safety procedures and carrying out work in a safe manner, whereas safety participation refers to helping co-workers, promoting the safety program within the workplace, demonstrating initiative and putting effort into improving safety in the workplace. Neal et al. (2000) have applied the model to the safety context, arguing that safety compliance is similar to task performance, and safety participation is analogous to contextual performance. That is, safety compliance can be considered a core activity for an individual’s safety, whereas safety participation involves behaviour that does not directly impact on an individual’s safety, but does help develop an environment that supports safety over time.

These components reflect conceptually distinct sets of behaviours, which potentially have different determinants and antecedents, and these in turn possibly have a differential effect on each component – for example, safety motivation may have a stronger effect on safety participation than on compliance. Therefore, it is important to consider them as discrete constructs in the climate-behaviour relationship. Further studies have also used this safety performance distinction in determining the influence of various predictive factors (Christian et al., 2009; Jiang et al., 2010; Newnam, Griffin & Mason, 2008; Vinodkumar & Bhasi, 2010).

2.6.2 Factors predicting safety performance

In examining the relationship between safety culture and safety behaviour, a number of additional factors have been investigated in regards to the magnitude and nature of their influence on the traditional relationship. Indeed, despite the assumed relationship between safety climate and safety outcomes, Johnson (2007) notes that a direct causal link between safety climate and observed safe behaviour was not established until Cooper and Phillips’ (2004) study comparing manufacturing industry employees’ behaviour before and after a behavioural safety intervention. Other researchers, however, had reported correlations between safety climate and self-reported safety behaviour (e.g., Cooper & Phillips, 2004; Mohammed, 2002; O’Toole, 2002; Seo, 2005; Zohar, 2000). However, safety climate is not the only reported factor predicting safety performance.

A number of predictive factors have been explored in the literature, including: safety knowledge (Neal et al., 2000); safety motivation (Newnam, Griffin & Mason, 2008), leadership (Clarke & Ward, 2006; Mullen & Kelloway, 2009; Zohar & Luria,
2005), environmental factors (Cui, Fan, Fu & Zhu, 2013; Nahrang et al., 2011), and individual factors (Christian et al., 2009). In a recent meta-analysis of person and situation factors predicting workplace safety, Christian et al. provide a comprehensive overview of existing constructs and hypothesised relationships. Factors receiving convincing support included safety climate and safety motivation. Similarly, Seo (2005) found both direct and indirect influences of safety climate on safety behaviour in a study on US grain workers. Using structural equation modelling, Seo found that perceived safety climate had a significant direct effect on unsafe work behaviour, as well as a significant indirect effect through perceived work pressure, perceived risk and perceived barriers.

A well-cited safety performance framework has been developed and tested by Neal et al. (2000), presented in Figure 2.4. The framework adopts Campbell, McCloy, Oppler & Sager’s (1993) model of job performance, where the components, determinants and antecedents of performance are distinguished, with knowledge and motivation comprising the determinants. Campbell et al. suggest that an individual’s motivation to perform a task will greatly influence their resulting performance in that task, assuming that they have the basic knowledge required.

![Figure 2.4. Safety performance framework. (From Neal et al., 2000)](image)

Subsequent studies have omitted organisational climate and safety knowledge (Neal & Griffin, 2006) due to poor predictive results. Organisational climate was
later omitted because Neal et al. found that it had no direct effects upon their derived measures of safety. Glendon and Litherland (2001) argue that this finding supports the investigation of safety climate in its own right. Similarly, safety knowledge was omitted from later studies due to poor predictive results. Certainly, in large construction organisations in developed countries such as Australia, levels of safety knowledge could be argued to be reasonably similar due to the comprehensive induction processes and standardised policies and procedures. Given this, safety motivation has been found by both Campbell et al (1993) and Neal et al (2000) to be the stronger determinant in the journey to the performance components of safety compliance and safety participation.

2.6.3 Motivation

In the context of organisational behaviour, motivation is often cited as a critical influencing factor for performance. Pinder (1998) describes work motivation as the set of internal and external forces that initiate work-related behaviour, and determine its form, direction, intensity, and duration. Internal forces refer to individual needs and motives, whereas external forces include factors relating to the type of work and the reward systems operating in the organisation.

In the safety context, motivation refers to an individual’s willingness to expend effort to act safely as well as the value an individual places on being safe (Neal & Griffin, 2006). Similarly, Newnam et al. (2008) consider safety behaviour to be a form of ‘motivated work behaviour’, whereby an individual’s compliance with and participation in safety activities at work is determined by their motivation to put in effort around safety. The positive relationship between safety motivation and safety performance has been established in a number of studies (Griffin & Neal, 2000; Neal & Griffin, 2002; Newnam et al., 2008).

Theories of motivation

There are two broad approaches to the understanding of motivation at work: content theories and process theories. Content theories describe the types of motivation individuals’ experience, whereas process theories attempt to explain how motivation influences individuals’ behaviour (Kallia et al., 2010). Maslow’s (1943) hierarchy of needs theory is perhaps the most commonly cited content theory, with needs presented as a pyramid. The bottom level incorporates physiological needs,
which are the basic human needs for food, air, water, and sleep. The next level addresses safety needs, including needs for physical shelter, and for psychological security and stability. The third level refers to belonging and love needs, including social needs for love, affection, friendship and affiliation. The next level relates to esteem needs, including both self-esteem, and admiration and respect from others. The final level in Maslow’s hierarchy is reserved for ‘self-actualisation’. This need relates to self-fulfilment, achieving our full potential and realising our capabilities. The theory suggests that once physical safety/security and social needs are met, people are motivated to meet their needs of self-esteem, such as having autonomy, status and receiving promotions. Maslow’s hierarchy suggests that safety needs are core and immediate, implying that we should be highly motivated to meet those needs.

Process theories are less interested in the motives or needs of individuals, and more focused on what processes might influence how people are motivated for certain behaviours or actions. Previous research on the content of motivation indicates that individuals vary widely in their motives (Pinder, 1998), and these individual differences are difficult to address in organisational policies and systems. As safety research is generally interested in how motivation works to influence safety behaviour, process theories are more relevant to guiding research.

Goal-setting theory (Locke & Latham, 1990) has a conceptually simple premise stating that people make rational choices about what they do, based on internalised intentions and goals. The setting of specific, challenging but achievable goals allows a conscious articulation of desired achievements that provides direction and motivation for supporting behaviour. Goal-setting theory has some support in the literature (Miner, 2003), and is particularly useful for tasks of moderate difficulty and complexity. Ludwig and Geller (2000) report on several field studies undertaken by themselves and additional colleagues over a 10-year span. The investigations evaluated behaviour-based interventions designed to increase safe driving practices of pizza delivery drivers. Goal setting both at group and individual level was a consistent behavioural change strategy across six of seven of these investigations, and the outcomes of these studies have provided a roadmap for future research in developing, fostering, and maintaining (i.e., continuously motivating) durable safety behaviours.
Equity theory (Adams, 1965) offers an alternative view of motivation. The theory posits that a person’s motivation, and therefore behaviour, will be influenced by the perceived ratio of outcomes to inputs (Kalliath et al., 2010). That is, individuals consider the rewards of an activity (e.g., monetary payment), and the investment made in performing those behaviours (effort and contributions), as compared to the ratio of others in a similar environment. Empirical support for equity theory is also mixed (Levy, 2003). Ultimately Equity theory is about fairness in the workplace and derives its analysis of fairness from comparisons of one’s ratio of outputs to inputs to that of another. If the perception is that the referent other’s ratio is comparable, then a state of equity is said to exist. If this is not the case, inequity is perceived and a number of strategies are suggested as being available to reduce this inequity. Most of the early research on this theory related to pay and incentive outcomes, with more recent emphasis on status outcomes such as job title and office accommodation. Such outcomes as remuneration, financial incentives, and job status are typically not strongly linked to safety behaviours, which could explain why equity theory is not considered a motivation driver in safety research.

Vroom’s (1964) Valence–Instrumentality–Expectancy (VIE) theory is a well-accepted modern theory of work motivation. The theory assumes that individuals adopt a rational approach to decisions (person-as-scientist paradigm), and that behaviours are a result of individuals choosing among various options (Kalliath et al., 2010; Landy & Conte, 2010). Like equity theory and goal-setting theory, VIE theory attempts to explain how motivation determines behaviour. Moreover, the theory can both explain and predict behaviour, as it suggests that employees’ efforts are motivated by the belief that rewards will follow performance (Bartol & Durham, 2000). The key characteristic of this theory is that it is a within-person decision-making model. That is, the individual chooses to behave in accordance with the alternative that he or she associates with the highest subjective expected utility. The theory suggests that individuals make conscious choices among alternative courses of action based on perceptions, beliefs, and attitudes about those alternatives and their associated outcomes (Pinder, 1998; Vroom, 1964).

Behaviour is guided by an individual’s consideration of three proximal factors: valence, instrumentality, and expectancy. Valence refers to the affective orientation that an individual has with respect to a given outcome. It is a preference that is
derived from the anticipated level of satisfaction associated with an outcome. Outcomes exist at two levels with task performance generally representing the first level, and intrinsic and extrinsic rewards occupying the second level in as much as these outcomes result from task performance. Instrumentality refers to the extent to which an individual believes that task performance will lead to second-level outcomes. High instrumentality motivates behaviour that facilitates performance as performance becomes valued by its association with a second-level outcome. Expectancy refers to the extent to which an individual believes s/he can accomplish a first-level performance outcome (Vroom, 1964).

**Motivation as a mediating factor**

A number of studies have investigated motivation in a safety context. Safety motivation is a key construct in Neal et al (2000)’s safety performance framework, suggesting it is one of the mediating factors between safety climate and safety behaviour components. Subsequent research has also tested safety motivation as a mediator finding support for an indirect climate-behaviour relationship, through safety motivation in both cross-sectional (Vinodkumar & Bhasi, 2010) and longitudinal designs (Griffin & Neal; 2006; Probst & Brubaker, 2001).

**2.6.4 Leadership**

The role of leaders in workplace safety is well established in the research literature (Clarke & Ward, 2006; Griffin & Hu, 2013; Mullen & Kelloway, 2009; Zohar, 2000). Leadership has been investigated as a safety-specific behaviour (Barling, Loughlin & Kelloway, 2002), a general behavioural trait (Rafferty & Griffin, 2004) and as an interaction between leader and employee (Hofmann & Morgeson, 1999). The theoretical approaches to leadership in the safety context are discussed below. The following review focuses on traditional leadership theories, rather than alternative modern approaches such as complexity leadership theory as they are considered most relevant for the project-based, hierarchy-dominated industries such as construction and mining (as opposed to more knowledge based industries such as professional services).

**Theories of leadership**

Traditional leadership theories differentiate between transactional leadership and transformational leadership. Transactional leaders recognise the needs of
employees and the organisation, with a view to improving task performance (Burns, 1978). Whereas transformational leaders also recognise these needs, but focus on higher order motivations and seek alternative ways of meeting performance goals (Bass, 1985). Both constructs are conceptualised as multi-dimensional, with the Multi-Factor Leadership Questionnaire (Avolio, Bass, & Jung, 1999) being widely used as a measure of transformational leadership. The Multi-Factor Leadership Questionnaire measures four related but conceptually distinct facets, namely: idealised influence, inspiration motivation, intellectual stimulations and individualised consideration. More recently, the dimensional model of transformational leadership has been refined by Rafferty and Griffin (2004). They argue that previous inconsistencies in transformational leadership research were due to blurring between the dimensions. They reconceptualised and refocused the dimensions, and found support for a five-factor solution including vision, inspirational communication, intellectual stimulation, supportive leadership and personal recognition. Zohar (2002b) found that transformational leadership predicted injury rates in a manufacturing and maintenance plant.

Another approach to investigating leadership considers the quality of the relationship between the supervisor and employee, known as Leader–Member Exchange (LMX; Hofmann & Morgeson, 1999). LMX is derived from social exchange theory, in that a high quality relationship or exchange between the leader and the employee can obligate the employee to reciprocate through increasing citizenship behaviours (e.g., ‘going the extra mile’ in a job). In the safety context, a high degree of LMX has been associated with employees raising safety concerns and being more committed to safety in the workplace (Hoffmann & Morgeson, 1999; Hofmann, Morgeson & Gerras, 2003). Despite many perspectives on leadership in safety, a common element is the recognition of the immediate supervisor, and in particular, their support for employees (Nahrgang et al., 2011).

Leadership as a mediating factor

Leadership has been considered as a predictor of safety climate and safety participation, but is less often considered as a potential mediator between the two. It is clear from the literature that leaders can play a critical role in influencing safe behaviours at work (Flin & Yule, 2004), but the exact nature of this influence is not agreed upon. Leaders also have a role in reinforcing behaviour-outcome
contingencies for safety (Zohar, 2002a), thus making it an important variable to consider alongside employee motivation (see section 2.6.3).

2.6.5 Stage of change

An important individual factor considered in the climate–behaviour relationship is an individual’s stage of change. Prochaska and DiClemente’s (1982) transtheoretical model of change was traditionally used to map individual changes in readiness for behaviours such as smoking cessation and weight loss. However, more recently the model has been successfully applied to health and safety interventions (Banks, Davey, Biggs & King, 2008; Barrett, Haslam, Lee & Ellis, 2005; Haslam & Draper, 2000). Prochaska and DiClemente’s model identifies a series of pre-defined stages of change reflecting progress towards improving health-related behaviours. The five stages represent increasing readiness for change: 1. Precontemplation (not considering changing behaviour); 2. Contemplation (thinking about changing); 3. Preparation (making definite plans to change); 4. Action (actually engaged in changing behaviour); and 5. Maintenance (working to prevent relapse and consolidate gains made). There is also a sixth stage referred to as Relapse, where the changed behaviour is discontinued and an individual begins working through the stages again.

In the safety context, Barrett et al. (2005) adopted the model to a questionnaire-based tool designed to assess readiness for change amongst key stakeholders in a manufacturing company. Managers, supervisors and operators participated in targeted interviews as well as completing a safety climate questionnaire. It was concluded that the model was a useful addition to traditional culture measurement, as it allowed a more structured approach to identifying individual’s receptiveness to safety interventions, and provided a complementary measure of safety beliefs.

More recently, Banks et al. (2008) used the stage of change questionnaire with a fleet safety sample. Participants included employees from a utility organisation and a not-for-profit service organisation, however, the overall sample size was quite small ($N = 10$). The authors concluded that the short stage of change questionnaire provided a useful framework for understanding employee readiness for road safety behaviour change. Importantly, it was also found that perceptions around initiative effectiveness were found to vary in relation to an individuals’ stage of change.
Stage of change as a mediating factor

Given the relationship between stage of change and behaviours, it is possible that an individual’s stage of change acts as a mediator between safety climate perceptions and self-reported safety behaviours. This has not been explored as yet in the literature, so represents a gap for further research to consider.

2.6.6 Summary of key factors predicting safety performance

A wide variety of variables have been explored in the pursuit of explaining safety performance. The review undertaken here has highlighted the factors that have considerable support in the literature both theoretically and empirically. In addition to safety culture/climate, the factors that seem to have the most potential in explaining safety performance include motivation, leadership and stage of change. Motivation has been explored in a number of safety studies, and more recent research suggests it may have a mediating effect on the climate-behaviour relationship. Similarly, leadership is frequently investigated in safety climate research, and a consideration of perceptions of leadership alongside employee motivation is an important contribution to the literature in this industry. Finally, stage of change has not been extensively studied in the safety culture field, and has potential to be a key predictor given the links between individual readiness for change and broader organisational cultural maturity. These factors will be explored in depth in the case study organisation, alongside facilitators and barriers to safety culture.

2.7 RESEARCH QUESTIONS

The research program addresses a number of significant deficits in safety culture research to date. As noted throughout the literature review, there is a need to further investigate how those who implement and manage safety culture initiatives within the organisation understand safety culture. There is also a need to better understand the factors that influence the relationship between safety culture and safety behaviour and related outcomes. This pathway is currently not well understood and articulated within the academic literature. Finally, it is important to explore how these influencing factors operate in an industry context, in this case the construction sector, from the perspective of frontline workers and managers. The research questions for this program were developed based on the gaps in the
literature and the objectives of the research program. Table 2.4 indicates how each research question addresses the research objectives.

Table 2.4

Research objectives as addressed by the research questions

<table>
<thead>
<tr>
<th>Research Objective</th>
<th>Addressed by</th>
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<tr>
<td>RQ1. Gain insight into how safety culture is understood in theory versus how it is applied in practice</td>
<td>◆</td>
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<tr>
<td>RQ2. Explore workforce differences in perceptions of safety culture across the organisation</td>
<td>◆</td>
</tr>
<tr>
<td>RQ3. Examine the relationship between safety culture and safety behaviour, and investigate additional factors that influence this relationship</td>
<td>◆</td>
</tr>
<tr>
<td>RQ4. Translate research findings into applied recommendations for improving safety culture and related outcomes within the industry</td>
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Research Question 1: How is safety culture understood and described by the safety leaders in the organisation? The current academic literature has a fragmented view of safety culture stemming from diverse theoretical positions and unresolved conceptual debates. It is important to understand how the leaders in an organisational setting understand safety culture, as this influences how cultural values and beliefs are translated through workforce levels. This research question will contribute to the first objective of the research program (see section 1.3) by providing an insight into the shared vision of safety culture, how safety culture is understood in terms of overarching concepts and principles, and the language used to describe and apply these principles in practice.

Research Question 2: What are the key facilitators and barriers to safety culture? Also contributing to Objective 1, this research question specifically considers the most important facilitators and barriers to safety culture, from the perspective of the organisational safety leaders and the broader workforce. The research literature to date has not considered facilitators and barriers from this
perspective, so this will address a gap in the literature. It is not enough to simply explore descriptions of safety culture; the factors that help or hinder the development and maintenance of a positive safety culture need to be identified and explored in terms of impact for this organisation.

*Research Question 3: Are there intra-organisational differences in safety culture perceptions and safety behaviour?* Specifically addressing Objective 2, this research question explores differences in perceptions of safety climate and safety behaviours of the workforce. Previous research suggests that perceptions vary amongst organisational workforce levels and functional areas, especially when organisations are large and diverse such as the current construction and mining contracting company. Determining any group differences within an organisation is critical to understanding the safety culture and to developing and implementing effective interventions that are tailored to the organisation’s needs.

*Research Question 4: What additional factors influence safety behaviour and related outcomes?* In addition to understanding organisational variations in safety climate and behaviour, this research program aims to investigate the relationship between safety climate and safety performance, as well as any additional factors that influence this relationship (Objective 3). A number of factors have been suggested in the literature, and Study Two will empirically investigate the contribution of safety climate, safety motivation, leadership, and stage of change in predicting safety behaviour within the chosen organisation. Investigating these relationships in this way will provide guidance on the variables that should be the focus for any interventions and ongoing safety culture strategies.

*Research Question 5: How can workers be encouraged to perform desired safety behaviours?* Also related to the third objective, this research question delves deeper into understanding how and why workers are encouraged to perform safety behaviours, and the influencing role of supervisors. Understanding this from the perspective of frontline workers is critical to informing practical safety culture interventions for the organisation, as these workers have the most risk exposure. A frontline perspective also assists in the translation of research findings to the organisational environment (Objective 4).
2.8 CHAPTER SUMMARY

This chapter has reviewed the literature relevant to the research program. The burden of workplace safety incidents is evidently of concern to government and industry, and current approaches to workplace safety are now considering the cultural aspects of safety. This is particularly relevant in the construction and mining industries, as they bear much of the injury and fatality burden, and have challenging environments in which to operate. Despite safety culture being extensively discussed and researched, the academic literature is still undecided on some important conceptual and practical issues. Many models exist describing the content of safety culture and climate, but the relationship between safety culture and safety performance is not well defined. Factors suggested to influence safety performance include safety climate, leadership, safety knowledge and motivation. However, the exact recipe for predicting safety outcomes remains unclear. This research program will address a number of significant gaps in the current safety culture literature, and offers a unique, in-depth perspective of an influential industry organisation.

The next chapter describes the theoretical framework guiding the research program, and the research design chosen to address the research questions. The theoretical framework is presented and described in terms of each study in the research program, followed by an outline of the methodological approach for each study. Ethical considerations are presented, and the strengths and limitations of the methodological approach. The benefits of applied research are also discussed as they relate to the current research program.
This chapter describes the theoretical framework guiding the program of research, and the research design adopted to address the research questions posed in the literature review. The basis for the theoretical framework is described, followed by an explanation of each component of the framework. Next, the research design is presented, including the methodological approach to each study within the research program. The ethical considerations are then discussed, including issues of confidentiality, anonymity and recruitment implications. Next, the strengths and limitations of the chosen methodology are presented. The chapter concludes with a discussion of the benefits of applied research as they relate to the research program.

3.1 BACKGROUND

Given the diversity of safety culture, climate and performance research described in the literature review, it was important to define a theoretical framework to guide the research program. The framework outlines the conceptualisation of culture, climate and behaviour underpinning this thesis. It also informs the research design for the studies in the program as safety culture research has a number of methodological challenges. Research methodologies vary widely dependent on the conceptual understanding of culture as well as the practical issues of measuring a construct that is by its nature difficult to define and observe.

Safety culture is widely accepted (Glendon, 2003; Zohar, 2010) as an amorphous, complex construct, which is difficult to both define and measure, even by those operating within it. Safety culture improvement is a common aim amongst organisations in high-risk industries such as construction and mining. However, the relationship between cultural aspects and individual safety behaviour is often not well articulated, and other influencing factors are not always considered in a systematic way.

In addition, safety culture and safety climate models are relatively diverse within the literature. It is difficult to navigate through the large amount of literature often tackling culture/climate and workplace safety from different perspectives,
whether this entails a human factors approach, an organisational psychology viewpoint or a business management slant. This thesis has synthesised frameworks from the organisational psychology literature, which has a strong history in organisational culture and climate theory and measurement, and more recently in safety culture and climate.

3.2 THEORETICAL FRAMEWORK

The theoretical framework guiding the research program is depicted in Figure 3.1 below. The key constructs are presented as they are investigated in each research study, and the arrows between the boxes represent the relationships between the constructs. Safety culture is investigated as a dependent variable in Study One, where the descriptions and content of culture are investigated alongside the facilitators and barriers to safety culture. Next, Study Two investigates safety climate within the organisation, as well as its relationship to safety behaviour and other mediating factors. Study Two also investigates perceptions of safety culture facilitators and barriers with a different sample (represented by the dotted lines). Finally, Study Three explores the nature of the relationship between the important mediating factors and resulting safety behaviour of frontline workers.

Safety culture is conceptualised as a layered construct in this framework, as presented by Guldenmund (2010), extending upon Schein’s (1992) earlier model (see section 2.4.3). Safety culture is represented in the figure by the large purple box, encompassing safety climate. According to the layered model, the core of safety culture is very difficult to measure, and usually has to be inferred from the middle and outer layers, being climate and other artefacts respectively (Guldenmund). Thus, whilst safety culture is the construct of interest in this thesis, safety climate is measured in the workforce survey. Safety culture is the shared values and beliefs that interact with an organisation’s structures and control systems to produce behavioural norms. Whereas safety climate refers to the workers’ perceptions of the value and importance of safety within the organisation, typically reflected in policies, procedures and practices (Huang et al, 2013). Additionally, and in a unique contribution to the literature, the facilitators and barriers to safety culture development and maintenance are explored from the perspective of both organisational safety leaders and the general workforce. If safety culture is predictive of safety performance, then it is important to know not only how this pathway
operates, but also what factors help or hinder the development of this predictive construct.

Figure 3.1. Theoretical framework and research program design

Also represented in the framework is the relationship between safety climate and safety behaviour, which is conceptualised in a similar fashion to Neal et al.’s (2000) safety performance framework (see section 2.6). As previously described, this framework is an adaptation of a recognised employee performance model outlining the antecedents, determinants and components of job performance, with knowledge and motivation comprising the determinants (Campbell et al, 1993). Safety climate is conceptualised as a psychological (individual) measure of the perception of management commitment to safety, as is now common in the literature (Guldenmund, 2010; Jiang et al., 2009; Neal & Griffin, 2006). Whilst other measurement methods are also accepted in the literature (e.g., group safety climate; Zohar, 2002), the current research context calls for an individual measure. As will be discussed in later sections, the industrial environment does not suit a group safety climate approach. Work groups are not stable over time and thus group-level shared
perceptions would be difficult to accurately measure within the construction and mining industries.

Safety behaviour is operationalised in a number of ways in this thesis. Primarily it is considered as two components—compliance and participation—in accordance with Neal et al.’s framework. Safety compliance includes behaviours around following safety rules and procedures, whereas safety participation includes behaviours around workers involvement in safety initiatives. Additional measures of compliance, including non-compliance (warnings received for non-compliance and self-reported incident involvement) and procedural compliance, are also operationalised in this framework based on Mohamed’s (2002) measure of safe behaviour, in order to provide a comprehensive measure of safety performance. Further detail on safety behaviour measures is provided in Chapter 5 (section 5.2.3).

Finally, the framework incorporates mediating factors as an extension of existing literature, highlighting a number of variables potentially contributing to the explanation of safety performance components. Neal et al.’s framework included safety motivation as a proximal determinant of safety performance, with safety climate being an antecedent of these. Also evident in the literature and included in this framework are the influence of perceptions of leadership (e.g., Clarke & Ward, 2006; Hofmann & Morgeson, 1999; Nahrgang et al., 2011) and stage of change (Banks et al., 2008; Barrett et al., 2005).

3.3 RESEARCH DESIGN

The research program comprises three studies that explore organisational safety culture, and attempt to unravel the experience of safety culture throughout various levels of a large Australasian construction and mining company. The three studies followed a sequential process, whereby Studies Two and Three were informed by the findings of the previous study. The research program was also informed by a review of both academic and industry literature. Participants for all three studies were organisational employees or managers, and were recruited from various sites across Australia.

3.3.1 Approach to Study One

Study One adopted a mixed-methods approach in the form of a modified-Delphi method. The research questions addressed related to understanding safety
culture from the perspective of safety leaders in the organisation, so this was best explored using a qualitative interviewing technique. Semi-structured interviews were conducted with organisational safety leaders in order to determine: how safety culture was defined and described; the factors comprising safety culture; facilitators of safety culture; and barriers to safety culture development and maintenance.

3.3.2 Approach to Study Two

Study Two investigated safety climate perceptions with a cross-sectional sample of the organisation. The study employed a survey technique, administered in both hardcopy and online versions to all levels of the workforce. Gaining a large sample of self-report data on safety climate, motivation, performance and non-compliance, as well as perceptions of leadership and stage of change, allowed the relationship between safety climate and safety behaviour to be investigated through statistical analyses. In addition, group differences such as divisional areas and workforce levels were explored on key constructs.

3.3.3 Approach to Study Three

Study Three also adopted a qualitative approach, in order to further investigate how the mediating factors identified in Study Two influence behaviour on site. Frontline workers and supervisors were interviewed in their respective groups in order to determine how different factors influence their safety behaviour, and the behaviour of others in their workplace. The first study investigated safety culture barriers from an organisational/managerial perspective, and the third study revealed how the workforce experiences these barriers from a frontline perspective.

3.3.4 Ethical considerations

The research program was awarded ethical clearance by the Queensland University of Technology Ethics Committee (Ethics number 1000000944). A number of ethical considerations influenced the design of this program of research. Although we did not ask participants to reveal personal details of their lives outside of work, we did ask about their opinions and perceptions of workplace safety, and their own safety behaviour. This has the potential to make some people feel uncomfortable. Participants were informed of the nature of their participation prior to providing their consent, including any further invitations they may receive for subsequent studies. The researcher’s details were clearly stated on the information
sheets and survey instruments, and business cards were distributed for any face-to-face meetings.

Another consideration was that the research was conducted with employees of a single organisation. It was important to ensure the confidentiality of participants’ responses in all phases of the research program. However, the geographical diversity of the organisation meant that organisational contacts were relied upon to identify possible participants and distribute invitations to participate. Therefore, complete anonymity regarding participation was not always possible for participants in these studies (some organisational contacts were aware of an individual’s participation in interviews, but not the information provided during their participation). This less than ideal situation was countered by providing participant information sheets with the initial invitation, as well as prior to participation commencing. The confidentiality of responses was emphasised in these information sheets, and verbally if possible. Of particular emphasis was the reporting of findings back to the organisation at a group level only, ensuring no individual could be identified in any written or verbal reports. By this means, anonymity and confidentiality were achieved for all respondents within the organisation for all studies, but respondents were not anonymous to the researcher in Studies One and Two due to the face-to-face qualitative research design.

### 3.3.5 Methodological strengths and limitations

The research design endeavoured to encapsulate a comprehensive view of safety culture and related outcomes in the construction and mining organisation. This was achieved through a number of design strengths. First, a theoretical framework that is a fusion of well-supported theories and models guided the research. By drawing on these established models, the research design has a strong foundation for application in a new context. In line with Guldenmund’s (2010) advice, the research presented here adopted a participatory approach to investigating safety culture, using a mix of qualitative and quantitative methods. Using multiple methods and gaining multiple workforce perspectives can result in a more comprehensive view of culture. This methodological and sampling triangulation is recommended within the research literature (Cooper, 2000).

However, the research program had a number of necessary limitations. First, the measurement of culture was primarily undertaken at the level of espoused values,
rather than objective observations of cultural markers. Second, the data collected was cross-sectional in nature, so causality cannot be directly assessed. Third, the investigation of safety culture in one organisation limits the external validity of findings. However, due to the size and influence of the organisation within the industry some extrapolation is possible to other similar organisations in the industry. The strengths and limitations of each study are further discussed at the end of the study chapter, and again in the thesis discussion (Chapter 7).

3.4 RESEARCH SETTING

The advantages of a case study approach in safety research are well established (Hopkins, 1995) and particularly utilised by regulatory bodies (Biggs et al., 2007) and by Workplace Health and Safety Authorities in safety leadership programs (e.g., Workplace Health and Safety Queensland in the Department of Justice and Attorney General, 2014). Single case studies provide a unique opportunity for depth of investigation and highly context-dependent understandings of complex human phenomena. The experience of an organisation’s safety culture is unique to the people in that organisation. Understanding the context in which the culture has developed and currently operates is important to effectively investigate and analyse both the content of safety culture and its impact on safety-related outcomes. A case study approach assists in translating research findings into practical recommendations for the business. In this case the organisation was carefully selected to maximise generalisation across the industry. The organisation has approximately 10,000 employees, and has a prominent place in the Australasian construction and mining industry. Primarily a contracting business, the company also often employs subcontractors and partners with other companies in project alliances. The company is also part of a larger holdings group with global business operations across a range of construction, resource and property sectors, and operates a number of companies throughout the Asia-Pacific region, the Middle East and Europe. In particular, the organisational structure is replicated across the industry, as it operates as both a principal contractor and a subcontractor across a large variety of projects.

The organisation is large and diverse, and provides a number of services or functions as a contracting business. These functions include construction work (road, rail, buildings), mining services, telecommunications services, and energy and gas projects. The organisation has undergone a period of rapid change, including
diversifying from primarily a construction company to the broad range of activities now conducted. Safety has become a keen focus for senior management in recent years, with high profile fatalities being a catalyst for seeking cultural change to balance technological advances in risk reduction across their business areas.

In relation to the workforce characteristics, the research setting allowed an exploration of safety culture in a complex workplace environment. Management is often operating remotely from the frontline workforce, necessarily relying on frontline supervisors to communicate safety messages and organisational priorities. In addition, similar to other organisations in the construction and mining industry, the workforce is dynamic and transient – with workers coming and going between work groups, sites and projects. The workers may have been exposed to varying safety cultures from previous organisations, and inducting diverse employees into the desired culture is a challenge within the changing work environment. These factors taken together with the broader organisational characteristics make this research setting both unique and important in the safety culture field.

3.5 BENEFITS OF APPLIED RESEARCH

This program of research benefited from many of the features of applied research. Applied research can be defined as original investigations undertaken in order to acquire new knowledge. However, in contrast to basic research, applied research is directed primarily towards a specific practical aim or objective (OECD, 2002). Characteristics of applied research include: considering available knowledge and its extension to solve a particular problem; determining possible uses for the findings of basic research and/or determining new methods to achieve specific objectives; and a limited scope of application, in that the results are usually intended to be predominantly valid for a limited number of operations, methods or systems (OECD, 2002). Therefore, this applied research program applies existing theoretical frameworks and methodologies, in combination with empirically derived data from one organisation. It does so in order to meet the practical objective of integrating safety culture theory and practice to improve safety culture and related outcomes with the organisation, and the industries in which the organisation operates.

A number of benefits are derived from applied research in this context. First, as the program was industry-funded by a single, but noteworthy, organisation this
provided a unique sampling population for data collection. In this instance a large organisation has a number of benefits over smaller organisations in regards to available resources for applied research and potential outcomes of this research. Therefore whilst the findings of the research program reflect data from this specific organisational population, the implications of the findings are likely to be relevant across the Australasian sector.

Second, applied research enables the ‘testing’ of theoretical frameworks for face validity and relevance in the target population. Academic literature has advanced considerably in its approach to understanding safety culture. A number of theoretical models have been proposed and a portion of these has been subjected to empirical testing. However, it is important to consider amorphous concepts such as culture from the perspective of the people that work within it. In applied research, theoretical frameworks are only useful to the extent to which they can be applied in the relevant population, and assist in the achievement of practical objectives for the organisation. Thus, applied research in the safety culture field is critical for advancing the relevance and usability of frameworks in order to improve safety outcomes.

Third, the research program benefits from collaboration with an industry partner, including the translation of research findings back to the organisation in ‘real-time’. This partnership is fundamental to successful research outcomes, in that the industry partner provides access to participants and resources, assists in defining the project goals, and ultimately applies the findings of the research to their business. The mutual reliance ensures that research objectives have relevance for both academic and applied environments, as well as providing an important feedback-loop for the progression of academic understandings of safety culture.

3.6 CHAPTER SUMMARY

This chapter presented the guiding theoretical framework and research design for the three studies in the program of research. The theoretical framework is a synthesis of both the content of safety culture and the relationship between safety culture and behaviour through climate and other mediating factors. Although not specifically tested in the current research, the framework provides a scaffold for investigating safety culture in the organisation, as well as understanding how safety
culture is related to safety outcomes, and what influences frontline workers to be safe on the job.

The next chapter describes the first study in the research program that investigated safety culture content, facilitators and barriers from the perspective of safety leaders in the organisation. A brief background to the study is presented, followed by the method and results of the modified Delphi rounds. Finally, the results are discussed as they relate to the research questions and broader program of research.
This chapter documents the first study of the PhD research program. A background to the research is provided, including the positioning of this study in the overall research design, and which research questions are addressed by the study. Next, a rationale is given as to why a modified Delphi method was chosen for this study, and a brief description of the application of the method in the context. Details of the participants, materials, procedure, and data analysis are then described. Results from the Delphi rounds are presented in two parts and are then discussed in relation to the implications for safety culture theory and practice, and as context for the rest of the research program.

4.1 STUDY AIMS

As discussed in the introduction to this thesis (Chapter 1), the research program takes an integrated approach to examining safety culture. Safety culture is viewed as a critical organisational culture, and it varies to the extent that it is positive or still maturing. However, in keeping with the applied nature of the research, safety culture is also understood as a top-down driven process, in that organisational leaders influence the culture, and interventions can be targeted to improve safety culture elements and therefore related outcomes. The implication of this approach is that it is critical to understand the perspective of the organisational safety leaders in order to understand how safety culture is articulated and led in the organisation.

Therefore, as described in Figure 3.1, the first study of the research program aimed to gain an understanding of safety culture from the people who have safety management responsibilities within the organisation. This study contributes to the overall program of research by addressing the first research objective and more specifically, research questions 1 and 2:

- **RQ1:** How is safety culture understood and described by the safety leaders in the organisation? Chapter 2 focused on providing a comprehensive review of the current understanding of safety culture in the research
literature. This first study investigates how safety culture is understood and described by the safety leaders in the organisation. This offers a critical perspective to balance the theoretical understanding of safety culture as presented in the academic literature.

- **RQ2: What are the key facilitators and barriers to safety culture?** This first study addresses an important gap in the current research literature by investigating the key factors and barriers to safety culture, from the perspective of the organisational safety leaders. The methodological approach adopted aims to identify the most important factors and barriers through a ranking process.

As discussed in the literature review (Chapter 2) there are considerable definitional difficulties in safety culture research. Not only are there a great variety of definitions within and across research areas, these definitions are most often developed without the consideration of organisational and industry contexts. Theory-driven conceptualisations of culture are important; however they are not sufficient for understanding how culture is reflected in an organisation’s values and practices. Definitions provide the foundation for organisational initiatives designed to influence and improve safety culture. They are critical for determining the relative importance of values, including safety in the context of other organisational priorities, and the way in which these values are reflected in policies and practices throughout the workforce levels.

The research literature has identified a number of factors describing various elements of safety culture (Dedobbeleer & Beland, 1991; Geller, 1994; Zohar, 2010). However, there is a lack of consensus on the key factors contributing to a positive safety culture. Similar to the definitional difficulties previously discussed in section 2.3.3, the factors that comprise safety culture and climate are often debated, and vary considerably depending on the theoretical position adopted (Glendon et al., 2006) and industry context (Hale, 2000). Additionally, the exploration of factors is most commonly reported in the safety climate literature. This has meant that the methodological approach has been focused on the development and refinement of safety climate survey items, and specifically focused on factor analysis techniques to determine underlying factor structures (Guldenmund, 2007). Whilst this is valuable, these studies do not consider the broader cultural factors that may be relevant to an
industry workforce trying to operationalise constructs into practical strategies to improve safety outcomes.

As previously discussed, the factors that comprise safety culture have been explored and debated in the literature in some depth. However, these debates have mostly occurred in a methodological sense, in terms of determining the underlying factor structure of safety climate surveys (Flin et al., 2000). Additionally, the safety culture models presented often suggest core ‘elements’ or components for positive safety culture (e.g., Reason, 1997), but these models provide a generic description of these elements, rather than an empirical analysis of the factors that help different organisations develop and maintain a positive safety culture. For example, Reason (2000) suggests that organisations should strive to develop a “learning culture” in order to avoid repeating organisational incidents. However, it is not clear how an organisation might implement strategies to achieve this, and furthermore how this component would impact on perceptions of safety culture and ultimately individual safety behaviours that reduce the risk of incidents.

Whilst the factors that contribute to positive safety culture are frequently discussed in the literature, there is a comparative lack of exploration into the practical barriers that can prevent safety culture improvement in organisations. A positive safety culture is something many organisations aspire to achieve, often utilising significant organisational resources, including time, money and people power. However, organisations are rarely just trying to improve their safety outcomes in corporate isolation, and the reality of operating in a competitive industry poses some challenges to balancing safety culture progress with other business imperatives such as quality, time and cost performance. Therefore, perceptions of facilitators and barriers to safety culture are important to investigate in safety culture research.

4.2 METHOD

An exploratory approach was considered most appropriate for this study as it was seeking to investigate safety culture perceptions of key organisational members. In depth, semi-structured qualitative individual interviews were conducted with a sample of safety leaders (described later in this section). Qualitative interviewing is a useful technique for assessing attitudes, perceptions and values, as these are difficult
to observe in situ (Silverman, 2006). The interviews followed a semi-structured format consisting of open-ended questions about various aspects of safety culture. The questions were based on the key issues identified in the literature review (Chapter 2), including defining safety culture, key factors for a positive safety culture, and barriers to creating and maintaining safety culture. The questions were designed around the identified gaps in the literature, and with the goal of understanding the organisational environment as a foundation for further studies in the research program. The follow-up online questionnaire was designed, based on the interview responses, and asked the safety leaders to rate the most important issues identified as part of a validation process.

The combination of qualitative and quantitative methods with a panel of experts is often referred to as a modified-Delphi method. Linstone and Turoff (1975) provide an underlying definition of the method: “Delphi may be characterised as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem.” The Delphi technique is a structured method used to gain consensus from a panel of experts (Hsu & Sandford, 2007; Keeney, Hasson & McKenna, 2001). The process involves a number of ‘rounds’ in which participants respond to questions with the aim of reaching consensus in the final round. Traditional Delphi methods usually include three or four rounds of surveys, with each round providing the same information as the previous, but with group statistical data included. Each panel member then has an opportunity to amend their responses in light of the group data, making it an iterative process (Linstone & Turoff, 1975).

More recently, the Delphi method has been used with various modifications to shorten the process and ensure participant involvement throughout the rounds. Modified Delphi methods are particularly prevalent in health and policy research (Keeney, Hasson & McKenna, 2001). Benefits of the Delphi method include: panel members remain anonymous to one another, reducing the potential for influence or bias throughout the rounds; it suits groups that are geographically distant; information and opinions are gained from a wide range of experts; and importantly, the process ensures that key stakeholders are involved from the beginning, which can assist in the implementation of future policies or programs that may be developed from the results. Recent research in the safety area used the Delphi method to
establish causes of accidents in repair and maintenance work, with a two-round Delphi providing an eight-category list of causes, and relative rankings of the importance of these causes (Hon, Chan & Wong, 2010).

The application of the Delphi method in this instance is an innovative approach in the safety culture field. It is particularly relevant in this context due to its focus on prioritising (ranking) key issues. As discussed, whilst there is a substantial body of research on safety culture, the issues raised and conclusions drawn are not universally agreed, and indeed appear to vary according to specific industry environments. This research employs the Delphi method in an attempt to find the key issues relating to safety culture from the perspective of safety leaders in a leading Australasian construction and mining organisation.

4.2.1 Participants

Participants were 41 safety experts from within the researched organisation. As noted in Chapter 3, the organisation is large and diverse. The organisational structure includes several functional and regional divisions, and has in the past operated as many individual businesses or silos. The formation of a Delphi panel for this study was therefore appropriate in encouraging discussion of the complex nature of safety culture, and in reaching a consensus across a diverse group of geographically dispersed participants.

More specifically, the divisions researched included a cross section of construction functions operating across a variety of industry sectors (e.g., commercial building, roads and transport, resources), involving a diverse workforce in terms of size and employment type, and in a range of environments including both rural and urban settings. At the time of data collection, the organisation was trialing a safety culture initiative using values-based inductions and training workshops. This was not specifically investigated in this study; however, it is relevant to interpreting the findings.

The interviewees were selected based on their current job position, relevant experience or through a peer nomination process. Potential participants were nominated by an organisational contact based on their position and experience within the organisation. Recruited participants were from a representative range of organisational positions and responsibilities, geographical locations and demographic
backgrounds. The intention was to be as inclusive and representative as possible within business operational constraints. The profiles of managers participating in this study were similar to those of others in the workforce who were unable to participate for business operational reasons at the time the study was undertaken, consistent with applied research in this area. In total, 48 people were invited to participate and 41 completed interviews, representing an 85.4% response rate. Participants were recruited from various sites and divisions across the organisation, and all interviewees thought that safety was a significant part of their role. The breakdown of the participants’ roles were as follows: three Senior Executives; six Alliance Project Managers; 11 Project Managers; 10 Safety Managers; three Corporate Managers; three Construction Managers; one Zone Manager; one Building Manager; one Site Manager; one Operations Manager; and one Plant Manager. Typical of the workforce, the majority \((n = 38; 93\%)\) of interviewees were male. Participants in the follow up questionnaire included 35 of the 41 interviewees in the first sample, representing an 83% response rate in the second round. The response rate was considered acceptable in this context, given the turnover rate in the organisation at the time and other factors, such as personnel leave.

4.2.2 Procedure

*Delphi method – round one*

Following nomination by the organisational contact, potential participants were contacted for interview. This initial contact was made via email, and followed up with a telephone call. All relevant study information and ethical clearance details were provided at the initial contact and prior to commencing interviews once arranged (see Appendix A for participant information sheet).

A combination of face-to-face interviews and telephone interviews were conducted over a three-month period. Participants were asked to respond to questions about the key issues drawn from the literature review (see Appendix B for interview schedule). The questions were open-ended to solicit broad responses to questions about safety culture in their organisation. Face-to-face interviews were conducted with 11 participants in private office spaces in the organisation’s premises. The remaining participants were interviewed via telephone during business hours at a mutually convenient time. Participation was voluntary and verbal consent was obtained from all participants. Participants were informed of the confidentiality of
the interview and the anonymity of their responses. The participants were interviewed individually to elicit responses free from any group bias. Interviews lasted between 20 and 60 minutes, varying with individuals’ willingness to share and explain their perceptions. The first 14 interviews were recorded and transcribed as verbatim records and transcriptions were provided to the interviewees to confirm their accuracy. Following this, the rest of the interviews were recorded by the same researcher in note form, including verbatim quotes for key points. It was considered that full transcripts were not required beyond the first 14 interviewees, as saturation was being reached and the researcher was able to sufficiently capture confirmatory and/or contradictory themes in note form during the interviews.

**Delphi method – round two**

Once interviews were complete and analysis was conducted on the data, participants were contacted again and invited to participate in a follow-up questionnaire (see Appendix C for participation information sheet). This process was signalled to participants during the interview round. The online questionnaire (Appendix D) was designed to test the accuracy of themes that arose in the interviews, and to determine perceptions around the importance of the previously identified factors and barriers. The questions were developed from the results of the thematic analysis conducted on the interview data. The questionnaire was delivered through an online survey provider, and was accessed by participants via a unique and secure email link. The questionnaire was available for completion for approximately one month (approximately two months after the last interview), and participants were provided with two reminders via email during that period.

**4.2.3 Data analysis**

The interview responses were analysed through a qualitative thematic analysis process. Braun and Clarke (2006) consider thematic analysis a foundational method in qualitative analysis. They argue that its flexibility makes it a useful research tool, providing a rich and detailed account of the data. However, qualitative research is also notoriously misused in research (Silverman, 2006) and in particular, the approach is criticised as lacking rigour and transparency. To counter these limitations, a number of processes were followed.
The analysis was both theoretically and empirically driven, addressing the specific research questions as determined by the underlying theoretical framework, as well as remaining open to unanticipated themes that emerged from the interviews. Each interview record was carefully examined, giving equal attention to all data and identifying themes through a thorough, inclusive and comprehensive coding process (Braun & Clarke, 2006). Relevant extracts that were particularly reflective of certain themes were chosen to include in the findings summary. Themes were identified through collating data codes and creating a thematic map of key ideas and thoughts, which were reviewed to ensure that themes were internally meaningful, and distinct from each other. Themes are presented in the results as they relate to each category of interest. As indicated by Banks, Biggs and Dovan (2014), it was considered important to analyse all qualitative data before proceeding to quantitative data collection, in order to avoid prejudicing interpretations of the subsequent analyses.

Data from the online questionnaire were analysed using a statistical software package (PASW Statistics 18). Descriptive analyses were performed, including identifying means, standard deviations and frequency statistics. These analyses were appropriate to explore the relative importance of different factors raised in the interviews and to simply assess agreement in ranking across the participants.

4.3 RESULTS

The research findings described in this section were derived from the two-round modified Delphi method, and include data from thematic analysis of interviews and descriptive analyses of data from an online questionnaire with the same sample. Key themes and descriptive data are discussed and supported under four categories of interest: defining and describing safety culture; key factors contributing to positive safety culture; barriers to safety culture; and enhancing and improving safety culture.

4.3.1 Defining and describing safety culture

In the interviews, the safety leaders were asked how they defined and described safety culture. As can be seen in Table 4.1, the first major theme to emerge from the analysis was a focus on the practical side of safety culture, with many using action-oriented definitions and descriptions. Whilst several interviewees mentioned values, beliefs and attitudes, it seemed that most emphasis was placed on the actions,
behaviours and practices of people in the organisation. This was evidenced by responses that related to how things were done in the organisation and the idea that safety culture is something created by the organisational members through their behaviours and actions. In particular, safety culture was understood to be largely created by the actions of influential organisational members, with many interviewees commenting on how safety standards are reinforced by management. This was further confirmed by additional responses that focused on how people acted when they were not being monitored by peers or management, reflecting the pervasive qualities of culture.

Table 4.1

Themes associated with safety culture definitions and descriptions

<table>
<thead>
<tr>
<th>Theme</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action-oriented descriptions</td>
<td>“The way we do things around here”</td>
</tr>
<tr>
<td></td>
<td>“It’s what we do and say and execute in relation to safety”</td>
</tr>
<tr>
<td></td>
<td>“Safety culture doesn’t invent itself, it is what comes out of the actions of people in the organisation”</td>
</tr>
<tr>
<td></td>
<td>“The standard you walk past is the standard you set”</td>
</tr>
<tr>
<td></td>
<td>“What people do when no-one’s looking”</td>
</tr>
<tr>
<td></td>
<td>“What people do when you’re not there”</td>
</tr>
<tr>
<td>Related to organisational culture</td>
<td>“An aspect of general team culture, that relates to people’s attitudes towards safe work”</td>
</tr>
<tr>
<td></td>
<td>“Safety culture is part of an organisational culture where safety is treated [as] sacrosanct by the organisation”</td>
</tr>
<tr>
<td></td>
<td>“I think that safety culture is a subset of organisational culture ... Safety is just one way an organisation expresses its culture”</td>
</tr>
<tr>
<td>Implicit nature of culture</td>
<td>“I don’t really use a definition of culture”</td>
</tr>
<tr>
<td></td>
<td>“Culture is a funny word. It’s the way we do things and the way we think about things. But I’ve never really thought about it as culture”</td>
</tr>
</tbody>
</table>

Another central theme identified from the data is the understanding of safety culture as a part of organisational culture. Definitions and descriptions of safety culture were often grounded as a component or a reflection of the broader culture. The strength of this theme is evidenced by a number of responses around safety leaders’ view of safety culture as an “aspect”, a “part” or a “sub-set” of the
organisational culture or team culture. Some responses included a statement about the relative priority given to safety, for example, whether safety was “treated as sacrosanct”.

The final theme recognised in the safety leaders’ descriptions was around the implicit nature of safety culture. Many interviewees said that they did not use the term safety culture regularly, and did not have a working definition that they used. A common statement was that they “don’t really use a definition of safety culture”. Many preferred not to use the term culture, as interviewees considered it too difficult to define. Phrases including “what people do” were used to reflect the outer layer of culture (artefacts) in terms of observable behaviours. Another commented that they had not really thought about it as culture, reflecting the intangible qualities of culture and particularly the difficulty of viewing one’s own group in terms of cultural descriptions.

4.3.2 Key factors contributing to positive safety culture

This category of interest was investigated in both the interview round and follow-up questionnaire round of the Delphi method. Results are presented from each round respectively.

Interview themes

Another interview topic related to what the safety leaders thought were the key factors contributing to positive safety culture (Table 4.2). This was an open question designed to generate their thoughts on the topic, with no reference to previous literature. The first theme to emerge from the data was around leadership commitment. Emphasis was placed on leaders demonstrating their commitment, in particular through high visibility on project sites, and through personalised actions and stories around safety. However, some interviewees cautioned about commitment being genuine and with a practical focus. Cynicism towards senior leaders was talked about as reasonably common in the organisation, particularly in relation to leaders’ espoused values not matching actual behaviours. This extended to site practices as well, with responses indicating that safety culture should be reflected in processes and practices in project work. Responses within this theme also reflected an emphasis on the supervisory level as key to positive safety culture. It was viewed as a “pinch point” that facilitated successful implementation of safety practices.
A related theme identified from the data was around safety communication. The main points raised in relation to safety communication were around clarity and simplicity. Some interviewees felt that messages that were too complex were not effectively translated through the organisational levels. The various forms of communication were also mentioned, with slogans and visual communication tools such as posters being frequently cited as evidence of safety culture on site. The communication of leaders was also reflected in this theme, with their ability to effectively communicate the organisation’s vision, values, expectations and standards around safety seen as critical for positive safety culture.

Another central theme identified in relation to factors contributing to positive safety culture was around worker involvement, engagement and participation in safety. It was recognised that safety culture, whilst driven by the leaders in the organisation, was largely a result of how the workforce thinks and acts in relation to safety. Emphasis was placed on getting everyone involved, and encouraging people to participate in the organisation’s safety agenda. The responses indicated that worker engagement in safety was considered vital to the overall safety effort, and interviewees talked about various methods for this, such as inductions, toolbox talks, videos, and workshops. Many interviewees also spoke about the involvement of workers in the improvement of safety processes and systems, with a focus on utilising their knowledge of the working conditions. In terms of safety education and competency, interviewees emphasised on-the-job training, coaching and mentoring as effective ways to engage workers in safety culture.

Another key theme to emerge in the interviews was around the organisation having defined safety accountabilities for different roles and clear performance standards. Several interviewees felt that it was important to clearly define and articulate safety accountabilities at all levels in the organisation, and for senior leaders to make sure that people are taking personal accountability for safety. Reward and recognition were also tied to this theme, evidenced by responses around there being consequences for both positive and negative actions. Others suggested that safety performance should be a factor in both selecting and promoting employees. Rewards were not only considered in a monetary sense, and many managers said they use positive incentives such as prize draws and certificates to encourage safe behaviours, but it was also perceived that intrinsic motivations were
important for some workers. A safe work environment is important to employees as the potential consequences of unsafe behaviour can result in personal injury. Defined safety accountabilities and performance standards motivate employees to be involved in safety and prioritise the safety components of their work.

Table 4.2

Themes associated with factors contributing to positive safety culture

<table>
<thead>
<tr>
<th>Theme</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership commitment</td>
<td>“It’s very simple and it’s exceptionally difficult. I think the thing that makes the biggest difference is for people on the ground to see people at the top talking to them about it.”</td>
</tr>
<tr>
<td></td>
<td>“It’s important to these guys to see their bosses because then they will work hard for them and it drives performance.”</td>
</tr>
<tr>
<td></td>
<td>“You have to be seen, do what you said you would do, and what you would expect others to do.”</td>
</tr>
<tr>
<td></td>
<td>“The frontline supervisor is critical for implementation. It’s the people under his control are the ones that get injured. If he’s not on board, then no matter how much effort you put in at leadership level, it’s going to fail at that pinch point.”</td>
</tr>
<tr>
<td>Safety communication</td>
<td>“It’s no good having the best systems in the world if you can’t communicate information effectively.”</td>
</tr>
<tr>
<td></td>
<td>“Messages are already fairly diluted once they get to the paddock”.</td>
</tr>
<tr>
<td></td>
<td>“Not all things are important, [we need to] identify the critical few things that are important.”</td>
</tr>
<tr>
<td>Workers’ involvement</td>
<td>“Everyone in the organisation needs to live and feel the values”</td>
</tr>
<tr>
<td></td>
<td>“It’s really important for the guys to get involved. And the right guys, the passionate ones, the ones who see how safety impacts on them.”</td>
</tr>
<tr>
<td></td>
<td>“[We] need to be more hands on with the guys. Videos are good, but more during the job.”</td>
</tr>
<tr>
<td>Defined safety accountabilities and performance standards</td>
<td>“You need accountability to make it happen. Any culture needs to have an element of fear around law and respect. If you take the Australian culture everybody knows you have to be a law-abiding citizen to live within the Australian culture, and there are consequences if you step outside the cultural norm. I think it’s exactly the same with safety culture.”</td>
</tr>
<tr>
<td></td>
<td>“Actions have consequences – positive actions have positive consequences and negative actions have negative consequences.”</td>
</tr>
<tr>
<td>Simple safety systems</td>
<td>“I think safety culture is significantly enhanced when there is simplicity in terms of process and framework for the safety system”</td>
</tr>
<tr>
<td></td>
<td>“Simplify the systems – make them work for you instead of you working for them”</td>
</tr>
</tbody>
</table>
A final theme to emerge from the data around safety culture factors was about safety systems and processes being simple. The responses indicated that interviewees thought systems needed to be streamlined in order to integrate safety processes with other business activities, and support cultural values. The concept of systems was considered quite broadly as the safety management system as a whole, including the processes involved in meeting legislative requirements and providing a safe workplace. Of those responses relating to systems as a part of the culture (rather than viewing them as parallel to culture, or as a pre-condition for culture), there was an emphasis on ensuring resources were devoted to systems to show that the organisation was ‘serious’ about safety.

**Questionnaire ratings**

In the follow-up questionnaire with the panel, the safety leaders were asked to rate the importance of various factors contributing to positive safety culture. In the thematic analysis, the factors were identified as belonging to three sub-categories reflecting Organisational, Leadership and Workforce factors. The rating required selecting the top three factors from each of the sub-categories. The ‘top three’ selection process was chosen to be consistent with the goal of panel consensus for Delphi methods (Keeney et al., 2001). Table 4.3 represents the number of people who rated each factor as one of their top three (that is, the item was ranked first, second or third in importance by at least one panel member), and the corresponding percentage.

The organisational factors most often selected as one of the top three were around the systems and frameworks supporting the desired culture, clearly defining safety roles and accountabilities, and safety being fully integrated in organisational documents, processes and systems. The leadership factors most often selected as one of the top three included leaders demonstrating a commitment to safety, encouraging personal accountability, and articulating a clear vision and values around safety. The workforce factors most often selected as one of the top three were around workers understanding what safety means for them personally, being involved in decisions around safety, and looking out for each other on the job.
Table 4.3

*Frequencies and percentages of importance of factors contributing to positive safety culture (N=35)*

<table>
<thead>
<tr>
<th>Organisational factors</th>
<th>Freq.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The organisation’s systems and frameworks support the desired safety culture</td>
<td>24</td>
<td>68.6</td>
</tr>
<tr>
<td>2. Safety roles and accountabilities are clearly defined</td>
<td>20</td>
<td>57.1</td>
</tr>
<tr>
<td>3. Safety is fully integrated in organisational documents, processes and systems</td>
<td>17</td>
<td>48.6</td>
</tr>
<tr>
<td>4. The organisation has a clear stance on safety</td>
<td>11</td>
<td>31.4</td>
</tr>
<tr>
<td>5. The organisation has a system for reporting on and learning from safety experiences</td>
<td>11</td>
<td>31.4</td>
</tr>
<tr>
<td>6. Safety policies are consistently applied across business units in the organisation</td>
<td>11</td>
<td>31.4</td>
</tr>
<tr>
<td>7. Communication channels are effective for safety messages</td>
<td>6</td>
<td>17.1</td>
</tr>
<tr>
<td>8. The organisation’s business operating structure (eg. Divisions) supports safety goals</td>
<td>4</td>
<td>11.4</td>
</tr>
<tr>
<td>9. Business units customise safety policies to meet the needs of their business</td>
<td>1</td>
<td>2.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leadership factors</th>
<th>Freq.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Leaders demonstrate commitment to safety</td>
<td>32</td>
<td>91.4</td>
</tr>
<tr>
<td>2. Leaders encourage personal accountability in relation to safety</td>
<td>19</td>
<td>54.3</td>
</tr>
<tr>
<td>3. Leaders can articulate a clear vision and shared values around safety</td>
<td>16</td>
<td>45.7</td>
</tr>
<tr>
<td>4. Leaders listen to workers’ ideas and concerns about safety</td>
<td>14</td>
<td>40.0</td>
</tr>
<tr>
<td>5. Leaders have a clear understanding of safety culture</td>
<td>9</td>
<td>25.7</td>
</tr>
<tr>
<td>6. Leaders support workers to “take safety on” in difficult situations</td>
<td>8</td>
<td>27.9</td>
</tr>
<tr>
<td>7. Leaders provide practical support for safety</td>
<td>7</td>
<td>20.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Workforce factors</th>
<th>Freq.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Workers understand what safety means for them personally</td>
<td>24</td>
<td>68.6</td>
</tr>
<tr>
<td>2. Workers are involved in decisions about safety</td>
<td>20</td>
<td>57.1</td>
</tr>
<tr>
<td>3. Workers “look out for each other” on the job</td>
<td>19</td>
<td>54.3</td>
</tr>
<tr>
<td>4. Workers are involved in improving safety processes</td>
<td>15</td>
<td>42.9</td>
</tr>
<tr>
<td>5. Workers receive on-the-job safety training</td>
<td>13</td>
<td>37.1</td>
</tr>
<tr>
<td>6. Workers understand what safety culture is about</td>
<td>12</td>
<td>34.3</td>
</tr>
<tr>
<td>7. Workers receive formal off-the-job safety training</td>
<td>2</td>
<td>5.7</td>
</tr>
</tbody>
</table>

In addition to rating the most important factors for positive safety culture, the panel were also asked to give a rating of how evident (on a 7-point scale from 1 representing never evident to 7 representing always evident) they thought each of the factors were in the organisation currently (Table 4.4). With average ratings from the panel ranging from 3.89 to 5.80, all the factors were considered to be at least ‘occasionally evident’ through to almost ‘mostly evident’ in the organization. The
factor rated as most evident was around the organisation having a clear stance on safety, whilst the least evident factor was around workers being involved in improving safety processes.

Table 4.4

Means and standard deviations of how evident the factors are in the organisation ($N = 35$) (rating scale: $1 = never evident, 7 = always evident)

<table>
<thead>
<tr>
<th>Organisational factors</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The organisation has a clear stance on safety</td>
<td>5.80</td>
<td>1.23</td>
</tr>
<tr>
<td>2. The organisation has a system for reporting on and learning from safety experiences</td>
<td>5.40</td>
<td>1.04</td>
</tr>
<tr>
<td>3. The organisation’s business operating structure (eg. Divisions) supports safety goals</td>
<td>5.26</td>
<td>1.22</td>
</tr>
<tr>
<td>4. Safety roles and accountabilities are clearly defined</td>
<td>4.74</td>
<td>1.07</td>
</tr>
<tr>
<td>5. Communication channels are effective for safety messages</td>
<td>4.74</td>
<td>1.44</td>
</tr>
<tr>
<td>6. Safety policies are consistently applied across business units in the organisation</td>
<td>4.57</td>
<td>1.15</td>
</tr>
<tr>
<td>7. Safety is fully integrated in organisational documents, processes and systems</td>
<td>4.51</td>
<td>1.25</td>
</tr>
<tr>
<td>8. The organisation’s systems and frameworks support the desired safety culture</td>
<td>4.40</td>
<td>1.19</td>
</tr>
<tr>
<td>9. Business units customise safety policies to meet the needs of their business</td>
<td>4.40</td>
<td>1.36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leadership factors</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Leaders demonstrate commitment to safety</td>
<td>5.14</td>
<td>1.26</td>
</tr>
<tr>
<td>2. Leaders encourage personal accountability in relation to safety</td>
<td>4.94</td>
<td>1.21</td>
</tr>
<tr>
<td>3. Leaders support workers to “take safety on” in difficult situations</td>
<td>4.91</td>
<td>1.25</td>
</tr>
<tr>
<td>4. Leaders have a clear understanding of safety culture</td>
<td>4.83</td>
<td>1.34</td>
</tr>
<tr>
<td>5. Leaders can articulate a clear vision and shared values around safety</td>
<td>4.83</td>
<td>1.34</td>
</tr>
<tr>
<td>6. Leaders provide practical support for safety</td>
<td>4.54</td>
<td>1.36</td>
</tr>
<tr>
<td>7. Leaders listen to workers’ ideas and concerns about safety</td>
<td>4.34</td>
<td>1.31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Workforce factors</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Workers receive on-the-job safety training</td>
<td>4.89</td>
<td>1.28</td>
</tr>
<tr>
<td>2. Workers “look out for each other” on the job</td>
<td>4.63</td>
<td>0.97</td>
</tr>
<tr>
<td>3. Workers understand what safety means for them personally</td>
<td>4.63</td>
<td>0.97</td>
</tr>
<tr>
<td>4. Workers are involved in decisions about safety</td>
<td>4.17</td>
<td>1.18</td>
</tr>
<tr>
<td>5. Workers receive formal off-the-job safety training</td>
<td>4.09</td>
<td>1.31</td>
</tr>
<tr>
<td>6. Workers understand what safety culture is about</td>
<td>3.94</td>
<td>1.28</td>
</tr>
<tr>
<td>7. Workers are involved in improving safety processes</td>
<td>3.89</td>
<td>1.16</td>
</tr>
</tbody>
</table>
When comparing the Tables 4.3 and 4.4, some interesting observations can be made. In particular, the ratings of the importance and evidence of key organisational factors are not aligned. The factor around systems and frameworks supporting safety culture was most often selected as top three for importance, but was rated as the second least evident factor in the organisation currently. Similarly, although not as stark, the factor around safety being integrated in organisational documents, processes and systems was selected as top three for importance by 48% of respondents, but rated third least evident.

The importance and evidence of the leadership factors were much more aligned, with two of the top three important leadership factors being viewed as ‘often evident’ and ‘sometimes evident’ by the safety leaders. Finally, the workforce factors varied in their alignment of importance and evidence, with some factors viewed as similarly important and evident, and others—such as workers receiving on the job training—being perceived as ‘quite evident’, but not as important.

4.3.3 Barriers to safety culture

This category of interest was investigated in both the interview round and follow-up questionnaire round of the Delphi method. Results are presented from each round respectively.

Interview themes

The organisational safety leaders were also interviewed about what they thought were barriers to both creating and maintaining safety culture in the organisation. Table 4.5 provides an overview of the key themes and extracts from the interviews. The first major theme to emerge was around competing business priorities, including production and cost pressures, and workload and time pressures. One interviewee’s comments on safety being an add-on, with “perceived time and cost implications” reflected this theme by displaying how safety is viewed as an extra activity on top of usual business, rather than something that is integrated in existing business activities. The benefits of operating safely were seen as less tangible than the benefits of meeting production outputs and time/cost charts. The responses indicated a perception that middle management felt production and cost pressures the most, and that the organisation needed to support managers and supervisors in managing their workload, and ensuring safety is included when
scoping roles. The strength of this theme is evidenced by responses about the compromising of safety in order to meet production pressures. Additional responses further confirmed that the difficulty of maintaining safety awareness was a barrier to safety culture, and that it was important to keep it alive and avoid being complacent about safety risks when other issues appear more urgent.

Another central theme to emerge in relation to barriers to safety culture was around workforce issues. These included the transience of the subcontractor workforce and the difficulties of managing individual differences. Subcontractor management was a significant barrier raised by many interviewees, not only in relation to the short work periods they perform, but also in terms of having to deal with cultural integration and competency gaps. Responses indicated that some safety leaders thought this issue increased risks on projects, and was seen as a significant barrier to safety culture in recent years and into the future. Also related to the theme of workforce issues were individual differences amongst the workers. Responses recognised that people are different, and that different educational methods are required to get the safety culture message across. However, some safety leaders thought that education was not enough to change some workers’ behaviours, and that ultimately safety decisions will be made by individuals with different motivations and attitudes towards safety.

The third theme identified from the data around safety culture barriers was in relation to the change process itself, including the amount and pace of change and putting things into practice. Responses indicated that the safety leaders felt the organisation was experiencing exponential growth and fast changes in both the workforce and organisational systems, and that this hindered positive cultural development. Other responses in relation to the change process theme suggested that some changes were not happening quickly enough, particularly in relation to operationalised safety culture initiatives. These two sub-themes are connected: the pace of organisational change makes the implementation of cultural initiatives difficult, which results in frustration when the initiatives are not implemented in time to match this pace of change.
Table 4.5

Themes associated with barriers to safety culture

<table>
<thead>
<tr>
<th>Theme and sub-themes</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Competing business priorities</strong></td>
<td>“We live in a life where safety is an add-on, rather than a part of doing business. That means that there are perceived time and cost implications.”</td>
</tr>
<tr>
<td>- Production and cost pressures</td>
<td>“The issue is middle management – they still feel the pressures of production and cost. They need to participate in it [safety culture].”</td>
</tr>
<tr>
<td>- Workload and time pressures</td>
<td>“People become daunted by the volume of what is required. They become overwhelmed and can’t see where to start. We need to help them see where to start by prioritising issues and providing support.”</td>
</tr>
<tr>
<td>- Maintaining a high level of awareness</td>
<td>“The reality is that compromises are made when the pressure is on.”</td>
</tr>
<tr>
<td><strong>Workforce issues</strong></td>
<td>“It’s hard to keep it as a priority – I find it hard – because there’s so much else on.”</td>
</tr>
<tr>
<td>- Subcontractor transience</td>
<td>“It’s like you’re starting from scratch all the time.”</td>
</tr>
<tr>
<td>- Individual differences</td>
<td>“Each individual thinks about safety in a different way”</td>
</tr>
<tr>
<td></td>
<td>“A common barrier is employee behaviour – people still willing to put themselves at risk. We provide all the encouragement and guidance and everything under the sun but sometime will still make a decision to do it a different way”</td>
</tr>
<tr>
<td><strong>The change process</strong></td>
<td>“Culture takes a while to build, and it takes a while for that culture to mature. If you are forever changing the leadership, the systems, the expectations or the values, the culture never has time to embed itself and mature. It generally just stays as more reactive.”</td>
</tr>
<tr>
<td>- Too much change too quickly</td>
<td>“The issue is in changing from theory to practice”</td>
</tr>
<tr>
<td>- Putting things into practice</td>
<td>“Everyone is saying the right things but we’re just not seeing things getting done, it’s taking too long. Give us the tools—we want to do it, not just talk about it”</td>
</tr>
<tr>
<td><strong>Industry issues</strong></td>
<td>“One of the biggest barriers I see is with the system that has been created to manage safety on big projects like this is, trying to comply with the multitudes of standards, regs, governing bodies, federal bodies. And they are constantly changing expectations and goalposts.”</td>
</tr>
<tr>
<td>- Legislative complexity</td>
<td>“It is a big call to ask [the company] to be a leader on this on their own. It would be much easier if all the big construction companies could come on board or if we had a similar regulatory system [as the oil and mining industries]”.</td>
</tr>
<tr>
<td>- Regulatory system</td>
<td>“The building business is competitive and we compete against people who don’t have the same safety standards as us”</td>
</tr>
<tr>
<td>- Competitive nature of industry</td>
<td>“Will [the company] still win work if we are more expensive?”</td>
</tr>
</tbody>
</table>
The final theme to emerge from the interviews with safety leaders related to industry barriers. These included issues around legislative complexity, a poor regulatory system for the industry and competition issues with other construction companies. Responses suggested that there was a concern about the organisation’s safety goals not being supported by the legislative and regulatory systems for the industry. The legislative requirements around safety were viewed as complex and requiring a lot of ‘paperwork’. The impact was perceived to stretch to internal systems, that many felt were further complicating legislative requirements, and were not sufficiently integrated into other organisational processes. Within this theme, responses also reflected a concern about the company’s competitiveness within the industry, as other companies who did not have the same safety standards could potentially win more work if evaluated on a (financial) cost basis.

**Questionnaire ratings**

In the follow-up questionnaire, the safety leaders were asked to select their top five barriers from a list derived from the interviews. Given the number of barriers identified in the interviews, and the various levels at which they operate, the selection of five barriers was considered most appropriate to capture potential variation amongst participants. Table 4.6 represents the number of people who rated each barrier as one of that top five, and the corresponding percentage.

Subcontractor management and operations was seen as a significant barrier by 63% of respondents. Similarly, the transience of the workforce rated as a top five barrier by 45% of the sample. This is reflected more strongly here than in the interview data. In addition, too much paperwork was also rated as a significant barrier by 60% of respondents, relating to the identified interview theme of industry barriers to safety culture, and in particular legislative requirements. However, comments around this theme also referred to internal processes complicating these issues, so the rating could also be reflective of a lack of alignment and support for safety culture. Interestingly, other industry issues discussed in the interview themes did not rate as highly here, with only 14% and 8% rating the competitive nature and poor regulatory systems respectively as one of the their top five barriers.
Table 4.6

Frequencies and percentages for the most significant barriers to creating and maintaining safety culture (N=35)

<table>
<thead>
<tr>
<th>Most significant barriers</th>
<th>Freq</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulties with subcontractor management and operations</td>
<td>22</td>
<td>62.9</td>
</tr>
<tr>
<td>Too much paperwork</td>
<td>21</td>
<td>60.0</td>
</tr>
<tr>
<td>The challenge of “Keeping it fresh”</td>
<td>16</td>
<td>45.7</td>
</tr>
<tr>
<td>Low levels of competency in safety leadership roles</td>
<td>17</td>
<td>48.6</td>
</tr>
<tr>
<td>Transiency of the workforce</td>
<td>16</td>
<td>45.7</td>
</tr>
<tr>
<td>Too much change too quickly</td>
<td>15</td>
<td>42.9</td>
</tr>
<tr>
<td>Competing business priorities e.g., production versus safety</td>
<td>13</td>
<td>37.1</td>
</tr>
<tr>
<td>Maintaining a high level of safety awareness even when incidents aren’t occurring</td>
<td>12</td>
<td>34.3</td>
</tr>
<tr>
<td>Excessive workload</td>
<td>11</td>
<td>31.4</td>
</tr>
<tr>
<td>Complexity of safety legislation</td>
<td>7</td>
<td>20.0</td>
</tr>
<tr>
<td>Not enough safety resources</td>
<td>7</td>
<td>20.0</td>
</tr>
<tr>
<td>Financial costs associated with safety</td>
<td>6</td>
<td>17.1</td>
</tr>
<tr>
<td>Competitive nature of the industry</td>
<td>5</td>
<td>14.3</td>
</tr>
<tr>
<td>“Bad attitudes” about safety</td>
<td>4</td>
<td>11.4</td>
</tr>
<tr>
<td>Poor regulatory system for industry</td>
<td>3</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Other barriers rated as significant by a high proportion of respondents related to ‘keeping it fresh’, competency in leadership roles, and the pace of change. Interestingly, competing business priorities was only rated as a top five barrier by 37% of respondents, despite this being a key theme identified in the interviews, and supported by statements around concern for the ‘cost’ of prioritising safety. It is possible that the ‘competing business priorities’ item was presented too broadly to rate highly in the questionnaire responses. Another possibility is that the safety leaders were affected by social desirability biases, as their positions would require them to communicate the message of ‘safety first’, and this may have affected their rankings.
4.3.4 Enhancing and improving safety culture

This category of interest was investigated in both the interview round and follow-up questionnaire round of the Delphi method. Results are presented from each round respectively.

**Interview themes**

After discussing safety culture factors and barriers, interviewees were asked about how they thought the organisation could enhance or improve its safety culture over the next few years. This question was included to identify how these experts thought the factors could be operationalised in the business, and how barriers may be overcome.

The view on the organisation’s safety culture in the future was very positive, despite the considerable barriers described in section 3.3. Many interviewees expressed a view that continuous effort would lead to an improved culture. One interviewee said “You just have to stay at it ... take stock regularly—sit back, check if the conditions have changed and if we need to do something differently”. Similarly, other interviewees commented that “Safety is like riding a bike up a hill—as soon as you stop pedalling you go backwards” and “Success will come through persistence—it’s a fragile space, safety”. The fragility of the organisation’s safety culture was also reflected in an interviewees comment that “It’s much harder to build a culture than break a culture”. Another recognised that the cultural journey was not a fast one and that the organisation was “still working on ownership and understanding—it takes time.”

Simplicity and consistency of cultural messages, material, processes and frameworks were also considered critical to the improvement of safety culture in the organisation. One interviewee emphasised that “not all things are important, [we need to] identify the critical few things that are important”. Another interviewee extended this, “I think safety culture is significantly enhanced when there is simplicity in terms of process and framework for the safety system”. This was something that should be led by the organisation’s leaders, through improved visibility: “I would like to see more from corporate and branch leadership in being visible, particularly to projects. It’s not just about what they say it’s what they do.” It was also suggested that systems and cultural objectives should be better aligned and integrated into an overarching safety management system.
Other comments related to improved change management of the cultural change process, including establishing a core group of change agents to assist the organisation in moving towards its cultural targets. The roles of corporate areas were also discussed, in particular around the improved coordination of safety efforts, including more guidance and support from corporate areas to reduce inconsistency and inefficiency across projects. Finally, it was recognised that the organisation’s growth and pace of change was critical to consider in any cultural approach to safety, including considering sustainability and flexibility to adapt to changing markets, “Whatever we put in place now needs to be sustainable and grow with the organisation.”

Questionnaire ratings

In the follow-up questionnaire, panel members were asked to rank their top three facilitators of safety culture in the organisation from a list derived from the interviews, in order to determine a level of consensus from the group. Table 4.7 shows the number of people who rated each strategy as one of that top three, and the corresponding percentage.

Table 4.7

<table>
<thead>
<tr>
<th>Facilitators of safety culture</th>
<th>Freq</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensuring the systems support the desired safety culture</td>
<td>23</td>
<td>65.7</td>
</tr>
<tr>
<td>Having clear and simple safety messages</td>
<td>19</td>
<td>54.3</td>
</tr>
<tr>
<td>Defining safety leadership roles and accountabilities</td>
<td>16</td>
<td>45.7</td>
</tr>
<tr>
<td>Managing safety culture as a change process</td>
<td>15</td>
<td>42.9</td>
</tr>
<tr>
<td>Having a framework for enforcing safety accountabilities</td>
<td>13</td>
<td>37.1</td>
</tr>
<tr>
<td>Making sure the business is ready for relevant safety culture initiatives</td>
<td>7</td>
<td>20.0</td>
</tr>
<tr>
<td>Identifying and supporting change agents/ champions across the organisation</td>
<td>7</td>
<td>20.0</td>
</tr>
<tr>
<td>Communicating organisational safety priorities</td>
<td>5</td>
<td>14.3</td>
</tr>
</tbody>
</table>

The results support the key interview themes identified, with systems supporting safety culture and clear and simple safety messages being most
commonly rated as important facilitators of safety culture. Defining safety roles and accountabilities and having a framework for enforcing these were also considered important strategies by a number of respondents. Interestingly, communicating organisational safety priorities was only rated in the top three most important by 14% of the panel.

However, it is important to recognise that some facilitators may have been rated as more important because they are perceived as currently lacking in the organisation, and are therefore ‘top of the list’ for improvement. Other facilitators may not have been chosen as the top three because they were not seen as urgent, or they were seen as already operating within areas of the organisation.

4.4 DISCUSSION

This study aimed to explore how safety culture is understood and described by safety leaders in the organisation, and to determine the key factors and barriers to safety culture development and maintenance in the industry context.

4.4.1 Theoretical implications

The key themes identified in the safety leaders’ definitions and descriptions of safety culture highlight that their understanding of safety culture related to the actions and behaviours of the workforce, and in particular how people behaved in their normal mode of operation. Thus, the focus was more on the outcomes of culture, such as behavioural expressions, rather than the content. The descriptions also recognised the link between safety culture and the organisation’s broader culture, highlighting the desire to integrate safety values with the broader business approach in the organisation. Relating this to the layered view of culture (Guldenmund, 2000; Schein, 1992), the outer layer of artefacts was reflected in descriptions much more than the middle or core layers. Given the nature of the construction industry, and the dominant disciplines within it – engineers, project managers, and trade-skilled construction workers – it is not surprising that the tangible components of complex concepts such as culture are given emphasis (e.g., leaders’ talking about safety with the frontline workforce). The implication of this is that many theory-based definitions of safety culture may not be easily understood and accepted in practice, and having simple and practical messages about safety was important to the safety leaders in this sample.
The key themes identified in the safety leaders’ understanding of the safety culture factors revealed that, consistent with the literature (e.g., Banks & Davey, 2010, Clarke & Ward, 2006; Hofmann & Morgeson, 2004; Zohar & Luria, 2005), leadership was identified as a key factor for positive safety culture in the organisation, and there was an emphasis on leaders demonstrating commitment to safety, and being visible to the project-based workforce. These findings align with the functionalist perspective, which views culture as something that can be deliberately influenced to support management strategies and systems (Glendon et al., 2006). Perhaps this is not surprising, given that the sample were all leaders themselves, and likely have experience in attempting to influence culture in their workplace. However, the emphasis on visibility and closely collaborative relationships between frontline workers and senior management is critical in the context of construction project work, and suggests the need for values to be translated into model leadership behaviours for a positive safety culture (Biggs et al., 2005).

Also consistent with the literature was an emphasis on effective communication and worker’s involvement in safety. A number of studies across various samples and industries have established the importance of these factors in fostering and maintaining a positive safety culture (Dedobbeleer & Beland, 1991; Dingsdag et al., 2008; Zohar, 2010). This study has confirmed the relevance and importance of these factors in a construction context. Worker’s involvement in safety can also be understood as an outcome of high safety motivation—another concept that has considerable support in the literature (e.g., Neal et al., 2000). This concept is reflected in the theme around worker’s involvement (participation is an outcome of safety motivation), and the theme around defined safety accountabilities—about organisational reward and recognition systems, and appropriate behaviour being rewarded and inappropriate behaviour having clear and consistently applied consequences.

Perhaps less obvious in the literature but clear and consistent in the responses of this sample, was the theme around simple and streamlined safety systems being critical to supporting cultural goals. Comments related to simplifying safety reporting and minimising paperwork so that other aspects of safety could be prioritised. This could reflect current organisational maturity around safety, insofar as a focus on...
systems is considered to be reflective of a reasonably immature culture (Hudson, 2007). The emergence of this theme could also be unique to the sample in this instance. Managers are more likely to be exposed to the frustrations of complex systems, particularly if they are not aligned to the values espoused at the senior management level.

### 4.4.2 Practical implications

The results from this study have a number of practical implications for the organisation studied, and industry more generally. The key themes identified in the safety leaders’ perceptions of barriers to safety culture identified a number of issues that were viewed as significant to the development and maintenance of safety culture, and that are likely to impact upon safety culture initiatives within the organisation. The company has built its reputation on its ‘can-do attitude’ to projects, and this has commonly been interpreted as a high production focus. Managers are now trying to reinterpret this as a ‘can-do safely’ approach to construction works, but there are clearly some perceived contradictions with this. The safety leaders raised diverse issues such as the transient subcontractor workforce, legislative and regulatory difficulties, and the challenge of maintaining safety awareness under high production pressures. The challenges presented by the subcontractor workforce may be highly relevant to the construction industry, but the other key barriers are likely to be experienced by many organisations across various industries. Whilst these barriers may not be possible to overcome in the short term, their impact can be lessened if they are identified early in the change process. The consideration of barriers is not common in the current research literature (see Banks & Davey, 2010, for an exception), but is critical to the ultimate success of any cultural initiatives.

More broadly, the safety leaders’ perceptions of culture reflect their understanding that culture change is complex, difficult, and time-consuming, and that values and ideals are difficult to translate into practice. However, this is balanced by a mostly functional view of culture, whereby culture is viewed as something that can be proactively influenced, and leaders are believed to be the drivers of cultural change. Interviewee comments about enhancing safety culture indicate that consistent effort is required to achieve better safety outcomes over time. Any change must be cognisant of current organisational maturity and change readiness, as well as the influence of barriers to that change.
4.4.3 Strengths, limitations and future research

This study provides an important insight into how safety culture is understood by the safety leaders in the organisation, offering a critical perspective to bridge the gap between safety culture theory and practice. An important gap in the current research literature was addressed, by exploring the key factors and barriers to safety culture from the perspective of the leaders who drive culture in the organisation. The most important factors and barriers have been identified through the modified Delphi method of iterative rounds with a panel of experts and discussed in detail. Further, this study offers a leadership perspective on safety culture, which will later be compared to a broader workforce sample in the second study. Finally, the themes from the interviews highlight the overriding importance of management commitment to safety, which is commonly reported as the higher order factor in safety climate measures. It appears that a management commitment measure of climate may be appropriate for further research in the organisation.

This study has contributed to the body of safety culture knowledge in that it derived safety culture descriptions from key stakeholders within the organisation for future investigations, as opposed to using traditional conceptualisations of safety culture that have not been customised for the organisation or the construction industry more broadly. A substantive body of research has investigated safety culture definitions and content (e.g., Cooper, 2000; Guldenmund, 2000) but few research studies begin with clarifying the understanding for that population prior to embarking on measurement, analysis and interpretation. One important strength of the study was that the interviewees were recognised safety leaders within the organisation, and were in a position to provide expert opinion on their understanding of safety culture. Insights gained from this research are critical to both researchers and practitioners attempting to integrate safety culture theory and practice to improve safety outcomes.

Given that this research has important applications within the safety culture field, further research would be beneficial to continue to explore the role of leaders’ perceptions in developing and maintaining positive safety culture in organisations. This will be a focus of investigation in Studies Two and Three. Furthermore, it is recognised that frontline workers may interpret leaders’ cultural messages differently, and it is important to explore perceptions of management commitment to safety with the broader workforce. Particularly relevant in this study is the possible
influence of social desirability biases within the management group. That is, it is likely that some interviewees felt the need to project positive perceptions of safety in their workplace, as safety is clearly an espoused priority within the organisation. The next phase of this research program, described in Chapter 5, surveyed a broader cross-section of the workforce to determine whether there are similar perceptions of the facilitators and barriers to safety culture at different levels of the organisation.

As previously described, safety culture is understood as a top-down driven process, in that organisational leaders influence the culture, and interventions can be targeted to improve safety culture elements and therefore related outcomes. Implicit in this approach is a critical need to understand the perspective of the organisational safety leaders to further understand how safety culture is articulated and led in the organisation. Figure 3.1 outlines the theoretical framework underpinning Study One, and this chapter has described the synthesis and contrast of the facilitators and barriers to safety culture development in this organisation. In particular the elicited themes of continuous effort leading to an improved culture, simplicity and consistency of cultural messages, material, processes, and frameworks as effective catalysts, improved change management of the cultural change process, and the organisation’s growth, pace of change, flexibility and sustainability were considered critical by the respondents to a cultural approach to safety.

4.5 CHAPTER SUMMARY

This chapter has presented the first study of the research program. The findings from the organisational safety leaders’ interviews provided an insight into how safety culture is understood and applied in practice within the organisation. The key facilitators and barriers to safety culture development and maintenance were identified and must now be confirmed with the broader workforce. Additionally, leadership and management commitment to safety culture was confirmed as the most important factor for a positive safety culture, which is aligned to current literature around safety culture and climate conceptualisations.

The following chapter presents the second study of the research program. The study involved the development and distribution of a quantitative workforce survey, designed to investigate the intra-organisational differences in perceptions of safety climate, the relationship between safety climate, safety behaviour, and other
mediating factors, and further explore facilitators and barriers to safety culture development and maintenance. The second study specifically builds on Study One by exploring perceptions of facilitators and barriers with the broader workforce, as well as examining how perceptions of management commitment to safety (a key factor identified in the current sample) are related to safety performance at an individual level.
Chapter 5: Investigation of safety climate perceptions in the workforce

This chapter describes the research undertaken for the second study in the PhD research program. Study One investigated safety culture barriers from an organisational/managerial perspective and explored how safety culture was defined and described; the factors comprising safety culture; facilitators of safety culture; and barriers to safety culture development and maintenance. Study Two investigated safety climate perceptions with a cross-sectional sample of the organisation, gaining a large sample of self-report data on safety climate, motivation, performance and non-compliance, as well as perceptions of leadership and stage of change and allowing investigation of the relationship between safety climate and safety behaviour. A background to the research is provided, including how this study fits in the overall research design, and the specific research questions addressed in the study. Hypotheses are presented as they relate to each research question. The method is then described in detail, including the development of the survey, the sample, survey distribution and data analysis. Results relating to each hypothesis are presented and discussed in terms of implications for both theory and practice.

5.1 STUDY AIMS AND HYPOTHESES

The second study of the research program aimed to empirically investigate the safety climate of the organisation, and the factors influencing the relationship between safety climate, safety behaviour, and related safety outcomes. Figure 3.1 outlines the theoretical framework underpinning this investigation. This study contributes to the overall program of research by addressing the second and third research objectives and more specifically, research questions 2, 3 and 4.

- **RQ2: What are the key facilitators and barriers to safety culture?** Study One (Chapter 4) explored the most important facilitators and barriers to safety culture from the perspective of safety leaders in the organisation. This study examines these with a broader workforce sample and attempts to distil higher order factors or categories to inform safety culture research.
• **RQ3:** *Are there intra-organisational differences in safety culture perceptions and safety behaviour?* This study measures the safety climate of a large cross-section of the workforce in order to determine overall climate and any intra-organisational differences. Similarly, the study explores potential intra-organisational variations in self-reported safety behaviour.

• **RQ4:** *What additional factors influence safety behaviour and related outcomes?* The final research question addressed by this study analyses the factors that influence safety behaviour and related outcomes in a cross-sectional workforce sample. Potential predictive variables are considered as they relate to self-reported measures of safety participation, safety compliance, procedural compliance and non-compliance, and incident involvement.

The research questions were investigated in this study through the use of testable hypotheses. Table 5.1 presents a summary of hypotheses as they relate to the research questions.

The safety leaders sample in Study One rated the themes from interviews in order to determine or ‘rate’ the most important safety culture facilitators and barriers. These were included as items in the current study, in order to determine if they were perceived similarly in the broader workforce. The most important facilitators rated by the leaders were ensuring the systems were aligned with the safety culture, and having clear and simple messages about safety. The most important barriers were managing subcontractor operations and quantity of safety paperwork. These themes were similar to those identified in previous literature.

Due to the safety leadership roles of the participants in Study One, it was expected that the identified facilitators and barriers to safety culture would be reflective of the broader organisational perceptions. Therefore, it was hypothesised that the highly ranked facilitators and barriers from leaders in Study One would be consistently perceived in this broader workforce sample (*H1*). Furthermore, in relation to the facilitators, it was hypothesised based on previous research that the items would load onto higher order factors around safety communication and worker involvement (*H2*). Similarly, it was hypothesised that the barrier items would load
onto higher order factors, reflecting more general themes around difficulties with developing and maintaining safety culture ($H3$).

Table 5.1

Hypotheses and Study Two research questions

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Research Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H1$. The highly ranked facilitators and barriers from leaders in Study One will be consistently perceived in this broader workforce sample</td>
<td>RQ2</td>
</tr>
<tr>
<td>$H2$. The facilitator items will load onto higher order factors around safety communication and worker involvement</td>
<td>RQ3</td>
</tr>
<tr>
<td>$H3$. The barrier items will load onto higher order factors, reflecting more general themes around difficulties with developing and maintaining safety culture</td>
<td>RQ4</td>
</tr>
<tr>
<td>$H4$. Safety climate, motivation, compliance and participation will differ across organisational divisions</td>
<td></td>
</tr>
<tr>
<td>$H5$. Safety climate, motivation, compliance and participation will differ amongst workforce levels</td>
<td></td>
</tr>
<tr>
<td>$H6$. Safety climate, safety motivation, leadership and stage of change will explain a significant proportion of variance in safety compliance and safety participation</td>
<td></td>
</tr>
<tr>
<td>$H7$. Safety climate, safety motivation, leadership and stage of change will explain a significant proportion of variance in incident involvement and non-compliance (receiving warnings)</td>
<td></td>
</tr>
<tr>
<td>$H8$. Safety motivation, leadership and stage of change will mediate the relationship between safety climate and safety compliance and participation</td>
<td></td>
</tr>
</tbody>
</table>

Given the size and diversity of the current construction and mining organisation, it is possible that a number of safety climates exist. Previous research suggests that work groups or workforce levels differ in their perceptions of how safety is valued and prioritised due to differing working environments and management approaches (Morris et al., 1999; Prussia et al., 2003). Divisional/functional areas were of specific interest in the current study given the breadth of operations conducted by the organisation. The organisation is structured around these divisional areas, and it is important to know if the divisions have their
own climate (that is, shared perceptions of how safety is valued by management) or whether these perceptions are shared at the organisational level. Therefore, based on previous literature, it was hypothesised that safety climate, motivation, compliance and participation would differ across organisational divisions ($H4$). Additionally, it was hypothesised that safety climate, motivation, compliance and participation would differ amongst workforce levels ($H5$).

As discussed in Chapter 3, safety culture is very difficult to measure. It encompasses many intangible layers of individuals’ values, opinions and assumptions about the world that are often not explicitly known to the individual (Guldenmund, 2000). Safety climate is often used as a measure of culture because it can be determined easily and efficiently through survey questions. Safety climate refers to the individual perceptions of the value of safety in the work environment (Neal et al., 2000). More specifically, safety climate is measured as the aggregate perceptions of management commitment to safety, as reflected in organisational values and processes. Previous research suggests that what employees believe managers think about safety is important (Johnson, 2007). As the term suggests, climate reveals the safety temperature at a point in time, and is most valuable when measured at regular intervals to compare changes and track progress over time.

Safety climate has been shown to be strongly linked to safety performance (Johnson, 2007; Mohamed, 2002; Seo, 2005). In a recent meta-analysis Christian et al. (2009) identified a number of studies showing a link between climate and various measures of safety performance, including self-reported safety behaviour and incident involvement. As shown in Figure 3.1, this research is guided by a model of safety performance that defines two behavioural components of safety: safety compliance and safety participation. In addition to safety climate predicting safety behaviour, a number of mediating factors have been associated with the climate-behaviour relationship. The theoretical framework underpinning the research includes three influential factors with considerable support in the research literature: safety motivation, leadership and stage of change. Therefore, it was hypothesised that safety climate, safety motivation, leadership and stage of change would explain a significant proportion of variance in safety compliance and safety participation ($H6$).

In addition to the components of safety behaviour described above, further measures of safety performance were included to provide a comprehensive view of
the climate–behaviour relationship. Self-report measures of incident involvement and non-compliance (receiving warnings for not following safety rules) were also included as dependent variables. Given the conceptual similarity between these measures and safety behaviour components, it was expected the predictive factors would exhibit a similar relationship. Therefore, it was hypothesised that safety climate, safety motivation, leadership and stage of change would explain a significant proportion of variance in incident involvement and non-compliance (receiving warnings) ($H_7$).

Further to the expected predictive value of the above variables, previous work suggests that the relationship between safety climate and behaviour may be mediated by the additional predictive factors discussed above. That is, safety climate may influence safety behaviour through more proximal variables such as safety motivation, leadership and stage of change. As presented in Figure 3.1, these variables potentially provide a more sophisticated explanation of the classic safety climate–behaviour relationship, whereby climate affects behaviour because of these proximal variables. Therefore, it was hypothesised that safety motivation, leadership and stage of change would mediate the relationship between safety climate and safety compliance and participation ($H_8$).

5.2 METHOD

The development of the survey was cognisant of industry considerations, in particular the research team was aware that the survey needed to be suitable for the workforce, in relation to length and question language. Several drafts were reviewed by appropriate organisational contacts (primarily divisional safety managers) for appropriate format, length and language, and the resulting survey was a result of review and amendment. The survey also underwent a pilot with blue-collar workers ($N = 8$) on a Brisbane project site to ensure relevance and comprehension. Some questions were re-worded to be relevant to the workforce, while not compromising their empirical validity. For example, “senior executive team” was changed to “senior management” to reflect organisational terminology. Additionally, two barrier items were reworded to aid understanding. The item “the challenge of keeping it fresh” was reworded to “people losing enthusiasm for safety initiatives quickly”. Also, the item “transiency of the workforce” was reworded to “workers coming and going regularly (especially subcontractors)”. Demographic measures were also
reviewed to ensure comparison would be possible with other organisational surveys. Details of work locations and business units were also obtained from existing organisational data.

5.2.1 Participants

All employees of the organisation were invited to participate. At the time of the survey the direct workforce included approximately 10,000 employees. A total of 3,209 surveys were received representing a response rate of approximately 32%. Of those surveys received, 2,957 were usable (that is, had at least one section of the key measures completed, representing 92% of returned surveys).

The majority of respondents were male (86%) and aged between 30 and 50 years of age, with an average age of 39 years. The majority of survey respondents were waged employees (40%) and ‘other’ managers (15%). Subcontractors accounted for 7% of the sample (Appendix E has further details of position types and other demographic characteristics of the sample). In this case-study organisation, subcontractors are closely aligned in policy and practice with the principal contractor, which is atypical of the industry generally. Thus in this organisation, there would be a high likelihood that their responses would reflect mainstream beliefs and attitudes of the workforce, and hence no controls were applied in the analyses. Thirty-four senior managers completed the survey—representing just over 1% of the sample. The great majority of survey respondents worked full-time, with 47% working shifts, and 44% working standard hours. Part-timers and casuals accounted for 1% and 4% of the sample respectively. Average role tenure was just over three years, with 67% of respondents having been in their current role between one to five years. Average organisational tenure was just under four years, with 37% of respondents having been in the organisation between two to five years. Average industry tenure was almost eight years, with half of the respondents having been in the industry between two to ten years. Table 5.2 outlines respondents for each division, whether they completed online or hardcopy surveys, and the total headcount data for the divisions at the time of the survey.

The Resources Division had the highest number of respondents at 1584 and the highest response rate based on headcount data (49%). This was followed by Telecommunications at 27% and Industrial and Energy division at 26% response rate. The lowest response rate was in the Group Services Division, with a 14% rate.
Chapter 5: Investigation of safety climate perceptions in the workforce

Table 5.2

**Divisional respondents by survey type**

<table>
<thead>
<tr>
<th>Division</th>
<th>Online</th>
<th>Hard-copy</th>
<th>Total number</th>
<th>% of sample</th>
<th>Headcount (Dec 2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>440</td>
<td>249</td>
<td>689</td>
<td>23.30</td>
<td>4,258</td>
</tr>
<tr>
<td>Industrial and Energy</td>
<td>1</td>
<td>70</td>
<td>71</td>
<td>2.40</td>
<td>278</td>
</tr>
<tr>
<td>Resources</td>
<td>311</td>
<td>1,273</td>
<td>1,584</td>
<td>53.57</td>
<td>3,264</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>111</td>
<td>7</td>
<td>18</td>
<td>3.99</td>
<td>865</td>
</tr>
<tr>
<td>Corporate</td>
<td>38</td>
<td>1</td>
<td>39</td>
<td>1.32</td>
<td>288</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>362</td>
<td>0</td>
<td>362</td>
<td>12.24</td>
<td>1,330</td>
</tr>
<tr>
<td>Other/ Not specified</td>
<td>58</td>
<td>36</td>
<td>94</td>
<td>3.18</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>1,303</td>
<td>1,654</td>
<td>2,957</td>
<td>100%</td>
<td>10,283</td>
</tr>
</tbody>
</table>

The representativeness of the sample was an important consideration for this study, as the survey distribution was managed through organisational contacts on site. It was important to determine if the people that responded to this survey were similar to people in the organisation generally. Comparison analyses with organisational data suggest that the people that responded to this survey were representative of the organisation more broadly. Data from a 2010 organisational survey were used as a comparison point for this purpose. There were over 7000 respondents to that corporate-driven survey, representing a 70% response rate compared to payroll headcount data at that time. The demographic profile of the current survey respondents was compared to the 2010 organisational survey respondents in terms of category percentages (see Appendix E for descriptive data for these comparisons). Overall, this sample was very similar in terms of gender, age, position type, employment status and organisational tenure, and based on this comparison we had some confidence that the respondents to this survey were representative of the organisation’s workforce.

**5.2.2 Procedure**

The study was cross-sectional and survey based. The survey was conducted over an eight-week period between November 2011 and January 2012. Distribution to all company employees was through organisational safety managers and on-site
visits, where respondents were invited to complete either a hardcopy or online version of the survey. Direct distribution by the researcher was only possible for a limited number of sites due to the geographical dispersion of the organisation. An information sheet was provided to the organisational contacts, stating all relevant information in relation to completion of the survey (see Appendices F and G). Email scripts were also provided for distribution of online links (see Appendices H and I).

Demand characteristics, including the ‘good-participant role’ of the workplace were minimised by ensuring anonymous and confidential online completion of the survey. This was seen as important as demand characteristics refer to the effects of experimental participation, increasing participants’ awareness of being ‘evaluated’ in some way and wanting to produce data that is consistent with what they believe to be the hypotheses of the experiment (Nichols & Maner, 2008). In addition, those employees that completed hardcopy surveys were ensured confidentiality by distribution through safety managers directly to the research team, rather than through line management channels.

The online survey tool was created in Key Survey Enterprise Online Survey Software. Hardcopy survey versions were also created for those participants unable to access a computer. All survey responses were sent to the QUT research team via post or downloaded via the online survey site, Key Survey. Hardcopy surveys were manually entered into spread sheets by the research team and then stored in a locked room with restricted access. All analyses were conducted using SPSS version 20.

5.2.3 Measures

The study survey was four pages including the participant information section (see Appendix J). The first page included demographic questions, the second page included safety climate, safety motivation, safety compliance, safety participation, procedural compliance, non-compliance (receiving warnings) and incident involvement. The third page included leadership and stage of change questions. The final page included questions about safety culture barriers and facilitators.

Demographics

A number of demographic variables were included in the survey to provide a comprehensive description of the sample and for some specific hypotheses.
Gender. Gender of respondents was measured by a two-option response type where respondents indicated male or female as their gender.

Age. Age of respondents was measured by an open response question requiring participants to indicate their age in years.

Employment status. Employment status was measured by a four-option response type where respondents selected from Full-time – Shift worker, Full-time – Non-shift worker, Part Time and Casual. These categories were based on previous employee surveys administered within the case study organisation (primarily focused on measuring constructs such as employee engagement and job satisfaction, and used to drive human resource strategy).

Tenure. Three types of tenure were measured: role tenure, being how long respondents had been in their current role; organisational tenure, being how long respondents had worked for the organisation; and industry tenure, being how long respondents had worked in the industry. Previous research has found that organisational tenure is positively correlated with safety climate perceptions (Beus, Bergman & Payne, 2010). Due to the nature of the industry—including a dynamic and moving workforce—role tenure and industry tenure were also included as they reflect experience and immersion in the construction culture more generally.

Position type. Position type was measured using a categorical response option. Position types included 10 options: Graduate Engineer, Engineer/Senior Engineer, Team Leader /Supervisor/Foreperson, Senior Manager, Functional/Divisional Manager, Other Manager, All Other Salaried Employees, All Other Waged Employees, Subcontractor and Other. For the purposes of analysis, position types were further categorised into four groups: workers, frontline management, middle management and senior management. These categories were validated by the organisational contact as appropriate for this workforce population.

Organisational division. Organisational division was also of interest, given the size and diversity of the organisation. Divisional area was measured as self-reported allocations to one of seven divisional categories: Construction, Resources, Industrial/Energy, Infrastructure, Corporate, Telecommunications, or ‘other’. These categories were also validated by the organisational contact as appropriate for this workforce population.
Project type. In addition to selecting the organisational division they were employed in, respondents were asked to indicate the project on which they were employed. This was an open-response question, as the organisation had over 100 projects active at the time.

**Safety culture facilitators and barriers**

The results of Study One indicated a number of significant facilitators and barriers of safety culture as identified by the management sample interviewed. One of the aims of Study Two was to obtain a view from the broader workforce on these same facilitators and barriers. Therefore the main themes from the leader interviews were presented as items in this workforce sample. Some items from Study One were adapted to suit the broader sample. For example, the item “bad attitudes about safety” was extended to two items in the current survey, specifically: “bad attitudes about safety amongst managers” and “bad attitudes about safety amongst employees”. Additionally, two barrier items were re-worded to aid understanding (as described in section 5.2).

The survey measured respondents’ views on the facilitators of safety culture (ways to improve safety culture). Eight strategies were presented (consistent with Study One), and respondents were asked to indicate how strongly they agreed or disagreed with the significance of the facilitators, on a scale from 1 to 5 (1 = strongly disagree to 5 = strongly agree). Also consistent with Study One, 16 safety culture barriers were presented, and respondents were asked to indicate agreement with the item being a significant barrier to safety culture within the organisation. All items were measured on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The mid-point was defined as ‘neutral’.

**Safety climate**

Safety climate was measured using a three-item scale from Neal and Griffin (2006) that was designed to measure perceptions of management commitment to safety and is operationalized by the value and priority given to safety (i.e., safety values). This three-item measure was chosen for a number of reasons. As discussed in Chapter 3, an individual perception measure of climate was considered most appropriate for the organisational context, as opposed to a group-level measure. Additionally, a higher order measure relating to management values was deemed appropriate given the trend in current literature (see section 2.3.5) and clear theme
from safety leader interviews in Study One. An example item was “Senior management places a strong emphasis on workplace health and safety”. Items were measured on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The mid-point was defined as ‘neutral’. The authors reported an internal reliability alpha (the ability for the items to yield consistent scores) of .95.

**Safety motivation**

A three-item scale from Neal and Griffin (2006) was used to measure safety motivation as a potential contributing and mediating factor. The items reflect an intrinsic view of motivation, and assess the motivation of an individual to perform safety-related activities. Previous studies have also used this measure of motivation in safety research (Vinodkumar & Bhasi, 2010). An example item was “I feel that it is worthwhile to put in effort to maintain or improve my personal safety”. Items were measured on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The mid-point was defined as ‘neutral’. The authors reported an internal reliability alpha of .92.

**Safety compliance**

As discussed in section 2.6.1, it is important to clearly define and measure safety performance, and current literature (e.g., Neal & Griffin, 2006) considers there to be two components of performance: safety compliance and safety motivation. A number of items measured safety compliance. These measures were chosen to provide a comprehensive view of self-reported safety compliance behaviours, including both positive behaviours and ‘negative’ behaviours such as being involved in an incident and receiving warnings. The primary measure was a three-item scale from Neal and Griffin (2006) and was used to assess behaviours involving following safety procedures and carrying out work in a safe manner. An example item was “I use the correct safety procedures for carrying out my job”. Items were measured on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The mid-point was defined as ‘neutral’. The authors reported an internal reliability alpha of .93.

Additionally, two items measuring safe work behaviour were adopted from Mohamed (2002). The items asked respondents to indicate on a scale of 0-100% the average percentage of time that a) they follow all of the safety procedures for the jobs they perform, and b) their co-workers follow all of the safety procedures for the
jobs that they perform. Lastly, one item assessed non-compliance with safety procedures by asking respondents to indicate the number of times in the last 12 months that they had received a warning for not following safety procedures. Previous research has used a similar measure of incident involvement (e.g., Gyekye, 2006). These items were included with a view to matching responses with organisational data; however, this was not possible due to the method of data capture in the organisation.

**Safety participation**

In addition to safety compliance behaviours that directly contribute to an individual’s personal safety, behaviours relating to safety participation were also of interest as an outcome variable. A three-item scale from Neal and Griffin (2006) was used to assess safety participation. An example item was: “I put in extra effort to improve the safety of the workplace”. Items were measured on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The mid-point was defined as ‘neutral’. The authors reported an internal reliability alpha of .89.

**Incident involvement**

A further outcome variable included in this study included incident involvement. One item assessed self-reported incident involvement. Respondents were asked to indicate the number of times in the last 12 months that they had been directly involved in a workplace injury or near-miss event (i.e., an incident that could have resulted in an injury but did not in this instance) in the workplace. As Probst and Brubaker (2001) contend, self-report measures of incident involvement and unsafe behaviour had been previously found to be related to independent observations of the same variables.

**Leadership**

As discussed in 2.6.4, leadership is an important construct to consider in the safety climate–behaviour relationship. Two measures of transformational leadership were investigated as potential mediating factors in this study: supportive leadership and personal recognition. The measures were sub-scales from a validated transformational leadership scale (Rafferty & Griffin, 2004). Both measures were considered especially relevant to current research, given the importance of immediate supervisors in encouraging safe behaviour of employees. Supportive leadership was
measured by three items assessing perceptions of support from an immediate supervisor. An example item was “My immediate supervisor considers my personal feelings before acting”. Items were measured on a 5-point Likert scale, where 1 = strongly disagree, and 5 = strongly agree. The mid-point was defined as ‘neutral’. Personal recognition was measured by three items assessing perceptions of personal recognition from an immediate supervisor. An example item was “My immediate supervisor commends me when I do a better than average job”. The authors reported internal reliability alphas of .95 and .96 respectively.

**Stages of change**

Finally, another potential mediating factor in the climate-behaviour relationship was considered in this study. As discussed in section 2.6.5, stage of change is a measure of individuals’ preparedness for taking action to change their behaviour. Stages of change were measured using Barrett et al.’s (2005) adapted scale. Previous safety research has used this scale to identify stage of change in a survey-like format (Banks et al., 2008). The item asked respondents to indicate their approach to workplace safety risks, with higher scores indicating a more mature approach. The scale used was a forced-choice response type ranging from 1 to 5, with each number representing an approach to workplace safety risks, specifically:

1. I’m not exposed to risk and I’m not considering changing my work behaviour
2. I’m planning to take action to reduce my risk in the next six (6) months
3. I have definite plans to reduce my risk in the next month
4. I have already taken actions to reduce my risk
5. I’m continuing to take actions to reduce my risk

**5.2.4 Statistical analyses**

A number of statistical analyses were conducted to test the hypotheses, including factor analysis, bivariate correlations, regressions, mediation and analyses of variance (ANOVAs).

**Data cleaning and assumption checking**

*Missing data.* There was a considerable amount of missing data across key variables. The greatest amount missing occurred for organisation tenure (57% missing), industry tenure (70%) and role tenure (60%). Several other variables were
missing between one and five per cent. Therefore, pairwise deletions were used in subsequent analyses to maximise sample size.

**Outliers.** There were a number of univariate and multivariate outliers in the data. Examination of a boxplot for the non-compliance variable revealed four univariate outliers. The decision was made to delete these as they were considered outside of the normal population. Multivariate outliers were examined in relevant analyses using Mahalanobis distance and Cook’s distance for residuals. None of these outliers had a Cook’s distance greater than 1, so were not considered to influence the regression coefficients.

**Normality, linearity, multicollinearity and homoscedasticity.** Assumptions of normality were violated for a number of variables. In particular, most variables were negatively skewed (described in section 5.3.1.). To account for this, a more stringent alpha level was adopted for relevant analyses ($p < .01$). Transformation was not considered necessary as regressions and ANOVAs are robust to violations of normality (Cone & Foster, 2006; Tabachnick & Fidell, 2001). In addition, the variables were similarly skewed so it was considered that transformation may only offer marginal improvements in analysis (Tabachnick & Fidell, 2001). To be certain, however, analyses were conducted on both transformed and untransformed data to assess the impact of transformations. As transformations had no significant impact on overall results, untransformed data were used for the reported analyses (Tabachnick & Fidell, 2001). Normality of residuals was also tested where relevant and is reported as appropriate in the following analyses. The data met linearity, multicollinearity and homoscedasticity assumptions for regression analyses; however, homogeneity of variance requirements were violated for the ANOVAs, and appropriate $F$-tests and post-hoc tests were used to counter this.

Finally, the ample sample size for this study ($N = 2957$) and the comparison groups (minimum $n = 35$) meant that there were no concerns regarding sufficient power to detect differences. In contrast, as described above, a more stringent alpha level was set to reduce the likelihood of Type 1 errors. Commentary is provided throughout the results regarding statistical significance and practical significance (meaningfulness) using additional indicators such as effect size.
Factor analysis

The items relating to safety culture facilitators and barriers were developed based on qualitative data from Study One. The items were tested with the sample from Study One (N=41), and were again used in the survey for the current study. In addition to the importance ratings as measured by the Likert scale response type, the underlying factor structure of the items was also of interest for this study. The eight facilitator items and 16 barrier items were each subjected to principal components analysis (PCA) using SPPS version 20. PCA was chosen over factor analysis as it provides an empirical summary of the dataset, rather than a theoretical solution that ignores unique and error variability (Tabachnick & Fidell, 2007). Prior to performing PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of .3 and above. One barrier item was poorly correlated (range from $r = .07$ to $r = .28$) with other items, so was removed for the final factor analysis. The Kaiser-Meyer-Olkin value was .92, exceeding the recommended value of .6 (Kaiser, 1970, 1974). In addition, Bartlett’s Test of Sphericity (Bartlett, 1954) reached statistical significance ($p < .001$), supporting the factorability of the correlation matrix.

ANOVARs

One-way analysis of variance was performed to test hypotheses relating to group differences on continuous dependent variables. Specifically, scores on safety climate, safety motivation, safety compliance and safety participation, were compared across organisational divisions (functional areas in the organisation) and workforce levels (worker, frontline management, middle management and senior management). Post-hoc analyses were performed using Tukey’s HSD or Games-Howell tests as relevant for each specific analysis.

Bivariate correlations

Bivariate correlations were performed to describe the relationship between continuous variables (and gender as a dichotomous variable). Pearson product-moment correlation coefficients I were calculated. Strength of relationships were determined using Cohen’s (1988) guidelines, where $r = .10$ to .29 are considered small or weak relationship, $r = -.30$ to .49 are considered medium strength, and $r = .50$ to 1 is considered a strong relationship. Negative $r$ values indicate an inverse relationship but do not affect strength.
**Regressions**

Regression analyses were performed to test the hypotheses. Generally, regression is employed to predict a score on one variable from a score on the other variable (Tabachnick & Fidell, 2004). For this study, two hierarchical multiple regressions were used to test the hypotheses predicting safety compliance and safety participation. These hypotheses were informed by the theoretical framework described in Chapter 3 (Figure 3.1). Hierarchical multiple regression analysis allows the examination of the individual contribution of independent variables on the dependent variable, over and above the effect of other independent variables. Similarly, logistic regressions were performed to test the hypotheses predicting incident involvement and non-compliance (receiving warnings), as these dependent variables were dichotomous.

**Mediation**

Mediation describes an indirect relationship between an independent variable and dependent variable, whereby a third variable mediates the relationship. That is, the link between the independent and dependent variables are because of the influence of the mediator. Simple mediation and multiple mediation analyses were performed to test potential relationships between antecedents, determinants and components of safety performance.

In the current study, bias-corrected bootstrapping was used to test the significance of the indirect effects and to obtain confidence intervals using an SPSS macro provided by Preacher and Hayes (2008). Whilst Baron and Kenny’s (1986) causal steps approach is still common in mediation testing, a focus on the magnitude of the indirect effect is now widely accepted as the preferred approach to mediation testing (Hayes, 2013; Mackinnon, Fairchild & Fritz, 2007; Rucker, Preacher, Tormala & Petty, 2011; VanderWeele & Vansteelandt, 2009). The bootstrap estimates were based on 5,000 bootstrap samples, as recommended by Preacher and Hayes (2008) and Hayes (2013).

**5.3 RESULTS**

The results from the workforce safety climate survey are presented as they relate to each research question. First, the importance ratings of safety culture facilitators and barriers are presented, followed by factor analyses of both sets of
items. Next, the descriptive statistics and ANOVAs relating to group differences are presented, including organisational division and workforce level comparisons. Finally, results relating to the factors predicting safety performance are presented including bivariate correlations, hierarchical regressions and mediation analyses.

5.3.1 Key facilitators and barriers to safety culture

This section presents on the perceptions of importance given to each facilitator and barrier of safety culture. Descriptive statistics are presented for the sample, followed by results from the factor analyses.

Importance of facilitators and barriers

Table 5.3 and 5.4 present the means, standard deviations and breakdown of frequencies for the Likert-scale points for the facilitator items and barrier items. Higher scores indicate that on average, employees agreed with that item being a significant facilitator or barrier of a positive safety culture respectively.

Table 5.3

<table>
<thead>
<tr>
<th>Facilitator</th>
<th>M</th>
<th>SD</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Making sure everybody knows the most important safety issues</td>
<td>4.27</td>
<td>.68</td>
<td>0.3</td>
<td>0.7</td>
<td>9.1</td>
<td>51.9</td>
<td>38.0</td>
</tr>
<tr>
<td>2 Leaders knowing their responsibilities for safety</td>
<td>4.25</td>
<td>.67</td>
<td>0.3</td>
<td>0.9</td>
<td>8.0</td>
<td>54.7</td>
<td>36.1</td>
</tr>
<tr>
<td>3 Having clear and simple safety messages</td>
<td>4.21</td>
<td>.64</td>
<td>0.3</td>
<td>0.8</td>
<td>8.3</td>
<td>59.3</td>
<td>31.3</td>
</tr>
<tr>
<td>4 Everybody understanding what safety issues they are responsible for</td>
<td>4.14</td>
<td>.69</td>
<td>0.4</td>
<td>1.5</td>
<td>11.1</td>
<td>57.4</td>
<td>29.7</td>
</tr>
<tr>
<td>5 Getting passionate people to speak up about safety issues</td>
<td>4.04</td>
<td>.81</td>
<td>0.7</td>
<td>3.4</td>
<td>16.9</td>
<td>49.7</td>
<td>29.3</td>
</tr>
<tr>
<td>6 Matching safety programs to business needs in different areas</td>
<td>4.02</td>
<td>.71</td>
<td>0.4</td>
<td>1.4</td>
<td>17.9</td>
<td>56.7</td>
<td>23.6</td>
</tr>
<tr>
<td>7 Making the work systems support safety goals</td>
<td>3.99</td>
<td>.66</td>
<td>0.4</td>
<td>1.0</td>
<td>16.6</td>
<td>63.0</td>
<td>18.9</td>
</tr>
<tr>
<td>8 Understanding culture change is difficult and takes time</td>
<td>3.85</td>
<td>.84</td>
<td>0.8</td>
<td>6.4</td>
<td>20.0</td>
<td>53.0</td>
<td>19.8</td>
</tr>
</tbody>
</table>

Facilitators of safety culture were all rated positively, with means ranging from 3.85 (slightly agree) to 4.27 (mostly agree). Standard deviations (SDs) ranged from 0.64 to 0.84 indicating reasonably small variability in responses (people felt similarly about the items). The facilitators with the highest importance rating were ‘making
sure everybody knows the most important safety issues’, ‘leaders knowing their responsibilities for safety’ and ‘having clear and simple safety messages’.

Table 5.4

Importance of barriers

<table>
<thead>
<tr>
<th>Barrier</th>
<th>M</th>
<th>SD</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Workers coming and going regularly (especially subcontractors)</td>
<td>3.57</td>
<td>0.97</td>
<td>2.0</td>
<td>12.7</td>
<td>27.7</td>
<td>41.5</td>
<td>16.1</td>
</tr>
<tr>
<td>2 Too much paperwork</td>
<td>3.53</td>
<td>1.05</td>
<td>2.3</td>
<td>15.9</td>
<td>28.0</td>
<td>34.3</td>
<td>19.4</td>
</tr>
<tr>
<td>3 Maintaining a high level of safety awareness even when incidents aren’t occurring</td>
<td>3.37</td>
<td>1.01</td>
<td>3.1</td>
<td>17.4</td>
<td>27.8</td>
<td>40.3</td>
<td>10.7</td>
</tr>
<tr>
<td>4 People losing enthusiasm for safety initiatives quickly</td>
<td>3.36</td>
<td>0.97</td>
<td>2.4</td>
<td>19.0</td>
<td>28.5</td>
<td>40.7</td>
<td>9.4</td>
</tr>
<tr>
<td>5 Competing business priorities (e.g. production versus safety)</td>
<td>3.31</td>
<td>1.09</td>
<td>4.6</td>
<td>19.6</td>
<td>30.9</td>
<td>29.8</td>
<td>15.1</td>
</tr>
<tr>
<td>6 Difficulties with subcontractor management and operations</td>
<td>3.24</td>
<td>0.94</td>
<td>3.4</td>
<td>17.2</td>
<td>40.7</td>
<td>30.5</td>
<td>8.5</td>
</tr>
<tr>
<td>7 Complexity of safety legislation</td>
<td>3.22</td>
<td>0.95</td>
<td>3.0</td>
<td>19.7</td>
<td>39.0</td>
<td>30.3</td>
<td>8.5</td>
</tr>
<tr>
<td>8 Excessive workload</td>
<td>3.21</td>
<td>0.98</td>
<td>2.2</td>
<td>21.8</td>
<td>36.3</td>
<td>29.5</td>
<td>9.6</td>
</tr>
<tr>
<td>9 Too much change too quickly</td>
<td>3.14</td>
<td>0.98</td>
<td>3.1</td>
<td>23.6</td>
<td>37.9</td>
<td>26.0</td>
<td>9.1</td>
</tr>
<tr>
<td>10 Low levels of competency (knowledge, skills &amp; abilities) in safety leadership roles</td>
<td>3.13</td>
<td>1.08</td>
<td>4.6</td>
<td>27.4</td>
<td>29.4</td>
<td>27.3</td>
<td>11.0</td>
</tr>
<tr>
<td>11 Competitive nature of the industry</td>
<td>3.08</td>
<td>0.94</td>
<td>4.1</td>
<td>21.7</td>
<td>42.1</td>
<td>26.2</td>
<td>5.9</td>
</tr>
<tr>
<td>12 Financial costs associated with safety</td>
<td>2.96</td>
<td>1.01</td>
<td>6.2</td>
<td>27.4</td>
<td>38.3</td>
<td>20.6</td>
<td>7.5</td>
</tr>
<tr>
<td>13 “Bad attitudes” about safety amongst workers</td>
<td>2.93</td>
<td>1.06</td>
<td>7.4</td>
<td>30.9</td>
<td>31.1</td>
<td>23.3</td>
<td>7.4</td>
</tr>
<tr>
<td>14 Not enough safety resources</td>
<td>2.89</td>
<td>1.02</td>
<td>5.9</td>
<td>32.3</td>
<td>34.2</td>
<td>20.6</td>
<td>6.6</td>
</tr>
<tr>
<td>15 Poor regulatory system for the industry</td>
<td>2.80</td>
<td>0.91</td>
<td>6.5</td>
<td>30.3</td>
<td>44.3</td>
<td>14.9</td>
<td>4.0</td>
</tr>
<tr>
<td>16 “Bad attitudes” about safety amongst managers</td>
<td>2.72</td>
<td>1.01</td>
<td>11.4</td>
<td>34.7</td>
<td>30.6</td>
<td>16.6</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Barriers to safety culture were rated more neutrally, with means ranging from 2.72 (mildly disagree) to 3.57 (slightly agree). Standard deviations ranged from 0.91 to 1.09 indicating a larger variability in responses (people felt differently about the items). The barriers with the highest importance rating were ‘workers coming and going regularly (especially subcontractors), ‘too much paperwork’, and ‘maintaining a high level of safety awareness even when accidents aren’t occurring’. Interestingly, the barrier item with the lowest importance rating was ‘bad attitudes about safety amongst managers’.
Factor analysis

In addition to perceptions of most significant facilitators and barriers to safety culture, the factor structure of the items was of interest. To determine the factor structure of the items, exploratory factor analyses were conducted.

For the facilitator items, a one-factor solution provided the best fit. Principal components analysis (see Table 5.5) revealed the presence of one component with eigenvalues exceeding 1, explaining 54.90%, of the variance. An inspection of the scree plot revealed a clear break after the first component. Using Catell’s (1966) scree test, it was decided to retain one component. This was further supported by the results of the Parallel Analysis, which showed only one component with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the same size (8 variables x 2557 respondents). Closer inspection of the facilitator items reveals that the component could reflect a higher-order factor around safety communication.

Table 5.5
Principal components analysis of safety culture facilitator items

<table>
<thead>
<tr>
<th>Facilitator item</th>
<th>Component 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making sure everybody knows the most important safety issues</td>
<td>.81</td>
</tr>
<tr>
<td>Leaders knowing their responsibilities for safety</td>
<td>.79</td>
</tr>
<tr>
<td>Having clear and simple safety messages</td>
<td>.79</td>
</tr>
<tr>
<td>Everybody understanding what safety issues they are responsible for</td>
<td>.79</td>
</tr>
<tr>
<td>Getting passionate people to speak up about safety issues</td>
<td>.74</td>
</tr>
<tr>
<td>Matching safety programs to business needs in different areas</td>
<td>.74</td>
</tr>
<tr>
<td>Making the work systems support safety goals</td>
<td>.69</td>
</tr>
<tr>
<td>Understanding culture change is difficult and takes time</td>
<td>.56</td>
</tr>
</tbody>
</table>

Note. The solution could not be rotated as it has only one component.

For the barrier items, a three-component solution provided the best fit. Principal components analysis revealed the presence of three components with eigenvalues exceeding 1, explaining 38.56%, 8.30% and 7.26% of the variance respectively. An inspection of the scree plot revealed a clear break after the first component, however, there was a second break after three components. Using Catell’s (1966) scree test, it was decided to retain three components for further investigation. This was further supported by the results of the Parallel Analysis.
which showed three components with eigenvalues exceeding the corresponding
criterion values for a randomly generated data matrix of the same size (15 variables x
2557 respondents). To aid in the interpretation of these three components, oblimin
rotation was performed. The rotated solution (see Table 5.6) revealed the presence of
a relatively simple structure, with all components showing a number of strong
loadings and all variables loading mostly on only one component. Three exceptions
were ‘poor regulatory system for the industry’, ‘low levels of competency in safety
leadership roles’ and ‘too much paperwork’ which all had cross-loadings on more
than one factor. There were moderate positive correlations between the three factors
($r = .57, .63, .63$).

Table 5.6

*Principal components analysis with oblimin rotation of safety culture barrier items*

<table>
<thead>
<tr>
<th>Barrier item</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial costs associated with safety</td>
<td>.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competitive nature of the industry</td>
<td>.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not enough safety resources</td>
<td>.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complexity of safety legislation</td>
<td>.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive workload</td>
<td>.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competing business priorities</td>
<td>.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Bad attitudes” about safety amongst workers</td>
<td></td>
<td>-.81</td>
<td></td>
</tr>
<tr>
<td>“Bad attitudes” about safety amongst managers</td>
<td></td>
<td>-.78</td>
<td></td>
</tr>
<tr>
<td>Poor regulatory system for the industry</td>
<td></td>
<td>-.49</td>
<td></td>
</tr>
<tr>
<td>Low levels of competency in safety leadership roles</td>
<td></td>
<td></td>
<td>-.49</td>
</tr>
<tr>
<td>Workers coming and going regularly (especially subcontractors)</td>
<td></td>
<td>.73</td>
<td></td>
</tr>
<tr>
<td>Difficulties with subcontractor management and operations</td>
<td></td>
<td>.73</td>
<td></td>
</tr>
<tr>
<td>Too much change too quickly</td>
<td></td>
<td>.59</td>
<td></td>
</tr>
<tr>
<td>Too much paperwork</td>
<td></td>
<td>.58</td>
<td></td>
</tr>
<tr>
<td>People losing enthusiasm for safety initiatives quickly</td>
<td></td>
<td>.57</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Rotation method Oblimin with Kaiser normalisation. Rotation converged in 49
iterations. Only fifteen items were included as one item was removed from the analysis due
to poor correlations with other items (range from $r = .07$ to $r = .28$). Cross loadings removed
for final PCA.
Inspection of the component items reveals themes for each. The first component includes items relating to safety resourcing. ‘Too much paperwork’ had a split loading on this component and the third component, however, conceptually it fits with the first as it is related to complexity of the safety legislation and excessive workload. The second component includes items relating to safety attitudes and competency in safety leadership roles. Finally, the third component includes items relating to a dynamic workforce, such as difficulties with subcontractors coming and going and too much change too quickly.

5.3.2 Descriptive statistics

This section presents descriptive statistics for the variables relating to Research Question 3, exploring intra-organisational differences in safety culture perceptions and behaviour. Table 5.7 (on the following page) presents the means, standard deviations and scale type of the demographic variables, climate and behaviour variables, and stage of change and leadership variables.

The mean safety climate score across the organisation was positive at 4.26 out of 5 ($SD = 0.75$). This means that on average, respondents agreed or strongly agreed with the statements around senior management valuing safety. Similarly positive scores were obtained for safety motivation ($M = 4.65$, $SD = 0.50$), safety compliance ($M = 4.47$, $SD = 0.59$) and safety participation ($M = 4.25$, $SD = 0.67$).

The procedural compliance items were also rated very highly, with respondents indicating that they follow the safety procedures required for their work on average 93% of the time, and that their co-workers follow safety procedures 88% of the time. The self-reported incident involvement measure was very low, with the average number of times respondents reported being involved in an incident less than one (that is, less than once in the last 12 months). Similarly, reports of non-compliance (receiving a safety warning) in the last 12 months averaged less than once.
Table 5.7

*Means, standard deviations and scale type of survey measures*

<table>
<thead>
<tr>
<th>Variable</th>
<th>( n )</th>
<th>( M )</th>
<th>( SD )</th>
<th>Skew</th>
<th>Kurtosis</th>
<th>Scale and range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gender</td>
<td>2937</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2. Age</td>
<td>2786</td>
<td>39.21</td>
<td>11.25</td>
<td>.26</td>
<td>-.71</td>
<td>In years (17–83)</td>
</tr>
<tr>
<td>3. Role tenure</td>
<td>1175</td>
<td>3.36</td>
<td>3.85</td>
<td>3.60</td>
<td>19.75</td>
<td>In years (0–40)</td>
</tr>
<tr>
<td>4. Organisation tenure</td>
<td>1274</td>
<td>3.85</td>
<td>4.12</td>
<td>3.10</td>
<td>.14</td>
<td>In years (0–34)</td>
</tr>
<tr>
<td>5. Industry tenure</td>
<td>905</td>
<td>7.80</td>
<td>8.84</td>
<td>1.99</td>
<td>3.69</td>
<td>In years (0–51)</td>
</tr>
<tr>
<td>6. Safety climate</td>
<td>2859</td>
<td>4.26</td>
<td>0.75</td>
<td>-1.27</td>
<td>2.50</td>
<td>Likert scale (1–5)</td>
</tr>
<tr>
<td>7. Safety motivation</td>
<td>2882</td>
<td>4.65</td>
<td>0.50</td>
<td>-2.19</td>
<td>9.24</td>
<td></td>
</tr>
<tr>
<td>8. Safety compliance</td>
<td>2880</td>
<td>4.47</td>
<td>0.59</td>
<td>-1.22</td>
<td>3.26</td>
<td></td>
</tr>
<tr>
<td>9. Safety participation</td>
<td>2879</td>
<td>4.25</td>
<td>0.67</td>
<td>-.74</td>
<td>.88</td>
<td></td>
</tr>
<tr>
<td>10. Proc. comp (self)</td>
<td>2855</td>
<td>93.08</td>
<td>12.76</td>
<td>-4.01</td>
<td>21.61</td>
<td>Percentage (0–100%)</td>
</tr>
<tr>
<td>11. Proc comp (others)</td>
<td>2811</td>
<td>87.55</td>
<td>15.78</td>
<td>-2.51</td>
<td>8.81</td>
<td></td>
</tr>
<tr>
<td>12. Incident involvement</td>
<td>2843</td>
<td>0.56</td>
<td>4.09</td>
<td>18.76</td>
<td>400.12</td>
<td>Number of times (last 12 months)</td>
</tr>
<tr>
<td>13. Non-compliance</td>
<td>2828</td>
<td>0.11</td>
<td>0.49</td>
<td>8.21</td>
<td>108.12</td>
<td></td>
</tr>
<tr>
<td>14. Stage of change</td>
<td>2805</td>
<td>4.33</td>
<td>1.33</td>
<td>-1.86</td>
<td>1.82</td>
<td>Interval scale (1–5)</td>
</tr>
<tr>
<td>14. Supportive leadership</td>
<td>2827</td>
<td>3.80</td>
<td>0.85</td>
<td>-.70</td>
<td>.63</td>
<td>Likert scale (1–5)</td>
</tr>
<tr>
<td>15. Personal recognition</td>
<td>2826</td>
<td>3.79</td>
<td>0.91</td>
<td>-.80</td>
<td>.05</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Proc. comp = procedural compliance

The mean stage of change score was 4.33, indicating that on average respondents were at an advanced stage of change (already or continuing to take actions to reduce their risk). Perceptions of supportive leadership were more moderately rated, with the mean of 3.80 indicating respondents on average slightly agreed that their immediate supervisor was supportive. There was a very similar result for average perceptions of personal recognition received from immediate supervisors.

Due to the very positively skewed distributions for incident involvement and non-compliance (receiving warnings), dichotomous categories were created for use in analyses. Table 5.8 shows the descriptive statistics for these categories.
Table 5.8

Descriptive statistics for dichotomised incident involvement and non-compliance (receiving warnings)

<table>
<thead>
<tr>
<th>Involvement in incident</th>
<th>n</th>
<th>%</th>
<th>Received warning</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>2,330</td>
<td>79</td>
<td>None</td>
<td>2,613</td>
<td>88</td>
</tr>
<tr>
<td>Once or more</td>
<td>513</td>
<td>18</td>
<td>Once or more</td>
<td>219</td>
<td>7</td>
</tr>
<tr>
<td>Missing</td>
<td>114</td>
<td>4</td>
<td>Missing</td>
<td>125</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>2,843</td>
<td>100</td>
<td>Total</td>
<td>2,832</td>
<td>100</td>
</tr>
</tbody>
</table>

The vast majority of respondents did not report being involved in an incident or receiving a safety warning in the last 12 months (79% and 88% respectively). For those that reported being involved in an incident, 314 respondents (61%) indicated involvement in a single incident. For those that reported receiving a warning, 158 respondents (72%) indicated receiving a single warning in the last 12 months.

Table 5.9 (on the following page) presents the frequency statistics for position type and workforce level category. Position type was re-coded into four ‘workforce levels’ for the purposes of analysis. The worker level included engineers, subcontractors and all other salaried and wages employees who did not indicate management responsibilities. Frontline management included team leaders, supervisors and forepersons. Middle management included functional and divisional managers. And finally, senior management included senior managers which were defined as the managing director, and all divisional general managers.
Table 5.9

Descriptive statistics for position type and workforce level

<table>
<thead>
<tr>
<th>Position type</th>
<th>n</th>
<th>%</th>
<th>Workforce level</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate Engineer</td>
<td>57</td>
<td>1.9</td>
<td>Worker</td>
<td>2,004</td>
<td>67.8</td>
</tr>
<tr>
<td>Engineer/Senior Engineer</td>
<td>173</td>
<td>5.9</td>
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<td></td>
<td></td>
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<tr>
<td>Subcontractor</td>
<td>205</td>
<td>6.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All other salaried employees</td>
<td>399</td>
<td>13.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All other wages employees</td>
<td>1,146</td>
<td>38.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team leader/Supervisor/Foreperson</td>
<td>299</td>
<td>10.1</td>
<td>Frontline management</td>
<td>314</td>
<td>10.9</td>
</tr>
<tr>
<td>Functional/Divisional manager</td>
<td>107</td>
<td>3.6</td>
<td>Middle management</td>
<td>528</td>
<td>17.9</td>
</tr>
<tr>
<td>Other manager</td>
<td>407</td>
<td>13.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior manager</td>
<td>34</td>
<td>1.1</td>
<td>Senior management</td>
<td>35</td>
<td>1.2</td>
</tr>
<tr>
<td>Total</td>
<td>2,957</td>
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<td>2,957</td>
<td>100</td>
</tr>
</tbody>
</table>

5.3.3 Intra-organisational differences in safety culture perceptions and safety behaviour

Intra-organisational differences were investigated to compare variance between groups on key measures. Relevant descriptive statistics and analyses are presented below, followed by ANOVA results for each group comparison. Post-hoc comparisons were performed using Tukey’s HSD test or the Game-Howell test as appropriate to account for unequal variances. The Game-Howell test was considered the most appropriate post-hoc test due to unequal group sample sizes and the large total sample.

**Divisional differences**

Analyses of variance (ANOVAs) were conducted to determine significant differences between intra-organisational groups on key measures. The following analyses were designed to test for any significant differences between divisional areas on safety climate, safety motivation, safety compliance and safety participation.

Divisional area was measured as self-reported allocations to one of seven divisional...
categories: Construction, Resources, Industrial/Energy, Infrastructure, Corporate, Telecommunications or ‘other’.

Table 5.10 provides a summary of the analyses. Statistically significant differences were found across organisational divisions on all key measures. Despite reaching statistical significance, the actual difference in mean scores between the groups was reasonably small. The effect sizes were quite small, with safety climate’s medium effect size an exception ($\eta^2 = .05$; Cohen, 1988).

Divisional differences on safety climate scores. There were statistically significant differences found between divisions on safety climate scores: $F (6, 2806) = 26.05, p < .001, \eta^2 = .05$. Post-hoc comparisons for safety climate scores using the Tukey HSD test indicated that the mean safety climate score for Resources Division ($M=4.12, SD=0.75$) was significantly lower than Construction Division ($M=4.49, SD=0.69$) and Infrastructure Division ($M=4.53, SD=0.71$).

Divisional differences on safety motivation scores. There were statistically significant differences found between divisions on safety motivation scores: $F (6, 2829) = 5.16^a, p < .001, \eta^2 = .01$. Post-hoc comparisons using the Games-Howell test indicated that the mean safety motivation score for Construction Division ($M=4.73, SD = 0.44$) was significantly higher than Resources Division ($M = 4.63, SD = 0.45$) and Telecommunications Division ($M = 4.57, SD = 0.55$).

Divisional differences on safety compliance scores. There were statistically significant differences found between divisions on safety compliance scores: $F (6, 2827) = 4.66^a, p < .001, \eta^2 = .01$. Post-hoc comparisons using the Games-Howell test indicated that the mean safety compliance score for Construction Division ($M = 4.54, SD=0.56$) was significantly higher than Telecommunications Division ($M = 4.36, SD=0.63$).

Divisional differences on safety participation scores. There were statistically significant differences found between divisions on safety participation scores: $F (6, 2826) = 7.81, p < .001, \eta^2 = .02$. Post-hoc comparisons using the Tukey HSD test indicated that the mean safety participation score for Telecommunications Division ($M = 4.08, SD = 0.74$) was significantly lower than Construction Division ($M = 4.35, SD = 0.66$), Resources Division ($M = 4.23, SD=0.65$), and Infrastructure Division ($M = 4.36, SD = 0.65$).
Table 5.10

Summary of ANOVA results for divisional differences on outcome variables

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>LL</th>
<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Safety climate</strong></td>
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<td></td>
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<tr>
<td>Construction</td>
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<td>4.49</td>
<td>.69</td>
<td>4.44</td>
<td>4.55</td>
</tr>
<tr>
<td>Industrial/Energy</td>
<td>71</td>
<td>4.34</td>
<td>.74</td>
<td>4.16</td>
<td>4.51</td>
</tr>
<tr>
<td>Resources</td>
<td>1555</td>
<td>4.12</td>
<td>.75</td>
<td>4.08</td>
<td>4.15</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>115</td>
<td>4.53</td>
<td>.71</td>
<td>4.40</td>
<td>4.66</td>
</tr>
<tr>
<td>Corporate</td>
<td>39</td>
<td>4.56</td>
<td>.80</td>
<td>4.31</td>
<td>4.82</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>322</td>
<td>4.34</td>
<td>.77</td>
<td>4.26</td>
<td>4.43</td>
</tr>
<tr>
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<td>38</td>
<td>4.38</td>
<td>.69</td>
<td>4.15</td>
<td>4.60</td>
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</table>

\[ F (6, 2806) = 26.05, \ p < .001, \ \eta^2 = .05 \]

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<tr>
<td><strong>Safety motivation</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Construction</td>
<td>682</td>
<td>4.73</td>
<td>.44</td>
<td>4.70</td>
<td>4.76</td>
</tr>
<tr>
<td>Industrial/Energy</td>
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<td>4.64</td>
<td>.45</td>
<td>4.54</td>
<td>4.75</td>
</tr>
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<td>4.63</td>
<td>.51</td>
<td>4.61</td>
<td>4.66</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>116</td>
<td>4.67</td>
<td>.46</td>
<td>4.59</td>
<td>4.76</td>
</tr>
<tr>
<td>Corporate</td>
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<td>4.63</td>
<td>.70</td>
<td>4.40</td>
<td>4.86</td>
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<td>38</td>
<td>4.74</td>
<td>.34</td>
<td>4.63</td>
<td>4.85</td>
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</table>

\[ F (6, 2829) = 5.16^*, \ p < .001, \ \eta^2 = .01 \]

<table>
<thead>
<tr>
<th></th>
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<th>M</th>
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<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safety compliance</strong></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Construction</td>
<td>681</td>
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<td>.56</td>
<td>4.50</td>
<td>4.58</td>
</tr>
<tr>
<td>Industrial/Energy</td>
<td>71</td>
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<td>.60</td>
<td>4.30</td>
<td>4.58</td>
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<td>.59</td>
<td>4.43</td>
<td>4.48</td>
</tr>
<tr>
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<td>.50</td>
<td>4.43</td>
<td>4.61</td>
</tr>
<tr>
<td>Corporate</td>
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<td>.83</td>
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<tr>
<td>Telecommunications</td>
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<td>.63</td>
<td>4.29</td>
<td>4.43</td>
</tr>
<tr>
<td>Other/ Not specified</td>
<td>38</td>
<td>4.60</td>
<td>.53</td>
<td>4.42</td>
<td>4.77</td>
</tr>
</tbody>
</table>

\[ F (6, 2827) = 4.66^*, \ p < .001, \ \eta^2 = .01 \]

<table>
<thead>
<tr>
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<th>M</th>
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<th>LL</th>
<th>UL</th>
</tr>
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<tbody>
<tr>
<td><strong>Safety participation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>682</td>
<td>4.35</td>
<td>.66</td>
<td>4.30</td>
<td>4.40</td>
</tr>
<tr>
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<td>71</td>
<td>4.25</td>
<td>.68</td>
<td>4.09</td>
<td>4.41</td>
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<tr>
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<td>4.23</td>
<td>.65</td>
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<tr>
<td>Infrastructure</td>
<td>116</td>
<td>4.36</td>
<td>.65</td>
<td>4.24</td>
<td>4.48</td>
</tr>
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<td>.90</td>
<td>3.79</td>
<td>4.37</td>
</tr>
<tr>
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<td>38</td>
<td>4.36</td>
<td>.58</td>
<td>4.17</td>
<td>4.55</td>
</tr>
</tbody>
</table>

\[ F (6, 2826) = 7.81, \ p < .001, \ \eta^2 = .02 \]

Note. *Welsh’s F reported due to unequal variances
Workforce level comparisons

The following analyses were designed to test for any significant differences between workforce levels on safety climate, safety motivation, safety compliance and safety participation. The workforce level categories were: worker, frontline management, middle management and senior management. Table 5.11 shows a summary of the analyses. Statistically significant differences were found across workforce levels on all key measures; however, the actual difference in mean scores between the groups was reasonably small. The effect sizes were also quite small ($\eta^2 = .01$ to .03; Cohen, 1988).

Workforce level differences on safety climate scores. There were statistically significant differences found between workforce levels on safety climate scores: $F (3, 2786) = 41.80$, $p < .001$, $\eta^2 = .03$. Post-hoc comparisons using the Games-Howell test indicated that the mean safety climate scores for Workers ($M=4.20$, $SD=0.76$) and Frontline Managers ($M=4.31$, $SD = 0.73$) were significantly lower than Middle Management ($M = 4.49$, $SD = 0.69$) and Senior Management ($M = 4.78$, $SD = 0.39$). Workers and Frontline management did not differ significantly on safety climate scores. Similarly, Middle Management and Senior Management did not differ significantly on safety climate scores.

Workforce level differences on safety motivation scores. There were statistically significant differences found between workforce levels on safety motivation scores: $F (3, 2805) = 15.38$, $p < .001$, $\eta^2 = .01$. Post-hoc comparisons using the Games-Howell test indicated that the mean safety motivation score for Workers ($M=4.63$, $SD = 0.52$) was significantly lower than Middle Management ($M = 4.75$, $SD = 0.40$) and Senior Management ($M = 4.84$, $SD = 0.28$). Frontline management ($M = 4.67$, $SD = 0.47$) also had a significantly lower average score than Senior Management.

Workforce level differences on safety compliance scores. There was not a statistically significant difference at the $p < .001$ level in safety compliance scores for the different organisational levels: $F (3, 2804) = 5.12$, $p = .002$.

Workforce level differences on safety participation scores. There were statistically significant differences found between workforce levels on safety participation scores: $F (3, 2803) = 27.09$, $p < .001$, $\eta^2 = .03$. Post-hoc comparisons
using the Games-Howell test indicated that the mean safety participation score for Workers ($M = 4.18$, $SD = 0.68$) was significantly lower than Frontline Management ($M = 4.42$, $SD = 0.61$), Middle Management ($M = 4.39$, $SD = 0.63$) and Senior Management ($M = 4.57$, $SD = 0.51$).

Table 5.11

**Summary of ANOVA results for workforce level differences on outcome variables**

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>$M$</th>
<th>SD</th>
<th>LL</th>
<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safety climate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worker</td>
<td>1948</td>
<td>4.20</td>
<td>.76</td>
<td>4.17</td>
<td>4.23</td>
</tr>
<tr>
<td>Frontline management</td>
<td>307</td>
<td>4.31</td>
<td>.73</td>
<td>4.22</td>
<td>4.39</td>
</tr>
<tr>
<td>Middle management</td>
<td>500</td>
<td>4.49</td>
<td>.70</td>
<td>4.43</td>
<td>4.55</td>
</tr>
<tr>
<td>Senior management</td>
<td>35</td>
<td>4.78</td>
<td>.39</td>
<td>4.65</td>
<td>4.91</td>
</tr>
<tr>
<td>$F (3, 2786) = 41.80^a$, $p &lt; .001$, $\eta^2 = .03$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Safety motivation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worker</td>
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<td>4.63</td>
<td>.517</td>
<td>4.60</td>
<td>4.65</td>
</tr>
<tr>
<td>Frontline management</td>
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<td>.473</td>
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<td>4.79</td>
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<tr>
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<td>.28</td>
<td>4.75</td>
<td>4.95</td>
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<td>Worker</td>
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<td>4.44</td>
<td>.60</td>
<td>4.42</td>
<td>4.47</td>
</tr>
<tr>
<td>Frontline management</td>
<td>308</td>
<td>4.50</td>
<td>.56</td>
<td>4.44</td>
<td>4.57</td>
</tr>
<tr>
<td>Middle management</td>
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<td>4.49</td>
<td>4.59</td>
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<td>4.49</td>
<td>4.80</td>
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<tr>
<td>$F (3, 2803) = 5.12$, $p = .002$, $\eta^2 = .01$</td>
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<tr>
<td>Worker</td>
<td>1962</td>
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<td>.68</td>
<td>4.16</td>
<td>4.22</td>
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<tr>
<td>Frontline management</td>
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<td>4.43</td>
<td>.61</td>
<td>4.36</td>
<td>4.50</td>
</tr>
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<td>.63</td>
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<td>4.45</td>
</tr>
<tr>
<td>Senior management</td>
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<td>4.57</td>
<td>.51</td>
<td>4.39</td>
<td>4.75</td>
</tr>
<tr>
<td>$F (3, 2803) = 27.09^a$, $p &lt; .001$, $\eta^2 = .03$</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Note.** $^a$ Welsh’s F reported due to unequal variances

### 5.3.4 Factors influencing safety behaviour and related outcomes

This section presents analyses for the variables relating to Research Question 4a, which involves exploring the factors influencing safety behaviour and related outcomes. Bivariate correlations are presented first, followed by hierarchical multiple
regressions (testing $H_6$, that safety climate, safety motivation, leadership and stage of change will explain a significant proportion of variance in safety compliance and safety participation). Mediation relationships are then analysed and presented (testing $H_8$, that safety motivation, leadership and stage of change will mediate the relationship between safety climate and safety compliance and participation). Finally, logistic regressions predicting the likelihood of incident involvement and non-compliance are presented (testing $H_7$, that safety climate, safety motivation, leadership and stage of change will explain a significant proportion of variance in incident involvement and non-compliance [receiving warnings]).

As presented in section 5.2.3, a number of measures were used to assess factors influencing safety behaviour and related outcomes. Safety climate, safety motivation, safety compliance and safety participation were all assessed using three-item Likert scales from Neal et al. (2000). Safety compliance was also measured using additional percentage scales from Mohamed (2002) that assessed procedural compliance of self and others. Non-compliance was also measured as warnings received for not following safety procedures, and self-reported incident involvement was measured as a related safety behaviour outcome.

Leadership was also investigated as a potential factor influencing safety behaviour, and was measured using two three-item subscales from a transformational leadership scale (Rafferty & Griffin, 2004): supportive leadership and personal recognition.

**Bivariate correlations**

Inspection of the inter-correlations between variables (see Table 5.10) reveals a number of statistically significant relationships.

Safety climate had a significant positive relationship with safety motivation ($r = .37$, $n = 2855$, $p < .01$), safety compliance ($r = .33$, $n = 2854$, $p < .01$), safety participation ($r = .29$, $n = 2853$, $p < .01$), procedural compliance (self: $r = .12$, $n = 2828$, $p < .01$ and others: $r = .20$, $n = 2785$, $p < .01$), supportive leadership ($r = .38$, $n = 2796$, $p < .01$) and personal recognition ($r = .32$, $n = 2795$, $p < .01$). However, much stronger relationships were observed between safety motivation and safety compliance ($r = .69$, $n = 2880$, $p < .01$), and safety motivation and safety participation ($r = .59$, $n = 2879$, $p < .01$).
In terms of outcome measures, the two components of safety behaviour (safety compliance and safety participation) were strongly related as expected ($r = .67$, $n = 2878$, $p < .01$). In addition, safety compliance and procedural compliance (self and others) were significantly positively related (self: $r = .35$, $n = 2852$, $p < .01$ and others: $r = .22$, $n = 2808$, $p < .01$). Non-compliance (receiving warnings) was significantly positively correlated with self-reported incident involvement ($r = .30$, $n = 2821$, $p < .01$). Safety compliance and safety participation were also significantly negatively correlated with non-compliance (receiving warnings: $r = -.06$, $n = 2823$, $p < .01$ and $r = -.06$, $n = 2822$, $p < .01$).

Bivariate correlations were also performed to examine relationships between demographic variables of age and tenure (role, organisational and industry), and the four key constructs of safety climate, safety motivation, safety compliance, and safety participation. Whilst some correlations reached statistical significance (e.g., $r = .12$, $n = 1236$, $p < .01$, for safety climate and organisational tenure), none suggested a medium or strong relationship. Therefore, these demographic variables were not included as control variables in the following regression analyses.

Contrary to expectations, stage of change was not significantly correlated with safety climate ($r = -.03$, $n = 2773$, $p = .14$). However, weak relationships were observed with other variables: safety motivation ($r = .09$, $n = 2796$, $p < .01$), safety compliance ($r = .07$, $n = 2794$, $p < .01$), safety participation ($r = .13$, $n = 2794$, $p < .01$), and procedural compliance (self: $r = .09$, $n = 2779$, $p < .01$ and others: $r = .22$, $n = 2760$, $p < .01$). Due to the lack of relationship with safety climate, this variable was not included in further analyses.
## Table 5.12

**Inter-correlations for variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Gender (female)(^a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2 Age</td>
<td>-.11*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Role tenure(^b)</td>
<td>-.08*</td>
<td>.23*</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>4 Organisation tenure(^b)</td>
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<td>.54*</td>
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</tr>
<tr>
<td>5 Industry tenure(^b)</td>
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<td>.51*</td>
<td>.47*</td>
<td>.46*</td>
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<td></td>
</tr>
<tr>
<td>6 Safety climate</td>
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<td>.07*</td>
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<td>.12*</td>
<td>.08</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>(.94)</td>
</tr>
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<td>7 Safety motivation</td>
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<td>.08*</td>
<td>-.04</td>
<td>.04</td>
<td>.03</td>
<td>.37*</td>
<td></td>
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<td>(.88)</td>
</tr>
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<td>8 Safety compliance</td>
<td>.04</td>
<td>.10*</td>
<td>-.04</td>
<td>.03</td>
<td>.01</td>
<td>.33*</td>
<td>.69*</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>(.92)</td>
</tr>
<tr>
<td>9 Safety participation</td>
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<td>.18*</td>
<td>.01</td>
<td>.10*</td>
<td>.09</td>
<td>.29*</td>
<td>.56*</td>
<td>.67*</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>(.89)</td>
</tr>
<tr>
<td>10 Proc. comp (self)</td>
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<td>.02</td>
<td>-.05</td>
<td>.01</td>
<td>-.02</td>
<td>.12*</td>
<td>.17*</td>
<td>.35</td>
<td>.28</td>
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<tr>
<td>11 Proc. comp (others)</td>
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<td>-.01</td>
<td>-.08*</td>
<td>.04</td>
<td>-.11*</td>
<td>.20*</td>
<td>.10*</td>
<td>.22*</td>
<td>.16*</td>
<td>.69*</td>
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<td></td>
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<tr>
<td>12 Incident involvement</td>
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<td>-.01</td>
<td>.01</td>
<td>-.01</td>
<td>.05</td>
<td>-.03</td>
<td>-.00</td>
<td>.01</td>
<td>.02</td>
<td>.01</td>
<td>-.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Non-compliance</td>
<td>-.06*</td>
<td>-.03</td>
<td>.02</td>
<td>-.04</td>
<td>-.05</td>
<td>-.03</td>
<td>-.06*</td>
<td>-.06*</td>
<td>-.06*</td>
<td>-.07*</td>
<td>.30*</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>14 Stage of change</td>
<td>-.17*</td>
<td>.07*</td>
<td>.02</td>
<td>.04</td>
<td>.08</td>
<td>-.03</td>
<td>.09*</td>
<td>.07*</td>
<td>.13*</td>
<td>.09*</td>
<td>.04</td>
<td>-.02</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 Supportive leadership</td>
<td>.04</td>
<td>.01</td>
<td>-.02</td>
<td>.01</td>
<td>-.01</td>
<td>.38*</td>
<td>.26*</td>
<td>.27*</td>
<td>.30*</td>
<td>.15*</td>
<td>.22*</td>
<td>-.01</td>
<td>-.04</td>
<td>-.02</td>
<td></td>
<td>(.93)</td>
</tr>
<tr>
<td>16 Personal recognition</td>
<td>.03</td>
<td>-.02</td>
<td>.01</td>
<td>.02</td>
<td>-.01</td>
<td>.32*</td>
<td>.22*</td>
<td>.23*</td>
<td>.25*</td>
<td>.12*</td>
<td>.19*</td>
<td>-.01</td>
<td>-.03</td>
<td>-.01</td>
<td></td>
<td>.75*</td>
</tr>
</tbody>
</table>

Note: \(^*\)Correlation is significant at the \(p < .01\) level (2-tailed). \(^a\) Refers to point biserial correlation. \(^b\) Tenure items had fewer responses (ranging from \(n = 905\) to \(n = 1274\)). Bolded values are greater than \(r = .50\). Proc. Comp = procedural compliance. Reliability alphas are reported on the diagonal where relevant.
**Regressions**

Hierarchical multiple regression was used to assess the ability of safety motivation, supportive leadership and personal recognition to predict safety compliance after controlling for the influence of safety climate (Table 5.13).

Table 5.13

*Hierarchical regression analysis for variables predicting safety compliance*

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>95% CI</th>
<th>β</th>
<th>sr²</th>
<th>R²</th>
<th>ΔR²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LL</td>
<td>UL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety climate</td>
<td>.256</td>
<td>.229</td>
<td>.284</td>
<td>.329</td>
<td>.108</td>
<td>.108</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety motivation</td>
<td>.761</td>
<td>.021</td>
<td>.795</td>
<td>.649</td>
<td>.356</td>
<td></td>
</tr>
<tr>
<td>Supportive leadership</td>
<td>.057</td>
<td>.028</td>
<td>.085</td>
<td>.082</td>
<td>.003</td>
<td></td>
</tr>
<tr>
<td>Personal recognition</td>
<td>.000</td>
<td>-.026</td>
<td>.026</td>
<td>.001</td>
<td>.000</td>
<td>.490</td>
</tr>
</tbody>
</table>

*Note.* Dependent variable = Safety compliance

** p < .001

Safety climate was entered at Step 1, explaining 11% of the variance in safety compliance. At Step 2, the inclusion of safety motivation, supportive leadership and personal recognition explained 49% of the variance in safety compliance. The semipartial correlation coefficients indicate that safety motivation was the most important contributor, with a unique contribution of 36% of total variance in safety compliance. Supportive leadership contributed a small but significant amount of unique variance (0.3%) and personal recognition did not explain any unique variance in safety compliance.

Hierarchical multiple regression was also used to assess the ability of safety motivation, supportive leadership and personal recognition to predict safety participation after controlling for the influence of safety climate (Table 5.14).
Table 5.14

*Hierarchical regression analysis for variables predicting safety participation*

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>95% CI</th>
<th>β</th>
<th>sr²</th>
<th>R²</th>
<th>ΔR²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LL</td>
<td>UL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Safety climate</td>
<td>.260</td>
<td>.228</td>
<td>.291</td>
<td>.292**</td>
<td>.085</td>
<td>.085</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety motivation</td>
<td>.712</td>
<td>.669</td>
<td>.755</td>
<td>.532**</td>
<td>.240</td>
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</tr>
<tr>
<td>Supportive leadership</td>
<td>.091</td>
<td>.055</td>
<td>.128</td>
<td>.115**</td>
<td>.006</td>
<td></td>
</tr>
<tr>
<td>Personal recognition</td>
<td>.026</td>
<td>-.007</td>
<td>.059</td>
<td>.035</td>
<td>.001</td>
<td>.366</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.281</td>
</tr>
</tbody>
</table>

Note. Dependent variable = Safety participation

**p < .001

Safety climate was entered at Step 1, explaining 9% of the variance in safety participation. At Step 2, the inclusion of safety motivation, supportive leadership and personal recognition explained 37% of the variance in safety participation. The semipartial correlation coefficients indicate that safety motivation was the most important contributor, with a unique contribution of 24% of total variance in safety participation. Again, supportive leadership contributed a small but significant amount of unique variance (0.6%) and personal recognition contributed less than 0.1% of unique variance explained in safety participation.

*Testing mediation*

The hierarchical regressions revealed that safety motivation was the most significant predictor of variance in both safety compliance and safety participation. Based on previous literature (Neal & Griffin, 2006; Vinodkumar & Bhasi, 2010), it was hypothesised that the relationship between these variables may be a mediated one. Therefore, further analyses were undertaken to explore whether safety motivation and leadership dimensions mediated the relationship between safety climate and safety outcomes.
Table 5.15 reports the results of simple mediation analyses to explore indirect effects of each potential mediator on each safety outcome. The ‘c path’ refers to the relationship between the independent variable (IV: safety climate) and the dependent variable (DV: safety compliance or safety participation) with all mediators included. The ‘a path’ refers to the relationship between the IV and the relevant mediator, whereas the ‘b path’ is the relationship between the relevant mediator and the DV. The final path (c’ path) refers to the direct relationship between the IV and the DV when the mediators have been accounted for. In traditional mediation models, the c’ path should be reduced to zero if full mediation has occurred (that is, the relationship between the IV and the DV only exists because of the influence of the mediator variable).

In the simple mediations presented below, safety motivation, supportive leadership and personal recognition all predicted the outcome variables in this series of simple mediations; with all providing evidence of partial mediation (the direct c’ path is smaller but still significant).

Table 5.15

**Simple mediation analyses of effect of safety climate on safety compliance and safety participation**

<table>
<thead>
<tr>
<th>Mediator</th>
<th>N</th>
<th>Regression coefficient (B)</th>
<th>Mediation effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>c path</td>
<td>a path</td>
</tr>
<tr>
<td>DV: Safety compliance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety motivation</td>
<td>2854</td>
<td>.26**</td>
<td>.25**</td>
</tr>
<tr>
<td>Supportive leadership</td>
<td>2792</td>
<td>.26**</td>
<td>.43**</td>
</tr>
<tr>
<td>Personal recognition</td>
<td>2792</td>
<td>.26**</td>
<td>.39**</td>
</tr>
<tr>
<td>DV: Safety participation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety motivation</td>
<td>2853</td>
<td>.26**</td>
<td>.25**</td>
</tr>
<tr>
<td>Supportive leadership</td>
<td>2792</td>
<td>.27**</td>
<td>.43**</td>
</tr>
<tr>
<td>Personal recognition</td>
<td>2791</td>
<td>.27**</td>
<td>.39**</td>
</tr>
</tbody>
</table>

Note. *p < .01, **p < .001*
To further examine the potential role of these variables, multiple mediation analyses were conducted to determine the relative role of each mediator when considered together. Figures 5.1 and 5.2 reveal significant indirect effects between safety climate and both safety compliance and safety participation for the mediators, safety motivation and supportive leadership. Personal recognition did not have a significant indirect influence for either safety compliance or safety participation when other mediators were taken into account. Therefore, supportive leadership and safety motivation are both significant partial mediators of the climate–behaviour relationship.

Figure 5.1. Multiple mediation model for variables predicting safety compliance
Predicting the likelihood of incident involvement

Logistic regression was performed to assess the impact of a number of factors on the likelihood that respondents had reported that they were involved in an incident in the past 12 months. The model contained four independent variables (safety climate, safety motivation, supportive leadership and personal recognition). The full model containing all predictors was statistically significant, $\chi^2 (4, N = 2755) = 32.45, p < .001$, indicating that the model was able to distinguish between respondents who reported being involved in an incident and those who reported not being involved in an incident. The model as a whole explained a relatively low [between 1.2% (Cox and Snell R square) and 1.9% (Nagelkerke R squared)] amount of the variance in incident involvement, but correctly classified 82% of cases. As shown in Table 5.16, only safety climate made a uniquely statistically significant contribution to the model. The odds ratio of .78 indicates that there is a 22% decrease in the odds of reporting being involved in an incident for a 1-unit change in safety climate scores (i.e., in terms of a more positive safety climate).

Figure 5.2. Multiple mediation model for variables predicting safety participation
Logistic regression predicting likelihood of incident involvement

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>p</th>
<th>Odds ratio</th>
<th>95% CI for Odds ratio</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Safety climate</td>
<td>-.245</td>
<td>.070</td>
<td>12.216</td>
<td>1</td>
<td>.001</td>
<td>.783</td>
<td>.683 - .898</td>
</tr>
<tr>
<td>Safety motivation</td>
<td>.253</td>
<td>.107</td>
<td>5.603</td>
<td>1</td>
<td>.018</td>
<td>1.044</td>
<td>1.044 - 1.589</td>
</tr>
<tr>
<td>Supportive leadership</td>
<td>-.128</td>
<td>.089</td>
<td>2.077</td>
<td>1</td>
<td>.150</td>
<td>.880</td>
<td>.740 - 1.047</td>
</tr>
<tr>
<td>Personal recognition</td>
<td>-.072</td>
<td>.080</td>
<td>.805</td>
<td>1</td>
<td>.370</td>
<td>.930</td>
<td>.795 - 1.089</td>
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<td>3.416</td>
<td>1</td>
<td>.065</td>
<td>.405</td>
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</tr>
</tbody>
</table>

Note. N = 2755; Dependent variable = Incident involvement (no/yes)

Predicting the likelihood of non-compliance (receiving warnings)

Logistic regression was performed to assess the impact of a number of factors on the likelihood that respondents would report that they had received a warning in the past 12 months. The model contained four independent variables (safety climate, safety motivation, supportive leadership and personal recognition). The full model containing all predictors was statistically significant, $\chi^2 (4, N = 2746) = 15.40$, $p = .004$, indicating that the model was able to distinguish between respondents who reported receiving a warning and those who reported not receiving a warning. The model as a whole explained a relatively low [between 0.6% (Cox and Snell R square) and 1.3% (Nagelkerke R squared)] amount of the variance in non-compliance, but correctly classified 92.3% of cases. As shown in Table 5.17, only safety motivation made a uniquely statistically significant contribution to the model. The odds ratio of .67 indicates that there is a 33% decrease in the odds of reporting receiving a warning for non-compliance, for a 1-unit change in safety motivation scores (i.e., in terms of a more positive safety motivation score).
### Table 5.1

**Logistic regression predicting likelihood of receiving a safety warning**

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>p</th>
<th>Odds ratio</th>
<th>95% CI for Odds ratio</th>
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</thead>
<tbody>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>LL</td>
</tr>
<tr>
<td>Safety climate</td>
<td>-.049</td>
<td>.106</td>
<td>.216</td>
<td>1</td>
<td>.642</td>
<td>.952</td>
<td>.774</td>
</tr>
<tr>
<td>Safety motivation</td>
<td>-.394</td>
<td>.132</td>
<td>8.900</td>
<td>1</td>
<td>.003</td>
<td>.674</td>
<td>.520</td>
</tr>
<tr>
<td>Supportive leadership</td>
<td>-.150</td>
<td>.129</td>
<td>1.354</td>
<td>1</td>
<td>.245</td>
<td>.861</td>
<td>.669</td>
</tr>
<tr>
<td>Personal recognition</td>
<td>.073</td>
<td>.119</td>
<td>.377</td>
<td>1</td>
<td>.539</td>
<td>1.076</td>
<td>.852</td>
</tr>
<tr>
<td>Constant</td>
<td>-.177</td>
<td>.574</td>
<td>.095</td>
<td>1</td>
<td>.758</td>
<td>.838</td>
<td></td>
</tr>
</tbody>
</table>

**Note.** N = 2802; Dependent variable = Receiving a warning (no/yes)

### 5.4 DISCUSSION

This study aimed to empirically investigate the safety climate of the organisation, and the factors influencing the relationship between safety climate, safety behaviour, and related safety outcomes. An overview of the results relating to each research question and hypothesis is given below, followed by a discussion of the theoretical and practical implications of the findings, as well as the strengths and limitations of the study.

#### 5.4.1 Overview of results

Results are summarised here as they relate to each research question and the corresponding hypotheses.

**Key facilitators and barriers to safety culture**

The hypothesis that the highly ranked facilitators and barriers from Study One would obtain high levels of agreement (*H1*) was partially supported by the results. Facilitators of safety culture previously identified by safety leaders in Study One were all rated positively by workers in Study Two. The facilitators with the highest importance rating were ‘making sure everybody knows the most important safety issues’, ‘leaders knowing their responsibilities for safety’ and ‘having clear and simple safety messages’. This is consistent with previous research on safety barriers (Banks & Davey, 2010). The safety leaders in Study One also ranked having clear
and simple messages about safety in the top three, as well as leaders knowing their responsibilities for safety (originally worded as ‘defining safety leadership roles and accountabilities). However, they also ranked ‘ensuring systems were aligned with the safety culture’ as important, which differed from the current workforce sample. Also in contrast was that safety leaders ranked the item about making sure everybody knows the most important safety issues (originally worded as “communicating organisational safety priorities”) as the lowest importance whereas the workforce sample perceived this facilitator to be the most important. This finding is important as it hints at a disconnect between workers and managers on a factor we now know to be critical to safety culture: safety communication.

Barriers to safety culture were rated more neutrally than facilitators, with some mean item scores indicating mild disagreement with the item. The barriers with the highest importance rating were ‘workers coming and going regularly (especially subcontractors), ‘too much paperwork’, and ‘maintaining a high level of safety awareness even when accidents aren’t occurring’. Interestingly, the barrier item with the lowest importance rating was ‘bad attitudes about safety amongst managers’. This could reflect a different interpretation of the item ranking process. It is possible that respondents confused ‘importance’ with ‘evidence’ in that they did not think that this barrier was a problem so did not rate it as important. The safety leaders in Study One also ranked too much paperwork in their top three significant barriers. However, other highly ranked items related to ‘difficulties with managing subcontractor operations’ and ‘the challenge of keeping it fresh’. These items are quite similar to the items perceived as important to the workforce sample; but reflect more of a management perspective on the issues of a subcontractor workforce and maintaining a focus on safety. Therefore, whilst some similarities were found between the safety leader’s perceptions and the broader workforce’s perceptions of facilitators and barriers, there were also some points of difference, so the hypothesis is only partially supported.

The hypothesis that the facilitator items would load onto higher order factors around safety communication and worker involvement was not supported. Only one component was found in the factor analysis, with all items loading onto the same component. In reviewing the facilitator items, it is possible to interpret this finding as
a higher order factor around safety communication, as many items reflect this theme. However, this result is not conclusive.

The hypotheses that the barrier items would load onto higher order factors, reflecting more general themes around difficulties with developing and maintaining safety culture (H3) was supported. A three-factor solution was derived, indicating three higher order components to the barrier items. These components related to: safety resourcing; safety attitudes and competency; and the dynamic workforce. Relating these factors back to the importance ratings in both studies, it seems that the challenges of a dynamic workforce are seen as a consistent barrier to safety culture development and maintenance.

**Intra-organisational differences in safety culture perceptions and behaviour**

The hypothesis that safety climate, motivation, compliance and participation would differ across organisational divisions (H4) was partially supported. The descriptive statistics and F statistics revealed a number of significant divisional differences in mean scores on all outcome measures. Further post-hoc analyses revealed that construction division had a significantly higher average score than resources division on safety climate and safety motivation. Construction division also had significantly higher average scores than some other divisions on safety compliance and safety participation, although not significantly different from resources division on these behaviour measures. This result could reflect a greater risk exposure in construction compared to other divisions, coupled with a more focused education on safety concerns as a result of these risks. However, although differences were statistically significant, the mean differences and effect sizes were quite small, indicating a possible inflation of differences due to the large sample size. Thus, the hypothesis is cautiously supported.

The hypothesis that safety climate, motivation, compliance and participation would differ amongst workforce levels (H5) was partially supported by the results. ANOVAs revealed significant differences on three outcomes measures – safety climate, safety motivation and safety participation. No group differences were found on safety compliance scores. Post-hoc analyses revealed that workers had significantly lower scores than middle and senior management on the three outcome measures, and workers and frontline management were not significantly different on safety climate or safety motivation. In addition, frontline management had
significantly lower scores than middle and senior management on safety climate, and lower than senior management on safety motivation. The results indicate that there is a stark contrast between individuals at the frontline (both workers and frontline management) and office-based middle and senior management in terms of safety perceptions and behaviours, with those further removed from the core business of construction and mining having more positive perceptions. This is consistent with Morris et al.’s (1999) findings that blue-collar workers had less favourable perceptions of the climate than their white-collar counterparts. However, similar to the divisional group differences, the actual difference in mean scores was small across all analyses, and the effect sizes were even more modest. Given this, and the lack of significant differences on safety compliance, the hypothesis was only partially supported.

**Factors influencing safety behaviour and related outcomes**

The hypothesis that safety climate, safety motivation, leadership (personal recognition and supportive leadership) and stage of change would explain a significant proportion of variance in safety compliance and safety participation (*H6*) was partially supported. Bivariate correlations indicated very small correlations between stage of change and any key outcome variables, so this measure was not included in subsequent analyses. Hierarchical multiple regressions included safety climate in step one, and safety motivation, supportive leadership and personal recognition in step two. The total variance explained in safety compliance was 49%, with safety climate contributing 11%, safety motivation uniquely contributing 36% and supportive leadership contributing less than one percent. A similar result was found for the hierarchical regression predicting safety participation, with 37% total variance explained, safety climate contributing 9%, safety motivation contributing 24% and supportive leadership less than one percent. The results indicate that safety climate, safety motivation and supportive leadership were all significant predictors of safety compliance and safety participation, and safety motivation was the most important contributor in both cases. This is consistent with previous research on the climate-behaviour relationship (Griffin & Neal, 2000; Neal et al., 2000; Neal & Griffin, 2002). However as personal recognition was not a significant contributor to either outcome, the hypothesis is only partially supported.
The hypothesis that safety climate, safety motivation, leadership and stage of change would explain a significant proportion of variance in incident involvement and non-compliance (receiving warnings) \((H7)\) was partially supported. Using dichotomous outcome variables, the relative contribution of each IV in predicting incident involvement and non-compliance (receiving warnings) was tested. Consistent with previous research, safety climate was a significant predictor of incident involvement, and safety motivation was a significant predictor of receiving a warning. Inconsistent with previous research was that safety climate did not predict receiving warnings \((\text{Zohar, 2010})\) and safety motivation did not predict incident involvement \((\text{Griffin & Neal, 2000})\). With regard to receiving warnings, this result could reflect an enforcement paradox whereby receiving warnings is a healthy sign of a safety climate, in that those unsafe behaviours are monitored and acted upon. This may have muted the impact of safety climate in the prediction model. With regard to safety motivation not predicting incident involvement, this could reflect a measurement issue whereby incident involvement does not indicate responsibility. That is, despite being highly motivated to perform safety behaviours, respondents may have been involved in an incident that was not a result of their direct actions (and also not reflective of their safety motivation). In addition, the two leadership measures of supportive leadership and personal recognition were not significant predictors of either outcome variable. Previous research investigating leadership suggests that it may be a more distal factor in predicting safety outcomes (leadership as an antecedent; Griffin & Neal, 2000), which could explain the poor predictive influence in this case. Furthermore, for those variables that were predictive, the amount of total variance explained for each outcome was very small in this study (around one to two percent).

Finally, the hypothesis that safety motivation, leadership and stage of change would mediate the relationship between safety climate, and safety compliance and participation \((H8)\) was partially supported. Simple mediation analyses were conducted with safety climate as the independent variable, and safety compliance and safety participation as dependent variables respectively. Safety motivation, supportive leadership and personal recognition were identified as mediators of these two pathways. As with the regression analyses, stage of change was not included in the mediation tests due to poor bivariate correlations. The results revealed that all
potential mediators did in fact partially mediate the climate–behaviour relationship when considered on their own. The greatest decrease in the direct path due to the mediator was observed with safety motivation. Multiple mediation analyses were then performed to assess the effect of all mediators when considered together. As predicted based on similar previous research (Vinodkumar & Bhasi, 2010), the results revealed that both safety motivation and supportive leadership were significant partial mediators of the climate–behaviour relationship. However, the second leadership measure around personal recognition became non-significant when considered with others. Thus, the climate–behaviour relationship is a mediated one, and safety motivation and supportive leadership are significant partial mediators, so the hypothesis is partially supported.

5.4.2 Theoretical implications

A number of important theoretical implications stem from the results of this study. The first relates to the investigation of safety culture barriers. The items developed in this program of research were subjected to principal components analysis. The analysis suggested that barriers to safety culture appear to be multifactorial, and future studies could extend this research by developing reliable metrics to measure the impact of these in workforce safety climate surveys. Of particular value would be a measure of barrier impact or evidence in the workplace, so that perceptions of barriers could be included in the safety climate–behaviour relationship in future studies. That is, the current study aimed to determine the most important barriers to safety culture development and maintenance in a general sense, but did not measure perceptions of whether that particular item was a barrier for an individual at that point in time. This meant that we were not able to compare perceptions of barriers with safety climate perceptions, which may elucidate the impact of perceived barriers on climate and related outcomes.

Second, the results offer support for the use of Neal et al.’s (2000) safety performance framework in safety climate research. All measures were positively and significantly correlated, and as expected safety climate and motivation predicted the safety performance components. In addition, safety motivation was found to mediate the climate–behaviour relationship. This result supports the idea that safety climate is an antecedent, and safety motivation is a determinant of self-reported safety behaviour. Further, safety compliance and safety participation were negatively
correlated with additional measures of non-compliance and incident involvement, suggesting evidence of convergent validity for the measures. Further, the inclusion of leadership measures as predictors and potential mediators in this framework did not reveal a substantial amount of predictive variance, suggesting safety motivation is the most important contributor to the relationship. However, the total variance explained in both hierarchical regressions was less than half, indicating that other variables not considered in this study may also be exerting an influence on the climate–behaviour relationship. The multiple mediation results indicate a similar story, with the direct path reducing when the mediators were included, but not completely disappearing. The results extend Griffin and Neal’s (2000) model by finding support in a new industrial context, in a large and influential organisation. The results of the current study illustrate that management commitment to safety, and personally valuing safety remains critical to achieving individual safety performance.

Third, the multiple mediation effect on the climate–behaviour relationship is an important contribution to the literature. Previous studies have used structural equation modelling and multi-level modelling to map various independent and dependent variables (e.g., Zohar, 2005). This study is the first, to the author’s knowledge, to use multiple mediation analyses to test this relationship. Future studies could consider the use of multiple mediation analyses as a useful method to assess the nature of the relationship between variables. Further, the results here indicate that it is important to consider potential mediators together in a multiple mediation model, as some results indicated by the simple mediations were not confirmed in the multiple mediation analysis.

Finally, the lack of significant results for the stage of change measure is an interesting finding. In this case, the individual’s preparedness to take action to manage their safety risks was not related to their views of management commitment to safety, and only weakly related to their personal safety motivation and self-reported safety compliance and participation. The mean was high for this measure, with most indicating the most mature stage of change. Organisational safety training and induction emphases on personal responsibility and management of safety risks may have influenced the skewed results in this sample. It is also possible that the measure was not suited for adaption to the current context, as it may have lost some nuances in the translation to a five-item forced-choice scale (as opposed to a
qualitative, interview style format which determines stage of change through a series of questions and examples).

5.4.3 Practical implications

The findings from this study have a number of practical implications for the organisation, industry and workplaces more generally. First, the dynamic workforce was consistently viewed as a barrier to safety culture development and maintenance. Unfortunately, a transient workforce and use of subcontractors on big projects is a common characteristic of the construction and mining industry in Australia. This barrier may be difficult to overcome for the organisation in the short term due to wider industry influences. However, some of the specific items are around managing subcontractor operations, which does have scope for improvement across the organisation and within specific project sites. Organisations could usefully develop and foster durable subcontractor partnerships where possible, for example through preferred tender processes, to encourage shared development of safety culture.

Second, the differences between workforce levels on safety climate, motivation and behaviour indicate a need to ensure senior management commitment is translated through the workforce levels, particularly at frontline management levels. This may not need to be a straight replication of organisational level value statements, but the message should be consistent. Workers have little exposure to senior and middle management compared to their line supervisors, so it is important for safety messages to be communicated through the most relevant and present leader. The importance of supervisory safety practices is highlighted in previous research investigating safety climate and leadership (Zohar, 2002).

Finally, the finding that safety motivation mediated the climate–behaviour relationship suggests that safety motivation is the key to safety climate influencing safety behaviour outcomes. Potentially, safety initiatives that ignore safety motivation (that is, the motivation of individuals to perform safety-related activities) may not have the intended improvement outcomes, despite efforts around creating a positive safety climate. Supportive leadership was also a partial mediator of the relationship, so it is important to consider how supportive leadership and safety motivation may be linked for workers making safety decisions. Clearly, highlighting senior management commitment to safety is only one approach in encouraging safe behaviours. Other interventions leveraging supervisor support to motivate employees
in personally valuing safety could have greater impact on safety outcomes for the organisation.

5.4.4 Strengths, limitations and future research

The study had a number of strengths; including the replication of findings from study one using another methodology and broader sample, the use of a solid theoretical framework and reliable measures for safety climate and behaviour, and the application of this framework to the Australasian construction and mining industry.

This study built on findings from study one in order to further explore these within a broader workforce sample. In this case, the workforce sample was large and reasonably representative so we can be confident that the findings reflect perceptions within the organisation. The finding that facilitators and barriers to safety culture were perceived reasonably similarly across the organisation is important to informing future safety interventions within the current organisation and potentially other organisations in the construction and mining industry.

The theoretical framework underpinning the research program and this study specifically has good support in the literature, and aspects of it have been empirically tested in both cross-sectional and longitudinal designs. The inclusion of additional mediating variables was also a strength of this study, as it is important to know the relative contribution of variables to the prediction of safety behaviour. This is the first study to simultaneously consider mediators in a unique sample with influence across the Australasian construction sector.

Further, the predictive ability of a concise three-item safety climate measure in this study was comparable to other studies using up to 16-item measures (Johnson, 2007). The short measure had excellent internal reliability and bivariate correlations indicated concurrent validity in that all measures were correlated in a significant, positive direction. The validation of this concise measurement tool in a large workforce sample has practical applications for industry, and researchers working with industry. Perception surveys are often lengthy and cumbersome to conduct with large numbers of workers, and reducing time away from critical organisational tasks is an important benefit to industry. In industries such as construction and mining, with inherent pressures of production in the time available, the availability of a
reliable, valid, and concise short-item safety climate measure for future research is additionally likely to assist in a higher respondent rate and greater representativeness.

However, a number of limitations need to be mentioned. The main methodological limitation of this study relates to the use of self-report perception surveys. There is an inherent social desirability bias around safety (safety is ‘good’) that could have affected the trend in responses on safety questions. However, the research design ensured that confidentiality and anonymity were preserved so social desirability should have been reduced. Future studies could consider including measures of social desirability and demand characteristics to determine if these affected the results of the survey (see Crowne & Marlow, 1960 for an example). However, it has also been suggested that the magnitude of this distortion is commonly overestimated in perception research (Crampton & Wagner, 1994). Further, Mohamed (2002) argues that self-report measures can be more accurate than other sources of ‘objective’ incident data as under-reporting of incidents in organisational records is a widespread issue in construction organisations. Additionally, Work Safe Australia only records data from workers compensation claims which can only generally be lodged after a seven-day absence. A possible solution to self-report behaviour biases is to consider including a measure of supervisor-rated safety behaviour alongside self-reported safety behaviours (Christian et al., 2009), however, this naturally increases the survey size, which may meet resistance from organisational management in an applied research context.

Another limitation concerns the sample’s representativeness and generalisability. Despite the representativeness of the sample being quite good in this study, it is still possible that the survey did not reach less engaged staff. The previous organisational survey we compared our results to had a 70 per cent response rate. This is an excellent rate; however, we do not know whether the remaining 30 per cent have similar views to the survey sample. Thus, it is possible that the survey responses do not include the full range of potential opinions and perceptions of employees in the organisation. Further, as previously discussed, the sample was all drawn from one organisation. The organisation is considered reasonably representative of and influential within the Australasian construction and mining industry, however, caution should be taken in generalising the results to other organisations.
A further consideration in the interpretation of results from this survey relates to the level of measurement. All measures in the study were of individual perceptions that have been averaged to the organisational or group level for the purpose of group comparisons. Any difference in perception of climate at the group or organisational level is only a reflection of the mean differences. Other research has employed multi-level modelling techniques (Newnam et al., 2008; Zohar & Luria, 2005) as an alternative approach to climate measurement, however, the transient nature of the workgroups within the organisation precluded this approach.

Another methodological and theoretical consideration is the cross-sectional nature of the study. As explained in section 5.2, conducting the survey at more than one time point was considered unrealistic and burdensome for the participating organisation. The consequence of this decision is that causal inferences can only be made based on theoretical pathways rather than actual empirical data for this study. For example, the analyses relating to safety climate and incident involvement could also be muddled by the enforcement paradox, whereby receiving warnings may indicate a stronger safety culture, rather than a weaker one (a reversal of the proposed theoretical pathway). Despite this limitation, the results found are consistent with causal studies using the same measures. For example, Griffin and Neal (2006) found a significant lagged effect of climate and motivation on behaviour after a six-month period.

The results of this study suggest that a direction for future research should be to further investigate the factors predicting safety behaviour, particularly a consideration of the mechanisms for how employees are motivated to perform safety behaviours. The significant mediation role of safety motivation suggests that the safety climate is not the only consideration in improving safety outcomes, and understanding how employees are motivated and the role of supervisors in this is critical.

5.5 CHAPTER SUMMARY

This chapter presented the background, method, results and implications from the second study in the research program. The workforce safety climate survey was conducted with a large cross-section of the organisation, and used an extended model of safety performance to investigate the safety climate–behaviour relationship.
Differences on key measures were also explored between organisational divisions and workforce levels, with statistically significant results but limited applied significance. Finally, the barriers and facilitators identified by the safety leaders in Study One were rated on importance with the broader workforce sample.

Study Two results indicate that safety climate, safety motivation and supportive leadership were all significant predictors of safety compliance and safety participation, and safety motivation was the most important contributor in both cases. Study Three further investigates how and why workers are encouraged to perform safety behaviours, and the influencing role of supervisors from the perspective of frontline workers. This investigation is critical both for informing practical safety culture interventions for the organisation, and also assisting in the translation of research findings to the organisational environment.

The next chapter describes the final study in the research program. It details the background and method to the study, including a rationale for the chosen theoretical approach within the research program’s overall framework. The results of the study are presented as they relate to this framework, and implications are discussed in terms of research questions and broader theoretical and practical applications.
Chapter 6: Safety motivation and performance

This chapter describes the research undertaken for the final study in this PhD research program. A background to the research is provided, including the positioning of this study in the overall research methodology, a review of the key theories on motivation and an analysis of the chosen motivational theory as it was utilised in this study. Next, a rationale is given for why group interviews were the chosen method for this study, and a brief description of the application of the method in the context is provided. Details of the participants, materials, procedure, and data analysis are then described. Results from the thematic analysis are presented as key findings and are then discussed in relation to the implications for safety culture theory and practice.

6.1 STUDY AIMS AND APPROACH

As noted in section 2.6, the nature of the relationship between safety climate and safety behaviour is still being explored and refined by researchers (Christian et al., 2009). The survey results from Study Two offered evidence that safety motivation explained a significant proportion of variance in safety behaviour, and partially mediated the relationship between safety climate and safety behaviour. This relationship supports previous findings in the area (e.g., Neal & Griffin, 2006; Vinodkumar & Bhasi, 2010), and further highlights the need to consider how climate perceptions influence individual motivations to perform safely at work. Safety motivation was measured as a value perception, with items relating to personal beliefs about the importance of putting in effort to be safe and reduce incidents. Interestingly, safety motivation was also highlighted in the interview results from Study One, with safety leaders emphasising the importance of worker’s involvement and personal commitment to safety (see section 4.4).

Given that Study Two highlighted the significance of safety motivation, the aim of this final study was to understand how and why workers are motivated to be safe, and what factors might help or hinder this. In particular, the role of the frontline supervisor was of interest in this regard, as this had not been specifically explored in
Studies One and Two, but is well supported in the literature (e.g., Dingsdag et al., 2007; Zohar & Luria, 2005). The survey results do not explain what causes an individual to be motivated, and how this motivation translates to performance in a practical sense. Study Three aimed to address this gap by conducting group interviews with frontline workers and supervisors to determine what influences their motivation to engage in safe behaviours at work.

This study contributes to the overall program of research by addressing the third and fourth research objective and more specifically, research question 5:

- **RQ5: How can workers be encouraged to perform desired safety behaviours?** The final study in the research program delves deeper into understanding how and why workers are motivated to perform safety behaviours, and the influencing role of supervisors. The research employs a qualitative method to understand the process by which frontline workers and supervisors are motivated to be safe at work, and how this compares to other motivated work behaviours. This frontline perspective is critical to informing practical safety culture interventions for the organisation, as these workers have the most risk exposure.

As previously noted, in the context of organisational behaviour, motivation is often cited as a critical influencing factor for performance and the positive relationship between safety motivation and safety performance has been established in a number of studies (Griffin & Neal, 2000; Neal & Griffin, 2002; Newnam et al., 2008). Additionally, the role of leaders in workplace safety is well established in the research literature (Clarke & Ward, 2006; Griffin & Hu, 2013; Hoffman, Kines, & Anderson, 2010; Zohar, 2000).

An overview of employee motivation theories was provided in section 2.6.3, and Vroom’s (1964) Valence–Instrumentality–Expectancy theory was highlighted as a well-accepted modern theory of work motivation. Previous safety research has also adopted this understanding of motivation in a safety context (Griffin & Neal, 2006; Zohar, 2003); however, not specifically in a construction and mining context. Given its relevance in explaining why workers may be motivated to perform safety behaviours, the theory was used as a theoretical framework for guiding the group discussion and interpreting the results.
Figure 6.1 displays the VIE model that outlines how effort is linked to performance which leads to the desired outcome (Expectancy–Performance–Outcome). The theory suggests that people are in a motivated state when they believe the effort expended will lead to performance at the desired level, and that this performance is associated with valued outcomes or rewards.

![VIE Model Diagram]

Figure 6.1. Relationship between constructs in VIE theory

The key elements of the model relate to expectancy, instrumentality and valence. Expectancy refers to the individual believing that a certain level of effort will lead to desired performance. Instrumentality refers to the individual assessing that performance at the desired level will be linked to rewards or outcomes. Valence refers to the value placed on those rewards. If any part of this chain is broken then the effort may not be undertaken by the individual because motivation is compromised. The theory has practical utility; if the organisation can identify a weak link in this chain, then that link can be targeted for improvement (Levy, 2003).

VIE theory has considerable support within the research literature. Miner’s (2003) quantitative review of organisational behaviour theories ranks VIE theory highly on importance, scientific validity and practical usefulness. Included in the comparison were alternative motivation theories and other theories relating to leadership and decision-making. Additionally, the theory has validity in cross-cultural studies (e.g., Matsui & Terai, 1979, compared American and Japanese samples). Kalliath et al. (2010) also consider VIE one of the most valuable theories of work motivation. They explain how VIE can be applied to enhance worker motivation. First, managers need to ensure that valued rewards are available to workers. Second, workers need to be reassured that they have the skills and resources available to do the tasks required of them. Last, the organisation needs to ensure that individual performance is clearly linked to valued rewards. Managers can play a role
in clarifying expectations about effort leading to desired performance, as well as in ensuring that performance is consistently rewarded in a way that is valued.

However, others criticise the theory for being too complex to apply to normal everyday decisions, and for excluding non-cognitive elements such as emotions and personality traits (Landy & Conte, 2010). Another important note about VIE theory is that it is a within-individuals theory in that individuals are thought to weigh up different alternatives to determine what they will be motivated to do, rather than a theory that identifies which individuals are more motivated (Landy & Conte). Therefore, any between-individuals analysis is not appropriate, which unfortunately applies to a considerable portion of the early research on the theory (van Eerde & Thierry, 1996). Despite these complexities, VIE theory remains one of the most popular motivational theories in organisational performance research (Miner, 2003). In addition, the majority of studies on VIE theory are quantitative in nature, and no known studies have attempted to apply the theory specifically to safety performance using a qualitative method.

For the current research context, VIE theory was used as a framework for identifying the drivers of safety performance. Operationalising the theory is best introduced with an example. A safety-specific instrumentality cognition could be: “If I follow safety rules, it will lead to other valued outcomes”. These valued outcomes may include: a good performance review; promotion for safety record; not being injured in an incident; or, not being responsible for an incident. Alternatively, following safety rules at work could lead to less valued outcomes such as: running behind on a project; finishing a shift late; or, looking silly in front of workmates. In addition, perhaps the rewards valued by employees are more likely to be an outcome of other performance factors such as high productivity and cost-savings.

Table 6.1 describes the operationalisation of VIE theory for this research. Each VIE theory construct is detailed and defined. Organisational, Supervisor and Worker perspectives are then clarified across all VIE constructs. This comprehensive matrix which engages all elements of the theory then led to the development of the Interview Schedules which interrogate all theory elements (Appendices L and M).
Table 6.1

*Operationalisation of VIE theory for this study*

<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
<th>Organisational perspective</th>
<th>Supervisors perspective</th>
<th>Workers perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong> (P)</td>
<td><em>This research defines “safe behaviour” as safety compliance and safety participation.</em></td>
<td>Full safety compliance and participation with a view to preventing workplace incidents (is this clearly communicated?)</td>
<td>What level of performance do supervisors expect of their direct employees?</td>
<td>What do workers think is expected of them around safety?</td>
</tr>
<tr>
<td><strong>Effort</strong> (E)</td>
<td><em>The action required to perform at the desired level</em></td>
<td>What type of effort does the organisation ask employees to make to be safe?</td>
<td>What do supervisors expect employees to do to meet safety performance standards?</td>
<td>What do workers think they need to do to meet safety performance standards?</td>
</tr>
<tr>
<td><strong>Expectancy</strong></td>
<td><em>Belief that a specific level of effort will lead to a desired level of performance</em></td>
<td>What does the organisation expect employees to do to meet safety performance standards?</td>
<td>Do supervisors specify the effort required to successfully comply with safety rules?</td>
<td>Do workers think that their effort will result in them fulfilling safety performance expectations?</td>
</tr>
<tr>
<td><strong>Outcome</strong> (O)</td>
<td><em>The outcomes associated with performance at the desired level, particularly rewards. This may be positive or negative.</em></td>
<td>Are incidents avoided if everyone performs as expected?</td>
<td>Do supervisors communicate the outcomes associated with safety performance?</td>
<td>What outcomes do workers link to meeting safety performance standards?</td>
</tr>
<tr>
<td><strong>Valence</strong> (V)</td>
<td><em>The desirability of outcomes/rewards associated with performance at a given level</em></td>
<td>Are rewards communicated in a way that makes them desirable to employees?</td>
<td>Do supervisors have an insight into what workers value?</td>
<td>What outcomes do workers value? Are these the rewards that are associated with safety performance?</td>
</tr>
<tr>
<td><strong>Instrumentality</strong> (I)</td>
<td><em>Belief that performance at the desired level will actually result in the valued outcomes</em></td>
<td>What outcomes are currently linked to performance?</td>
<td>Do supervisors have discretion in the rewards that they provide for workers safe behaviour? How do supervisors clarify this link?</td>
<td>Are workers confident that a valued outcome will result they if they have the necessary safety performance?</td>
</tr>
</tbody>
</table>
6.2 METHOD

A semi-structured group interview methodology was used to determine the underlying factors for workers’ motivation to engage in safety behaviour. Interviews are commonly used in mixed method studies as a complement to quantitative methods (Krueger & Casey, 2000). Consistent with other qualitative techniques, the data derived offers more depth and meaning around concepts than scaled survey responses can, as well as an insight into the practical application and understanding of the same concepts. Interviews are suited to research that aims to reveal the factors that influence participants’ behaviours and motivations in the language of the participants (Krueger & Casey). The chief strength of the group interview technique is that participants are not just interacting with the researcher; they are engaging in discussion with other participants, which can lead to insights that may not arise through individual interviews. This is particularly relevant in the context of safety, as corporate messages are often so entrenched that responses can be automatic if not checked and questioned by peers.

As already mentioned, the underlying mechanisms for motivated behaviours are difficult to explore in a survey. It was considered important to gain a perspective from frontline workers in a way that elicits depth of understanding, including examples of scenarios in which decisions about safety are made. The basic premise of VIE theory is that individuals choose between various behaviours based on the likelihood of a positive outcome. In a dynamic working environment such as construction and mining, there may be situations where workers could comply with a safety rule, or could choose an alternative behaviour that will result in a more valued reward (for example, taking a shortcut in order to finish the job more quickly). A qualitative method of enquiry allows participants to explain the reasons behind their decisions, and to compare contextual factors in making these decisions. This approach was designed to complement the other studies in the research program, providing the necessary depth of data to explore the constructs within the guiding theoretical framework.

6.2.1 Participants

Participants were a convenience sample recruited from three project sites within the organisation. In an attempt to obtain a sample that was representative of the researched organisation (and representative of the workforce climate survey.
respondents), a mix of construction and mining sites was included, from various geographical locations (see Table 6.2). Frontline workers and supervisors were invited to participate in separate groups, with group sizes varying from 3 to 8 employees depending on the size of the site and availability of workers. Supervisors were particularly difficult to recruit in large numbers because of their role responsibilities. In fact two supervisors were interviewed individually as this was the only feasible option. Whilst group interview research often seeks to have heterogeneous group members to capitalise on different perspectives, homogenous groups have two important advantages in this context. First, discussing safety matters with peers in similar roles allows shared experiences to be captured with great depth. Second, given the potentially sensitive nature of the discussion topic, it was important to ensure that participants felt that they could share information and experiences freely, without being inhibited by those above or under them in the organisational hierarchy.

Table 6.2

*Group interview demographics*

<table>
<thead>
<tr>
<th>Site</th>
<th>Project type</th>
<th>Location</th>
<th>Worker n</th>
<th>Supervisor n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road construction</td>
<td>Victoria</td>
<td>5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Rail construction</td>
<td>New South Wales</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Coal mine</td>
<td>Queensland</td>
<td>8</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>16</strong></td>
<td><strong>13</strong></td>
<td></td>
</tr>
</tbody>
</table>

The total number of participants in this study was 29, with just over half (55%) being frontline workers and the remainder comprising frontline supervisors. One participant was female and 28 were male, consistent with the gender balance in previous studies, and across the sample population. This sample was considered sufficient for the purpose of the current study, as other research has noted that saturation is often reached early within the group interview methodology (Conchie et al, 2013). That is, new ideas and themes become less likely as the number of groups increases.
6.2.2 Materials

An interview schedule was used to guide the discussions for frontline supervisor groups and frontline worker groups (see Appendices L and M). As discussed in section 6.1, questions were designed around the theme of safety motivation, using VIE theory as a framework. An audio recorder was used for the purposes of transcribing the discussions. Participant Information Sheets were distributed to all participants prior to interviews commencing (see Appendix K).

6.2.3 Procedure

The interviews were conducted in private conference/training rooms at the relevant sites. Participants were provided with information sheets outlining the purpose of the research and the nature of their participation. As the interviews took place at the workplace, it was particularly important for participants to be assured of the confidentiality of their responses and their right to withdraw at any stage. Once participants had given their verbal consent the facilitator provided a brief introduction to the focus of the discussion and the importance of valuing everyone’s contribution to the discussion.

The interview schedule included a mix of open-ended questions and follow-up prompts as recommended by Krueger and Casey (2000). All participants were asked to respond to the first question about the level of safety performance expected at their workplace. This promoted equal contribution and openness amongst interviewees. Demand characteristics such as social desirability were managed by ensuring that questions included self-perceptions and general perceptions of safety behaviour. Discussions were facilitated by encouraging contributions from all participants and managing dominant participants (for example, at appropriate times the facilitator would prompt for similar or different experiences from other group members if one person had been the main contributor to discussions).

The group interviews varied in length between 20 to 50 minutes duration, with an average duration of 32 minutes. Duration was also necessarily restricted due to operational site requirements. Variances in length were mostly due to the size of the group, with larger groups taking longer. The two individual interviews with supervisors were the shortest duration. Interview transcripts were produced for analysis from the audio files, omitting any information that would allow the
individual or the organisation to be identified. The audio files were then destroyed in accordance with ethics committee requirements.

6.2.4 Data analysis

Data were analysed using thematic analysis (Braun & Clarke, 2006). A detailed discussion of thematic analysis as a qualitative technique is provided in Chapter 4. To protect participant anonymity, individuals were not identified in the interviews or in the resulting transcripts. Therefore analysis was restricted to group level themes rather than individual trends in responses. Responses were quite similar across the construction and mining sites, with group data indicating comparable themes. Therefore, the results across all three sites are presented, and the relevant site is indicated after quotes. In contrast to the interviews conducted in Study One, this study had a defined framework for discussion and analysis. Therefore, the framework guided the thematic analysis and results are presented in the same approach.

6.3 RESULTS

Frontline workers and supervisors’ motivation to perform safety behaviours was explored by adopting a well-established employee motivation theory to the safety context. The results from the group interviews are presented as they relate to each component of the theory. Thus, the results following relate to safety performance, effort and expectancy, instrumentality, outcomes and valence.

6.3.1 Safety performance

From the workers’ perspective, discussions primarily related to procedural compliance. Following safety rules and procedures was the most common perception of what workers thought was expected of them in the company and on the project site. One worker summarised the requirements: “Being responsible for one’s self and people around you” (Worker, Site 1). Other performance requirements described related to proactive hazard identification, and participation in group safety activities such as pre-starts, toolbox talks and the development of Job Safety Analyses (JSAs), Safe Operating Procedures (SOPs), or Safety Health and Environment Work Method Statements (SHEWMS) where relevant. An example of the importance of proactive safety behaviour illustrates: “If I see something that’s a problem I see anything that I should pick up on site, I am there to report [it] ” (Worker, Site 2).
The supervisors’ view of employee safety performance was well aligned to the workers’ perspective. Discussions confirmed the importance of following safety procedures and raising safety issues or concerns. Procedural compliance also extended to the completion of relevant safety paperwork, a requirement for the organisation and for the individuals in order to have evidence of compliance. Supervisors also reported an additional performance requirement around ‘safety leadership’ or leading by example. The following example reflects the perceived importance of modelling safety behaviours to team members:

“I think it’s just leading by example, you know. If people below you see that you care about their safety then they’ll think the same way about safety. You know what I mean. So that’s all I do—lead by example and look after your mates.” (Supervisor, Site 3)

6.3.2 Effort and expectancy

Workers’ discussions around the effort required to meet safety performance expectations included both compliance and participation components. There was some variation in the specific actions or behaviours required in following safety rules in different work areas, however, these had a consistent theme around prioritising safety considerations in decision-making. All job tasks were described as having a safety element, and the workers’ job was to implement the appropriate risk controls as specified by the relevant policy or procedure. In many instances, workers also had involvement in the development of these safe work procedures (for example, job safety analyses, standard operating procedures, and safety and health work method statements), and participation in this process was also seen as necessary for safety performance. Proactive hazard identification was also cited, for example: “if there’s anything unsafe you can’t just leave it, you got to fix it. As soon as you find something—anything—that’s unsafe, you have to report it and sort it out” (Worker, Site 3).

Generally, effort-to-performance expectancy was reasonably strong amongst workers, in that they believed if they followed the safety rules for their work area and participated in relevant safety activities, they would be successfully meeting the required performance standards. In response to a question targeting expectancy, one interviewee confirmed: “You would be happy with how safe you are 95 per cent of the time” (Worker, Site 1). This is likely due to the clear articulation of performance
standards at the organisational and work team levels. To provide some organisational context, a recent rollout had occurred of simple, branded safety rules articulating minimum safety requirements for different work environments within the organisation. The rules were known as “Above the line” and had a focus on risk minimisation through applying a hierarchy of controls. The organisation had put some effort into communicating these through various media (intranet, handouts, face-to-face leadership visits). However, despite this effort there were some exceptions relating to this, particularly in the construction areas, where some workers felt like expectations could vary according to idealised and realistic expectations, for example:

“With the pre-start, you are encouraged to—you are responsible for your own safety and to work safely. And then when you get out onto the work site, as with every job with safety, there are a lot of grey areas.” (Worker, Site 1)

From the supervisors’ perspective, there was consistency in how expectations were communicated across work teams and project sites. This was assisted by clear organisational policies on what effort was required of workers to successfully comply with safety rules. Supervisors generally used the language of the organisational policies, and did this through various mechanisms such as pre-starts, toolbox talks and behavioural observations. As employees themselves, some supervisors also discussed how their efforts around safety related to performance standards in their role. As part of the safety leadership modelling that was expected, supervisors perceived that their behaviour needed to be consistent with organisational policies. This included supporting and advocating for employees’ safety concerns and working with management at the project level to address hazards within their work group. For example, one interviewee described his accountability to raise hazards with higher management in the following phrase: “You gotta make noise, make the call” (Supervisor, Site 3).

6.3.3 Outcomes, valence and instrumentality

Workers’ discussions around the outcomes or rewards for safety compliance and participation had several common themes. Rewards such as retail vouchers, eskies, backpacks and branded shirts were often mentioned as tangible outcomes for safe performance. Project and organisational level awards were also discussed, with most examples being for group performance rather than individual effort (for
example, loss time injury (LTI) free periods were reportedly rewarded at the project level. Other forms of recognition cited included team barbecues and breakfasts, although there was some confusion about what performance was being rewarded at these events, as described in the following conversation extract:

W1: And we’ve had BBQs. Was that for safety?
W2: No, that was for getting the contract renewed.
W3: Yeah.
W1: Ok, production [laughter]. (Workers, Site 3)

Discussions also occurred around consequences in the work environment when performance expectations are met. At a basic level, workers understood that safety was so entrenched in organisational policies and procedures that meeting safety performance expectations was necessary to maintain employment with the organisation. For example, “keeping your job” and “going to the next job” were often brought up in discussion. However, there were some examples of safety performance having negative outcomes. The following examples highlight tension between competing performance priorities and outcomes:

Worker 1: If you bring up some safety issues you’ll be called a troublemaker. Stirring shit for nothing because they don’t deem it unsafe. They won’t say it to you; it’ll be like ‘thanks for that’. But then the next day you’ll be off that machine and you’re on a shit one for a couple of weeks.

Worker 2: Yeah. (Site 3)

“Sometimes you’ll have a really good safety issue but it’s going to affect production so when that happens they’ll talk to you outside alone. Basically you’ll have three people from management standing there and everything you say they’ll have a come-back for and they’ll just fire at you until you go ‘ok, forget about it’. ” (Worker, Site 3)

Worker 1: [You] come across a lot of things that work out very well in the office, but when you are out there, they don’t work at all. And the same way you can find yourself in a grey area because you get out and it says, ‘well do this’. But if we do this, we are going to cause another issue, and then you can set off a chain reaction. Or you can go back, start at the baseline and work it out.

Worker 2: Which could impede production
Worker 3: And time is money
Worker 4: At times there is encouragement to, well, ‘let’s get working’ (Site 1)
For some interviewees, the relative valence for production and safety outcomes was clear. For example,

“There’s a fine line between being efficient at your job and being safe at your job. You’ve just got to blend them together as best you can. But I’m going home in one piece, before I’m getting a truck out an hour earlier. That’s the way I look at it.” (Worker, Site 3).

Another outcome of safety performance discussed related to personal safety and well-being. Several workers reasoned that being compliant with safety rules led to intrinsic outcomes for themselves and their workmates, often expressed in the phrase “go[ing] home safe”. This expression acknowledges the potential for serious physical harm on site, and captures the motivation to avoid incident involvement, as well as motioning towards general well-being and impacts on family or home life. For example, “You go home unhurt, to enjoy whatever you do out of work” (Worker, Site 1).

In regards to the valence of the outcomes, maintaining employment was highly valued. Sometimes this was linked to safety performance (instrumentality), and other times it was more strongly linked to production performance. Job enrichment was also spoken about (for example, being given a more comfortable or newer truck to operate), however this was often linked as a positive outcome for production performance rather than safety performance.

Particularly in the mining context where financial remuneration is generous, retail vouchers did not hold much reverence. However, workers still reported appreciating receiving them, but not because of the financial reward, but for the recognition and acknowledgement that it represented. For many interviewees, a “pat on the back” from supervisors or project management was a valued outcome for their efforts. This could reflect an internalisation of organisational safety climate, in that workers strive to individually perform behaviours that they perceive are valued by the organisation, and through a process of reducing cognitive dissonance, these organisational values also become personal values for the individual.

Supervisors generally believed that their workers valued rewards such as retail vouchers and other small gifts. Supervisors reported some opportunities to exercise discretion with informal rewards such as ‘early marks’ and providing cool
refreshments on a hot day. Overall however, rewards were perceived to be controlled at the project level. There were also perceived discrepancies between how the frontline workers were rewarded and rewards available for project ‘staff’. This finding could be more aligned to equity theory in terms of fairness comparisons between self and others.

6.4 DISCUSSION

This study aimed to understand how and why workers are motivated to be safe, and what factors might help or hinder this, including the role of the supervisor.

6.4.1 Theoretical implications

This study utilised VIE theory to provide a framework for understanding workers’ motivations to behave safely. Whilst there are a number of theories explaining work motivation, VIE theory is argued to be the best fit for the safety context in this population (Levy, 2003; Miner, 2003). The theory demonstrated utility in uncovering the process for how employees are motivated to be safe at work. The results of this study highlight the breadth of application for VIE theory, particularly in a qualitative research context. This adds another dimension to the mediated climate-behaviour relationship described in Study Two, and is aligned with the overall theoretical framework underpinning the research program.

As previously outlined, VIE theory is a “within subjects” theory which argues that individuals make conscious choices among alternative courses of action based on perceptions, beliefs, and attitudes about those alternatives and their associated outcomes (Pinder, 1998; Vroom, 1964). Behaviour commences and receives direction as individuals consider valence, instrumentality, and expectancy to produce outcomes. Valence refers to the affective orientation that an individual has with respect to a given outcome. It is a preference that is derived from the anticipated level of satisfaction associated with an outcome. Outcomes exist at two levels with task performance generally representing the first level, and intrinsic and extrinsic rewards occupying the second level inasmuch as these outcomes result from task performance. Instrumentality refers to the extent to which an individual believes that task performance will lead to second-level outcomes. High instrumentality motivates behaviour that facilitates performance as performance becomes valued by its
association with a second-level outcome. Expectancy refers to the extent to which an individual believes they can accomplish a first-level outcome performance outcome.

Applying these concepts to safety behaviour, the first-level outcome would refer to successful task performance, including meeting safety compliance requirements and participating in safety initiatives. The second-level outcome(s) would refer to desired ‘rewards’, including maintaining employment, job enrichment, supervisor and leader recognition and ultimately securing personal safety. Thus, individuals should be motivated to engage in safety behaviour when they believe they can meet task performance requirements (expectancy) and that meeting these first-level outcomes would lead to other valued outcomes (instrumentality) as described above.

VIE theory also demonstrated utility for understanding the role of leadership in motivating workers. The safety field is awash with proponents of ‘safety leadership’ (e.g., Conchie et al., 2013) and this is described as being a critical skill for leaders at all organisational levels. This study has shown that frontline supervisors continue to be central in communicating safety expectations, standards and decision-making processes on the job. In addition, they appear to be an overlooked resource in terms of employee motivation. This is a positive extension to previous industry research. Newman et al. (2008), in a study on safety in work vehicles, found that drivers’ perception of fleet managers’ safety values were related to their motivation to drive safely. Although the study included drivers’ perception of supervisors’ safety values, this relationship was non-significant, whereas the present study offered contrasting evidence of employee motivation being influenced by frontline supervisor values. Frontline supervisors are potentially in the best position to provide immediate recognition for safety performance, in a way that is meaningful and valued.

6.4.2 Practical implications

The construction industry is a team-based, diverse and dynamic environment (Hoffmeister et al., 2014), which requires personal motivation and supportive leadership to negotiate the variety of physical and mental demands of the workplace. Previous studies have defined safety behaviour as motivated work behaviour (Newnam et al., 2008), and it is important to understand how that motivation occurs in the industry context. The results from this study indicate that decisions about complying with safety rules or participating in safety initiatives are not made in
isolation, but with a sense of other competing priorities and values. Several examples of this are provided 6.3.3 in the context of the highly valued outcome of maintaining employment, which was sometimes linked to safety performance (instrumentality) and at other times was more strongly linked to production performance. Further, as also evidenced this means that an intrinsically motivated employee may still need other extrinsic rewards to emphasise the importance of the desired behaviour.

Geller (1994, p.19) illustrates the difficulty of motivating safe work behaviours: “Unsafe work practices are often followed by motivating consequences (i.e., comfort, convenience and faster job completion). Conversely, safe work practices often require personal sacrifice (i.e., discomfort, inconvenience, delayed work break).” Geller argues that reward and recognition policies need to be based on criteria employees feel they can personally control (instrumentality). These comments complement the conceptual consideration in VIE theory from Effort to Performance to Outcome discussed earlier (see Figure 6.1). That is, it relates to behaviour of themselves and workgroup peers, rather than injury or incident rates (outcomes). In this sample, memorable rewards such as barbecues and gifts were often linked to group level injury-free days. Potentially this is not an effective link for individuals when making decisions to follow safety procedures and participate in safety activities. In addition, it also focuses on the negative aspect of safety—an absence of negative events—rather than positive practices such as the presence of observable safety behaviours.

One positive driver of safety performance from this study is the leadership perspective. Supervisor goals were to ensure consistency in how expectations were communicated across work teams and project sites. This was further assisted by clear organisational policies on what effort was required of workers to successfully comply with safety rules. To further this, supervisors generally used the language of the organisational policies and, as leadership models, perceived that their behaviour needed to be consistent with organisational policies. Supervisors generally believed that their workers valued extrinsic rewards and, whilst acknowledging that rewards were generally controlled at project level, reported some opportunities to exercise discretion with informal rewards.

In regards to encouraging positive safety behaviour in their employees, supervisors in this sample seemed to understand their roles and responsibilities
around safety, which is critical to any safety intervention. Understanding safety accountabilities is the first step (Biggs et al., 2005), and building further safety leadership skills in communicating a shared vision, modelling behaviours and applying motivational strategies is a further investment the organisation can make in improving safety outcomes. In particular, acknowledging the importance of workers’ health and wellbeing, rather than just a compliance focus, should be a focus of supervisors in motivating safety behaviours of their employees.

Based on the results, there are two major areas for the organisation to focus on. First, the results indicate that workers do not always receive rewards that are valued when they meet safety performance expectations. Second, a consistent link between valued rewards and safety performance needs to be clearly articulated both at the organisational level and, critically, through the frontline supervisors. The results of this study indicate that the workers in this organisation understand the level of safety performance required of them, and they know what they are expected to do in order to meet those requirements. However, as long as the outcomes for safety performance are not valued, or are inconsistently provided, or if outcomes for other performance metrics are more valued, or more consistently provided, the worker may experience conflicting motivations to perform safely. The instrumentality for this sample of employees (that is, the belief that performance at the desired level will actually result in the valued outcomes) was not always strong. These results have implications across the industry as well, given the similar work environment and workgroup structures. The industry’s focus on production output trickles down to employees on the frontline, and safety performance cannot compete with production drivers without clear organisational policies and strong leadership at all levels.

6.4.3 Strengths and limitations

There were a number of strengths to this study. First, the use of a qualitative technique allowed for depth of understanding that could not be obtained throughout the quantitative survey. This was important given the highly contextual nature of motivated behaviours and decision-making. Second, the study focused on the perspective of frontline workers and supervisors who are most exposed to risk in the workplace, and whose attitudes and behaviours are ultimately targeted through workplace culture initiatives. This group had lower safety climate scores in the workforce safety climate survey (see Chapter 5), so were important to target in this
follow up study. Third, the application of VIE theory in this context is unique, and addresses a gap in the current literature. VIE theory is well supported in the motivation literature, but has not been utilised to explore motivations and constraints for safety behaviour generally, nor specifically in a construction context.

However, the study also contained some limitations. First, the use of a group interview setting might have inhibited responses by some employees, and may have elicited socially desirable responses due to the content of the interview. This is a common limitation in safety research (e.g., Conchie et al., 2013) and is very difficult to overcome when accessing employees at their place of work. Additionally, some participants specifically expressed concerns about confidentiality and anonymity prior to the interviews commencing. Whilst stating the terms of ethical clearance for the study hopefully alleviated these concerns, some participants may have been cautious in offering opinions in front of peers in the workplace.

Another limitation concerns the theoretical framework for the structure of the interview content. As mentioned above, the application of VIE theory in this setting has resulted in many interesting insights into influencing safe behaviours of employees. However, the design of the interview schedule around this framework may have limited elicitation of other potential thoughts and views. To counter this, participants were offered an opportunity to provide any additional comments during the interviews; however, such commentary was limited and in all cases related to existing themes.

6.5 CHAPTER SUMMARY

This chapter described the final study in the research program. The study used a qualitative approach to explore the mechanisms underlying a major finding in Study Two, namely the significance of safety motivation. VIE theory was used as a framework to identify what motivates frontline workers and supervisors to perform safety behaviours. The theory assisted in identifying a potential opportunity to further motivate workers in regards to safety. This study addressed Research Objectives 3 and 4 and Research Question 5. More specifically, it examined the relationship between safety culture and safety behaviour from the perspective of frontline workers, investigated additional factors that influence this relationship and translated these findings through identified opportunities for improving safety culture.
and safety behaviour within the industry. In addition to identifying the critical impact of safety leaders on frontline workers, this study identifies two additional factors for positive organisational attention. First, there needs to be congruence and consistency that workers always receive rewards that are valued when they meet safety performance expectations. Second, a consistent link between valued rewards and safety performance needs to be clearly articulated both at the organisational level and, critically, through the frontline supervisors.

The next chapter synthesises the overall findings from the research. Findings are reported as they relate to each research question and the objectives of the research program. Practical and theoretical implications are discussed, with an emphasis on translating research findings into applied solutions for the organisation and industry more broadly.
Chapter 7: General discussion

This chapter provides a general discussion of the findings from the research program. First, a summary of key findings is provided as they relate to each research question and the objectives of the research program. Next, the theoretical implications of these findings are discussed, followed by a consideration of the practical implications for the findings. The overall strengths and limitations of the research program are then presented. The chapter concludes with some recommendations for translating research findings into applied solutions for the organisation and the construction and mining industry more broadly, as well as highlighting future safety culture and climate research priorities.

7.1 SUMMARY OF FINDINGS

The aim of the thesis was to explore safety culture in a large Australasian construction and mining contracting company, with a view to understanding how safety culture theory and practice can be integrated to improve safety culture and related outcomes within the industry. This aim included several objectives. The first objective was to gain insight into how safety culture is understood in theory versus how it is applied in practice. The second objective was to explore workforce differences in perceptions of safety culture across the organisation. The third objective was to examine the relationship between safety culture and safety behaviour, and investigate additional factors that influence this relationship. Finally, the thesis aimed to translate research findings to applied recommendations for improving safety culture and safety behaviour within the industry.

The literature review identified that further research was needed on a number of unresolved issues in the safety culture field. Specifically, the literature remains confused on a number of key theoretical points regarding safety culture and climate. Empirical safety culture research and empirical safety climate research is not well integrated, and this has led to divergent bodies of research. In addition, industry practice has adopted safety culture change programs without always knowing the theoretical and empirical foundation for such initiatives. This research has attempted to introduce some clarity and reduce confusion in an important industry setting by
undertaking a series of investigations to allow safety leaders and followers to articulate their attitudes, beliefs, and values about safety in the workforce in language and concepts commonly understood in industrial communication, and to formulate suggestions for positive change.

The research program addressed a number of significant deficits in safety culture research to date. An understanding of safety culture was gained from the perspective of those who implement and manage safety culture initiatives within the organisation. Further investigation of the relationship between safety climate and behaviour was undertaken, taking potential mediating variables into account. And finally, how these influencing factors operate in an industry context was explored from the perspectives of frontline workers and supervisors.

**Research Question 1:** How is safety culture understood and described by the safety leaders in the organisation?

This research program has taken an integrative view of safety culture; but a functionalist view of how management influences culture. That is, culture is a top-down driven process, and the views of management are critical to the resulting safety culture. As discussed in Chapter 2, the current academic literature has a fragmented view of safety culture stemming from diverse theoretical positions and unresolved conceptual debates. It was important to understand how the experts in the organisation understood safety culture, as this influences how cultural values and beliefs are translated through workforce levels. This research question contributed to the first objective of the research program by providing an insight into the shared vision of safety culture, how safety culture is understood, and what language is used to describe safety culture within the organisation. This offers a critical industry perspective to balance the theoretical understanding of safety culture as presented in the academic literature.

The key themes identified in the safety leaders’ definitions and descriptions of safety culture highlight a more pragmatic view of culture than that in the literature. The themes indicated that their understanding of safety culture related to the actions and behaviours of the workforce, and in particular how people acted in their normal mode of operation. Examples include statements such as “the way we do things around here” and “what people do when no one’s looking”. This can be related to the layered view of culture (Guldenmund, 2010; Schein, 1992), where the outer layer
of artefacts was reflected in descriptions much more than the middle or core layers. It seems logical that the tangible aspects of culture were given emphasis in this sample, given the nature of the construction industry and the disciplines within it (e.g., engineers, project managers, trade-skilled workers).

In addition to safety culture descriptions and definitions, the themes from the interviews highlight the overriding importance of management commitment to safety, which is commonly reported as the higher order factor in safety climate measures. This finding corroborates previous research on safety culture (Dingsdag et al., 2008) and safety climate (Guldenmund, 2007), and informed the conceptualisation and operationalization of safety climate in the workforce survey. That is, safety climate was measured as perceptions of management commitment to safety and was operationalized by the value and priority given to safety (i.e., safety values). Worker involvement in safety was another theme that emerged from the interviews, which also aligned with the choice of framework for study two, in that both safety motivation and safety participation were included as part of an investigation of the climate-behaviour relationship.

Research Question 2: What are the key facilitators and barriers to safety culture?

Also contributing to Objectives 1 and 2, this research question addressed a gap in the research literature to date by investigating the most important facilitators and barriers to safety culture, from the perspectives of the organisational safety leaders and the broader workforce. The elements that help or hinder the development and maintenance of positive safety culture were considered important to identify alongside descriptions and definitions. Whilst the factors that comprise safety culture are frequently discussed in the literature, there is a comparative lack of exploration into the practical facilitators and barriers that can influence safety culture improvement in organisations. Organisations are complex, and have a number of business priorities such as quality, time and cost performance, so a consideration of the contextual impacts on safety culture is important from an industry perspective. In addition, the unique nature of the construction and mining industries presents further contextual barriers to the development and maintenance of safety culture amongst a transient, diverse and dispersed workforce.
The research question was addressed by adopting a number of methodological approaches. First, safety leaders were interviewed, and resulting themes were identified. These themes were then confirmed through a quantitative ranking process with the same sample of safety leaders, as part of a two-round modified Delphi method. The results from these methods indicated a number of facilitators and barriers to safety culture. Specifically, the most commonly highly ranked facilitators were around systems being aligned, clear and simple safety messages and leaders knowing their responsibilities for safety. The most commonly highly ranked barriers were difficulties with subcontractor management and operations, too much paperwork and the challenge of keeping it fresh (relating to safety fatigue and complacency from message saturation).

The second study investigated perceptions of the importance of facilitators and barriers with a broader workforce sample and attempted to distil higher order factors or categories to inform safety culture research. The facilitators and barriers from Study One were included as items in Study Two, and converted to Likert-scale response questions in order to achieve a measure of perceived importance of each item. As expected, there was some similarity between safety leaders’ rankings of important facilitators and barriers, and average agreement scores on the Likert-scale questions within the broader workforce. The importance of clear and simple safety messages was perceived similarly, as was the significance of leaders knowing their responsibilities for safety. However, a difference was that the workforce sample indicated that making sure everybody knows the most important safety issues was important to facilitating a positive safety culture. A commonly perceived barrier was too much paperwork; however, the workforce sample also emphasised workforce transiency (workers coming and going regularly) and complacency (maintaining a high level of safety awareness even when accidents aren’t occurring) as important barriers.

These differences may be explained by the level of insight into organisational safety which is consistently understood and interpreted by safety leaders who typically are predominantly site based for the duration of the project and well aware of hazard history and site peculiarities. This is not the case with the transient workforce who are either subcontractors or employees subject to roster and site changes that disrupt continuity. The transient workforce and management of
subcontractor operations were identified as a significant barrier by respondents in this study and were seen by safety leaders as increasing risks on projects and significant barriers to contemporary and future safety culture development.

When considering the results from the principal components analysis, the barrier items loaded on components relating to safety resourcing, safety attitudes and competency, and the dynamic workforce. In the relative ranking and importance perceptions from safety leaders and the broader workforce, it appears, as noted previously, that the negative impact of the dynamic workforce is a consistent perception. Safety culture definitions refer to the shared attitudes, values and beliefs of organisational members, and having a transient workforce makes the building of a shared view difficult to achieve.

**Research Question 3: Are there intra-organisational differences in safety culture perceptions and safety behaviour?**

Also addressing Objective 2, this research question explored intra-organisational differences in perceptions of safety climate and safety behaviour. Previous research (see section 2.3.6) suggested that perceptions may vary within a large and diverse organisation. In particular, differences between functional areas (divisions) and workforce levels (workers vs. management) were of interest in this thesis. As part of the workforce safety climate survey (Chapter 5), demographic information about respondents was obtained in order to perform group comparisons. The current construction and mining organisation had six divisions at the time of the survey, each with arguably different functional operations and potential climates: Construction, Resources, Industrial/Energy, Infrastructure, Corporate, and Telecommunications. Analyses revealed statistically significant differences on all outcome measures (safety climate, safety motivation, safety compliance and safety participation). Specifically, individuals in the construction division had higher scores on average than a number of other divisions. In particular, construction division respondents reported significantly higher perceptions of safety climate and safety motivation than resources division however, did not differ on the safety behaviour measures.

Differences in perceptions across workforce levels were also investigated in the workforce safety climate survey. Position types were collected as part of the survey, and were later categorised into one of four workforce level categories: worker,
frontline management, middle management and senior management. Analyses revealed statistically significant differences on three outcomes measures, but not on safety compliance. Specifically, workers’ average perceptions of safety climate, safety motivation and safety participation were lower than middle and senior management. In addition, frontline managers had similar perceptions to workers, and differed significantly to senior management on all measures. These results resonate with findings by Dingsdag et al. (2008) who, in a study of worker perceptions on which positions in the construction industry have the most influence in driving and maintaining a site safety culture, found that such positions of influence were all site based (Site OH&S advisor, Foreman/Supervisor, Union representatives, the workers themselves). Middle management and senior management were seen as distal influences with poor communication channels. Given this, the results in this present study present a disconnect in perceptions, inasmuch as middle and senior management generally rated most measures higher than the workers and frontline managers, where it could be argued reality resides. This argues for better vertical communications and strategies to engage middle to senior management leaders as communication is frequently identified as the most or second most necessary element after leadership of a safety culture (e.g., Flin et al., 2000; Thompson et al. 1998).

**Research Question 4: What additional factors influence safety behaviour and related outcomes?**

In addition to understanding organisational variations in safety climate and behaviour, this research question contributed to Objective 3 by investigating the relationship between safety climate and safety performance, as well as any additional factors that influence this relationship. The research question was addressed by identifying possible influencing factors from the literature (Chapter 2) determining a guiding theoretical framework for the research program (Chapter 3), and measuring these constructs in the workforce safety climate survey (Chapter 5). The review of the literature identified a number of factors predictive of safety performance, including safety climate and other factors. The framework developed for the research program adopted a well-supported safety performance model and integrated additional factors from the literature review. The resulting framework could then be used to guide the measures for the climate survey.
The nature of the influence these factors have on safety behaviour and related outcomes was investigated by conducting a number of regression and mediation analyses. The relative predictive value of each independent variable on safety compliance and participation was assessed using hierarchical regression analyses. These analyses revealed that safety climate, safety motivation, and supportive leadership all significantly contributed to the variance explained in both behavioural measures, and safety motivation had the greatest unique contribution. Mediation analyses revealed that the climate–behaviour relationship was partially explained by safety motivation and supportive leadership. This finding supports the safety performance framework in that the more proximal determinants of safety behaviour (in this case, safety motivation and supportive leadership) mediate the impact of antecedents (in this case, safety climate) on safety behaviour.

The relative predictive value of each independent variable on non-compliance and incident involvement was assessed using logistic regression. Safety climate was a significant predictor of variance in incident involvement and safety motivation was a significant predictor of non-compliance. Other independent variables did not explain any significant variance in either outcome measure. Further, the overall percentage of variance explained in these analyses was very small, indicating that none of the variables were particularly important in explaining non-compliance and incident involvement, and that potentially other variables not considered in this study may have an influence.

_Research Question 5: How can workers be encouraged to perform desired safety behaviours?_

Also contributing to the third objective, this research question further examines the impact of these additional factors on safety behaviour amongst frontline workers and supervisors. The results from the workforce safety climate survey indicated that safety motivation and supportive leadership partially mediated the climate-behaviour relationship, and that safety motivation was the most important predictor of variance in self-reported safety behaviour. This research question considered the important detail of how these factors influence safety behaviour in the workplace.

Other analyses in Study Two also indicated that frontline workers and frontline management had lower scores on all key measures in the workforce safety climate survey. That is, on average they had lower scores than middle and senior
management on safety climate perceptions and safety motivation, as well as on self-reported safety compliance and safety participation. Furthermore, these levels of the workforce are exposed to the most safety risks in the workplace due to their job tasks and position types. Thus, this group was the target population for the final study of the research program. As previously argued, understanding how workers are motivated to perform safety behaviours, and the influencing role of supervisors, is critical to informing practical safety culture interventions for the organisation.

To understand how frontline workers are motivated and supported to be safe at work, VIE theory, an employee motivation theory of sound scientific validity and practical utility was adopted as a guiding structure for Study three, within the broader theoretical framework underpinning the research program. Previous studies on motivation in safety have referenced VIE theory, but this is the first investigation to adopt the theoretical components as a structure for a qualitative investigation of safety behaviour. Group interviews were conducted with workers and frontline supervisors across three project sites within the organisation. These sites were a mix of construction and mining projects across three Australian states.

Findings indicated that safety performance standards were well understood and consistently perceived by workers and supervisors. Additionally, the effort required to meet these safety performance requirements was generally understood and agreed upon in both types of group. However, when considering whether meeting performance standards led to positive outcomes for individuals, the link was less straightforward. This could relate to the perceived valence of the outcomes whereby maintaining employment was highly valued and this was on occasions linked (instrumentality) to safety performance, and at other times was more strongly linked to production performance. Many workers reported inconsistent outcomes for safety performance, and/or more valued outcomes for productivity performance. Themes from the group interview conversations indicated that despite the clear priority given to safety by senior management in their organisational communications, workers experienced conflicting priorities when choosing between safe behaviours and time-saving behaviours. Production was perceived as a competing value, and production performance was more obviously linked to valued rewards such as preferential job tasks and job promotions.
7.2 THEORETICAL IMPLICATIONS

The findings from the research described in this thesis have a number of theoretical implications. The guiding theoretical framework for this thesis integrated several theories in order to explore safety culture rigorously within the organisation. Each aspect of the framework has been supported by the findings of the research program (see Figure 3.1, reproduced below for convenience).

Figure 3.1. Theoretical framework and research program design
(reproduced here for convenience)

Safety culture remains a difficult concept to define and describe, even for those operating within it. The layered model of safety culture (Guldenmund, 2010) is a useful way to conceptualise the construct. Descriptions seem to reflect the outer layer of culture, according to the model, with espoused values also included in some descriptions. It is important for researchers to approach safety culture research with an understanding of this layered model, so that interpretations from collected data can be appropriately made. Further, the understanding of safety culture reported by safety leaders also indicated that perceptions of management commitment to safety
were considered an important reflection of a positive safety culture and climate. This aligned to modern safety climate studies in the literature, and led to the operationalisation of safety climate as a unidimensional construct in the workforce survey. That is, climate was operationalised as worker perceptions of the value and priority given to safety, especially by managers.

The factors that are perceived to help and hinder safety culture development and maintenance were also identified by safety leaders in the organisation, and validated by a large workforce sample. Barriers to safety culture were categorised into three overarching themes around inadequate safety resourcing, poor safety attitudes and competency and difficulties with a dynamic workforce. Safety leader and workforce perceptions of these indicated that the dynamic workforce is the greatest barrier to safety culture within the organisation. The key facilitators of safety culture appear to all relate to one higher-level idea around effective safety communication, including clear and simple messages and clearly defined safety accountabilities. Future research should consider adopting measures of safety culture facilitators and barriers within workforce surveys, in order to determine the impact of these for individuals and work groups, and whether there is a relationship between these and other predictive factors in the climate-behaviour relationship.

Another theoretical implication relates to the use a safety performance framework in safety climate research. This thesis adopted Neal et al.’s (2000) model, and incorporated additional influencing variables identified in the literature. The results further suggest that safety climate is an antecedent of safety behaviour, and that safety motivation is the most important determinant of safety behaviour. Safety motivation and supportive leadership are significant partial mediators of the relationship between safety climate and safety behaviours. However, safety motivation appears to be the most important contributor, as it explains more variance than perceptions of supportive leadership and personal recognition from supervisors. Conceptualising the climate–behaviour relationship in this way allows researchers to investigate the relative impact of influencing variables, as well as consider the nature of the relationship between perceptions of management commitment, internalised safety values, and self-reported compliance and participation within the workplace. Indeed, this thesis has made an important contribution to the literature in identifying a multiple mediation effect on the climate–behaviour relationship, in a unique
organisational context. Given the transiency and dynamic nature of the workforce in this sample, including changing workgroups and employee–supervisor dyads, there is limited opportunity for relationship development with frontline managers. The results of this thesis highlight that employee safety motivation and supportive leadership continue to be critical to the climate–behaviour relationship in this work environment.

Finally, VIE theory demonstrated utility in uncovering the process for how employees are motivated to be safe at work. The results of this study highlight the breadth of application for VIE theory, particularly in a qualitative research context and in the construction industry sampled here. The results of Study Three add a rich dimension to the mediated climate–behaviour relationship described in Study Two, and are aligned with the overall theoretical framework underpinning the research program. This thesis has also shown that frontline supervisors continue to be central in communicating safety expectations, standards and decision-making processes on the job. The results of Study Three highlight that clear performance standards are the first step in motivating safety behaviours, and frontline supervisors are in the best position to provide immediate recognition for safety performance, in a way that is meaningful and valued.

7.3 PRACTICAL IMPLICATIONS

There are a number of practical implications for organisations wanting to improve their safety performance. The findings from this program of research suggest that workers and managers perceive the dynamic workforce to be a barrier to safety culture development and improvement. This barrier may be difficult to overcome for the organisation in the short term due to wider industry influences. However, some of the specific items are around managing subcontractor operations, which may have scope for improvement across the organisation and within specific project sites. Organisations could usefully develop and foster durable subcontractor partnerships where possible, for example through preferred tender processes, to encourage shared development of safety culture. Further, simple and clear safety communication was perceived to be a facilitator of safety culture, so safety priorities and accountabilities should continue to be reinforced by senior management, project site management and frontline supervisors.
The findings also suggest that safety climate (perceptions of management commitment to safety) is important in influencing individuals’ safety behaviours, but more important is how these safety values are internalised for employees, resulting in motivation to perform safety behaviours. Whilst leadership was not as predictive in our workforce survey, Study Three results suggested that frontline supervisors have an important role in confirming the safety climate, communicating clear safety messages and in motivating employees by providing and/or communicating the positive outcomes related to safety performance. Therefore, frontline supervisors need to be supported in their safety leadership, including effective safety communication, and provided with tools and resources to help them balance this responsibility with other job functions and coached how to effectively communicate safety.

Competing values such as production versus safety confuse safety messages and dilute incentives to engage in safety behaviours. These competing values are not evident at senior management level but are communicated from middle management down. Frontline supervisors have an important role to play in motivating employees to engage in safe behaviour, and greater scope could be given to them in determining appropriate rewards for individual and team safety performance. They also need support in emphasising the link between performing safe behaviours and positive outcomes for employees, in order to buffer against perceptions of competing values. It would be additionally useful for all levels of management to engage more closely in communicating consistent safety messages as the current burden largely falls to frontline supervisors.

7.4 STRENGTHS AND LIMITATIONS

This thesis has contributed to the body of safety culture, climate and behaviour knowledge by addressing a number of gaps in the literature, and adopting an applied research approach in order to inform future safety culture interventions in the Australasian construction and mining industry. The research design was guided by a theoretical framework that was a fusion of well-supported theories and models. By drawing on these established models, the research design had a strong foundation for application in a new context. The theoretical framework incorporated models of safety culture and climate, safety climate and behaviour models as well as a theory of employee motivation and performance. The program of research is one of the few to
empirically investigate safety culture and climate and behaviour in one sample and due to the size and influence of the organisation within the industry, some extrapolation is possible to other similar organisations in the sector. Whilst a number of potential contributing factors are presented in the literature, this thesis focused on the variables with the strongest relationship to safety performance, and investigated the climate–behaviour relationship with a large cross-sectional workforce sample.

The research also adopted a participatory approach to investigating safety culture, using a mix of qualitative and quantitative methods. By using multiple methods and gaining multiple workforce perspectives, a more comprehensive view of culture could be obtained. This methodological and sampling triangulation is rare but recommended within the research literature. Perspectives on safety culture and workplace safety were obtained from individual interviews with 41 safety leaders in the organisation, survey data from 2,957 employees across all levels of the organisation, and group interviews with 29 frontline workers and supervisors. Taken together, these perspectives offer a comprehensive understanding that can be balanced with the theoretical understanding from the safety culture literature.

All three studies attempted to measure safety culture through tapping into the middle and outer layers of safety culture – respectively known as ‘artefacts’ and ‘espoused values’ as articulated by Guldenmund (2010), and represented in Figure 3.1. Although safety culture was the outcome variable under investigation in Study One, the measurement method involved seeking opinions and perceptions about culture, rather than conducting direct observations or examining organisational artefacts. However, as the core is so difficult to directly measure, inferences were made from data obtained from the middle or outer layers as is common in culture research. Additionally, it could be argued that direct observations of organisational traditions or rituals is still only a reflection of ‘espoused values’ in that the presence of the researcher affects the conduct of organisational members. Thus, an organisation’s safety culture is perhaps only known to the organisational members themselves, and a researcher can only extract articulations of the perceptions of this culture from those members and attempt interpretation from there.

Whilst the goal of this thesis is to ultimately contribute to reducing workplace safety incidents, it could be criticised for not directly measuring incident rates or severity as part of the investigation. As stated in Chapter 5, organisational incident
data was collected with a view to matching responses with self-report data; however, this was not possible due to the method of data capture in the organisation. Nonetheless, there are a number of limitations with using incident report data collected by organisations. First, organisational incident reporting is not truly objective, and can vary considerably depending on the organisation’s safety culture maturity. Underreporting is common so actual incident rates are difficult to obtain. Second, incidents are rare events that occur due to the culmination of a number of cultural, contextual, and individual factors. Therefore, incident data is difficult to work with, as there is rarely enough range to be able to apply predictive models. Finally, incident data is a reactive measure of safety performance, and it is argued that measuring individual’s compliance with safety rules and procedures, and participation in initiatives is a better method of proactively measuring safety performance.

Finally, the applied investigation of one organisation has both strengths and limitations. The limitations regarding generalisability and external validity have been previously discussed. In regards to advantages, first, it was a unique sampling population for data collection. The organisation is considered one of the largest construction and mining contractors in Australasia with over 10,000 employees. Furthermore, the organisation belongs to a parent holdings company with global influence. In particular, the organisational structure is replicated across the industry, as it operates as both a principal contractor and a subcontractor across a large variety of projects. Therefore whilst the findings of the research program reflect data from this specific organisational population, thus limiting external validity, the implications of the findings are likely to be relevant across the Australasian sector and potentially globally.

7.5 FUTURE RESEARCH PRIORITIES

The research was conducted with the scope and limitations of a doctoral program, as well as the operational requirements and business expectations of the participating organisation. Notwithstanding the limitations discussed above, a number of important findings were presented that address gaps in current research literature. These findings also suggest areas for safety culture researchers to extend upon in future research.
In terms of future research, a safety performance framework, operationalised with antecedents and determinants, seems to be a sound approach to investigating the climate–behaviour relationship. The findings also suggest that a participatory approach offers a comprehensive understanding of safety culture within an organisation, and conducting purely quantitative investigations may not be sufficient to properly understand the operation of influencing factors in practice, and amongst different employee groups.

Further studies can extend upon this approach when considering the way in which safety climate affects individuals’ behaviour at work. The nature of the organisational structure and work environment meant that individual perceptions were measured in the Study Two survey, and it may be beneficial for smaller studies to be undertaken with selected work groups to investigate group-level climates and the relative influence of different levels of management (e.g., senior management, project managers and line supervisors) on these. Future research should also consider adopting measures of safety culture facilitators and barriers within workforce surveys, in order to determine the impact of these for individuals and work groups, and whether there is a relationship between these and other predictive factors in the climate–behaviour relationship. Additional investigation of how facilitators and barriers might intersect with cultural maturity could provide further insight into an organisation’s cultural journey.

Finally, future research in safety culture should extend upon the insights gained in the final study of this research program. The application of VIE theory to understanding safety motivation in this sample of workers was particularly illuminating in understanding how safety culture barriers operate at an individual level. Further, the framework allowed a structured examination of how safety performance standards, individual expectancies and perceptions of valued outcomes interact to influence safety behaviours at work. Future research could explore potential interventions designed to increase instrumentality and identify relative valence of outcomes available to workgroups and individuals. Interventions may also consider varying the source of rewards and feedback to determine the relative impact on motivating safe behaviours.
7.6 RECOMMENDATIONS FOR INDUSTRY

The fourth objective of this research program was to translate research findings into applied recommendations for improving safety culture and related outcomes within the industry. A number of practical implications have already been presented throughout the thesis, and further recommendations are made here.

The findings from this research suggest that safety climate should be measured periodically to determine perceptions of management commitment to safety. Although this study cannot establish causality, previous studies using the same measures have found that safety climate is a good predictor of future safety performance. Additionally, measures of safety motivation should be included in workforce safety climate surveys, alongside complementary measures of motivation and situational constraints or barriers. Further, the connection between supportive leadership and employee motivation should be emphasised, particularly in initiatives targeting frontline supervisors.

As previously discussed, the construction industry is a team-based, diverse and dynamic environment, which requires personal motivation and supportive leadership to negotiate the variety of physical and mental demands of the workplace. As safety behaviour is motivated work behaviour, it is important to explore the mechanisms through which employees are encouraged to be safe at work. The results of Study Three highlight that safety decisions are not made in isolation, and that competing demands and priorities affect an individual’s motivation to perform safety behaviours. Frontline supervisors are critical in communicating organisational and personal safety values and in modelling required safety behaviours. Thus, organisations should receive a return on investment in terms of safety outcomes for individuals and the organisation, by providing supervisor training and support to facilitate effective safety communication and employee safety motivation.

7.7 CONCLUSION

This thesis contributes to the theoretical and practical understanding of safety culture within the Australasian construction and mining industry, and has relevance for the international body of research on safety culture. The exploration of safety culture in the participating organisation was guided by an integrated theoretical framework that offered a comprehensive view of safety culture, climate and
behaviour, as well as the factors influencing the relationship between these constructs. Balancing theoretical and applied understandings of safety culture is important to informing future safety culture interventions that may reduce workplace safety incidents and improve safety at work. The findings from this thesis have a number of theoretical implications for how safety culture and climate research is conducted in Australia and internationally, as well as implications for industry approaches to safety culture measurement and improvement, with a view to influencing safety outcomes for individuals, the organisation and the industry more broadly.

As previously discussed, the size and complexity of the researched organisation has meant that the research findings are particularly important to the Australasian construction and mining industry. However, the implications may be relevant to construction and mining globally. As companies become more globalised so do their workforces and many of the challenges faced by the current organisation are also of concern to international employers. Large organisations contend with complex organisational structures and separation between senior management and frontline workforces. Big construction projects often rely on local contractors to complete various phases of work, and the findings of this research suggest that ensuring consistent safety messages through the levels of safety leadership across contractors should be a priority for all major industry employers.

The research program has offered an important contribution to the research objectives under investigation. First, the program aimed to gain an insight into how safety culture is understood in theory versus how it is applied in practice. The results from the three studies show that theoretical definitions of safety culture are less relevant in an industry context, and more relevant are the tangible expressions of safety culture in the workplace. Gaining this understanding early in the research process is helpful in ensuring appropriate measures are used and in interpreting both qualitative and quantitative results. Whilst this sample may have had a unique understanding of safety culture, shaped by individual and shared experiences with safety in organisations, the importance of laying this foundation in the relevant context is highlighted for future researchers across industries and countries.

Second, the research program aimed to explore workforce differences in perceptions of safety culture across the organisation. The results illustrate that
frontline workers and supervisors are distinct from middle and senior managers in their perceptions of safety climate and personal safety motivation. Middle and senior management have higher perceptions of climate and report higher personal safety values. Additionally, the results suggest some differences in climate and motivation perceptions across different functional areas in the organisation. In contrast, the facilitators and barriers to safety culture were perceived similarly across the safety leader and workforce samples in Studies One and Two, which is an important leverage point for future safety interventions in the organisation.

Third, the research program examined the relationship between safety culture and safety behaviour, and investigated additional factors that influence this relationship. The results suggest that the current focus on safety climate and safety motivation is warranted in safety culture research, and that these factors can explain a notable amount of variance in self-reported safety behaviours. Whilst stage of change (readiness to take action to reduce personal risk) and personal recognition (supervisor’s recognition of an employee’s efforts) were not predictive of safety behaviour in this sample, there is still value in considering a number of influencing factors in the climate–behaviour relationship, as it is far from conclusively defined.

Finally, the research program aimed to translate these research findings into applied recommendations for improving safety culture and related outcomes within the industry. A number of important recommendations have been made regarding: the approach to safety culture research within the industry; the importance of gaining a foundational understanding of safety culture meaning amongst leaders; the relevance of considering the barriers and facilitators to safety culture development and maintenance in order to contextualise safety culture findings; the significance of encouraging the internalisation of organisational safety values to personal safety motivation for employees; and in supporting supervisors around their safety leadership in order to realise improved safety outcomes for the individual, organisation and industry.


Appendices

Appendix A Participant information sheet for Study One interviews
Appendix B Study One interview schedule
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Appendix A
Participant information sheet for Study One interviews

Reducing workplace incidents: Bridging the gap between safety culture theory and practice
(Study 1a - Interview stage)

<table>
<thead>
<tr>
<th>Research Team Contacts</th>
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<tbody>
<tr>
<td>Sarah Biggs – PhD Candidate</td>
</tr>
<tr>
<td>Centre for Accident Research and Road Safety</td>
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<tr>
<td>Email <a href="mailto:s2.biggs@student.qut.edu.au">s2.biggs@student.qut.edu.au</a></td>
</tr>
</tbody>
</table>

DESCRIPTION

This project is being undertaken as part of a PhD project for Sarah Biggs. The project is funded by [the organisation]. The funding body will not have access to individual data obtained during the project, but will receive results in de-identified, group form.

The purpose of this project is to explore individual’s experience of safety culture in the organisation, with a view to identifying the key factors that assist in creating and maintaining a positive safety culture, and providing guidelines on what sorts of programs or other interventions might be useful for this.

The research team requests your assistance because your expert views on safety culture are important to gaining a picture of how safety culture is experienced and understood at Leighton Contractors Pty Ltd. The information gained in this early stage of the research will inform the direction of the rest of the project.

PARTICIPATION

Your participation in this project is voluntary. If you do agree to participate, you can withdraw from participation during the project without comment or penalty. Your decision to participate will in no way impact upon your current or future relationship with QUT or with [the organisation].

Your participation will involve an interview that will take approximately 45 minutes of your time. The interview will include questions around your views on what safety culture is and the factors that contribute to a positive safety culture. (An example question is “In your opinion, what are the key factors that contribute to a positive safety culture?”). You will be invited to participate in the interview via email, and the interview will take place in an office space convenient to you, or over the phone. Your contact details will be retained for the purpose of inviting you to participate in a follow-up round.

You be contacted again in a few weeks via email, phone or mail to be invited to participate in a follow-up round that will include a short-form questionnaire. Your participation in this follow-up round will also be voluntary. Your contact details will not be used for any other purpose and will
not be retained once the study is completed.

**EXPECTED BENEFITS**

It is expected that this project may not directly benefit you in the short term. However, it may benefit you indirectly through the development of guidelines to assist in improving safety culture programs and initiatives and potentially safety outcomes in your workplace.

**RISKS**

The risks associated with your participation in this project are considered low. You may experience discomfort in sharing your responses, and in discussing work-related matters whilst at work.

**CONFIDENTIALITY**

All comments and responses will be treated confidentially and will be made anonymous when transcribed. Responses will be de-identified before results are analysed. To ensure that we have adequately recorded your comments during the interview, we will report back to you to verify your comments prior to their inclusion in the analysis.

The interview may be recorded in order to capture the information accurately. These audio recordings will only be accessed by the research team, and will not be used for any other purpose. The recordings will be destroyed after the contents have been transcribed. It is possible to participate in the project without being recorded. Please indicate this preference prior to the commencement of the interview.

**CONSENT TO PARTICIPATE**

Due to the nature of the project, prior to the commencement of the interview, the interviewer will ask you to provide your verbal consent to participate. In using verbal consent, we will not require recording of your name or any other identifying details.

**QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT**

Please contact the researcher team members named above if you would like further information about the project.

**CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT**

QUT is committed to researcher integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Unit on +61 7 3138 5123 or email ethicscontact@qut.edu.au. The Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

*Thank you for helping with this research project. Please keep this sheet for your information.*
# Appendix B
## Study One interview schedule

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
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<tbody>
<tr>
<td>1</td>
<td>How would you define safety culture?</td>
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<tr>
<td>2</td>
<td>In your opinion, what are the key factors that contribute to a positive</td>
</tr>
<tr>
<td></td>
<td>safety culture?</td>
</tr>
<tr>
<td>3</td>
<td>As an outsider looking in, where would I find/see safety culture?</td>
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<tr>
<td>4</td>
<td>Who is (a) important and (b) responsible in creating a safety culture in</td>
</tr>
<tr>
<td></td>
<td>this organisation?</td>
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<tr>
<td>5</td>
<td>What are the barriers to a) creating and b) maintaining a positive safety</td>
</tr>
<tr>
<td></td>
<td>culture?</td>
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<tr>
<td>6</td>
<td>How can safety culture be enhanced?</td>
</tr>
<tr>
<td>7</td>
<td>What is your opinion of this organisation’s safety culture status/maturity?</td>
</tr>
<tr>
<td>8</td>
<td>What programs or initiatives do you currently have in place around safety</td>
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<tr>
<td></td>
<td>culture?</td>
</tr>
<tr>
<td>9</td>
<td>Do you know of any programs/initiatives run by other organisations that</td>
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<td></td>
<td>might work in this organisation?</td>
</tr>
<tr>
<td>10</td>
<td>What else could the organisation do to improve safety culture?</td>
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</table>
Appendix C

Participant information sheet for Study One (b) short-form questionnaire

PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT

Reducing workplace incidents: Bridging the gap between safety culture theory and practice

(Study 1b: Short-form questionnaire stage)

<table>
<thead>
<tr>
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</table>
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Centre for Accident Research and Road Safety  
Phone: 3138 4963  
Email: t.banks@qut.edu.au |

DESCRIPTION

This project is being undertaken as part of a PhD project for Sarah Biggs. The project is funded by [the organisation]. The funding body will not have access to individual data obtained during the project, but will receive results in group form.

The purpose of this project is to explore individual’s experience of safety culture in the organisation, with a view to identifying the key factors that assist in creating and maintaining a positive safety culture, and providing guidelines on what sorts of programs or other interventions might be useful for this.

The research team requests your assistance because your views on safety culture in your workplace are important to this research. This stage of the project is looking to reach consensus on key issues around safety culture that have arisen from previous interviews.

PARTICIPATION

This is the follow-up questionnaire that you were previously informed of during your interview with Sarah Biggs about safety culture.

Your participation in this project is voluntary. If you do agree to participate, you can withdraw from participation during the project without comment or penalty. Your decision to participate will in no way impact upon your current or future relationship with QUT or with [the organisation].

This stage of the project involves the submission of anonymous (non-identifiable) information in the form of a short questionnaire. Because there is no way for us to identify you by your completed questionnaire it should be noted that it will not be possible to withdraw, once you have submitted (as we will not know which questionnaire was yours).

Your participation will involve completion of an online questionnaire that can be accessed via a link sent to your email address from the Research Team. The short questionnaire will take approximately 15 minutes to complete and will ask you to rate or rank various statements around safety culture that have arisen from previous interviews with yourself and other employees of the organisation. An example question is, “In your opinion, which
of the following are the most important leadership factors for positive safety culture in the organisation?"

**EXPECTED BENEFITS**

It is expected that this project will not directly benefit you in the short term. However, it may benefit you indirectly through the development of guidelines to assist in improving safety culture programs and initiatives and potentially safety outcomes in your workplace.

**RISKS**

There are no risks beyond normal day-to-day living associated with your participation in this project. You will be asked about your views on safety culture in your workplace, based on themes already raised in previous interviews on the topic.

**CONFIDENTIALITY**

All comments and responses are anonymous and will be treated confidentially. The names of individual persons are not required in any of the responses.

**CONSENT TO PARTICIPATE**

The return of the completed questionnaire is accepted as an indication of your consent to participate in this project.

**QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT**

Please contact the research team members named above if you would like further information about the project.

**CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT**

QUT is committed to researcher integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Unit on +61 7 3138 5123 or email ethicscontact@qut.edu.au. The Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

*Thank you for helping with this research project. Please keep this sheet for your information*
Appendix D
Study One online questionnaire (hardcopy version)

Survey Title: Understanding of Safety Culture

PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT

Project Title: Reducing workplace incidents: Bridging the gap between safety culture theory and practice

Research Team contacts:
Sarah Biggs, PhD Candidate, Centre for Accident Research and Road Safety – Queensland, Ph: 07 3138 4586, Email: s2.biggs@student.qut.edu.au
Jeremy Davey, Professor, Centre for Accident Research and Road Safety – Queensland, Ph: 07 3138 4574, Email: j.davey@qut.edu.au

Description:
This short questionnaire forms part of the first study in a PhD project for Sarah Biggs. The project is funded by [the organisation]. The funding body will not have access to individual data obtained during the project, but will receive results in group form.

The purpose of the project is to explore individual’s experience of safety culture in the organisation, with a view to identifying the key factors that assist in creating and maintaining a positive safety culture, and providing guidelines on what sorts of programs or other interventions might be useful for this.

The research team requests your assistance because your views on safety culture in your workplace are important to this research. This stage of the project is looking to clarify the key issues around safety culture that have arisen from previous interviews.

Participation:
This is the follow-up questionnaire that you were previously informed of during your interview with Sarah Biggs about safety culture.

Your participation in this project is voluntary. If you do agree to participate, you can withdraw from participation during the project without comment or penalty. Your decision to participate will in no way impact upon your current or future relationship with QUT or with [the organisation].

This stage of the project involves the submission of anonymous (non-identifiable) information in the form of a short questionnaire. Because there is no way for us to identify you by your completed questionnaire it should be noted that it will not be possible to withdraw, once you have submitted (as we will not know which questionnaire was yours).

Your participation will involve completion of an online questionnaire that can be accessed via a link sent to your email address from the Research Team. The short questionnaire will take approximately 15 minutes to complete and will ask you to rate or rank various statements around safety culture that have arisen from previous interviews with yourself and other employees of the organisation. An example question is, “In your opinion, which
of the following are the most important leadership factors for positive safety culture in the organisation?"

**Expected benefits:** It is expected that this project will not directly benefit you in the short term. However, it may benefit you indirectly through the development of guidelines to assist in improving safety culture programs and initiatives and potentially safety outcomes in your workplace.

**Risks:** There are no risks beyond normal day-to-day living associated with your participation in this project.

Confidentiality: All comments and responses are anonymous and will be treated confidentially. The names of individual persons are not required in any of the responses.

**Consent to participate:** The return of the completed survey is accepted as an indication of your consent to participate in this project.

**Further information:** Please contact the researcher team members named above if you would like further information about the project.

QUT is committed to researcher integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Unit on +61 7 3138 5123 or email ethicscontact@qut.edu.au. The Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

### About You

1. Please select the most appropriate description of your current role in the organisation. *(Check all that apply)*
   - Senior Executive
   - Alliance Project Manager
   - Project Manager
   - Safety Manager
   - Corporate Manager
   - Construction Manager
   - Building Manager
   - Zone Manager
   - Operations Manager
   - Plant Manager
   - Site Supervisor
   - Other: Please specify

2. Please select your Division *(Pick one or specify ‘other’)*
   - Construction
   - Resources
   - Investment and Facility Management
   - Industrial and Energy
   - Telecommunications
   - Other: Please specify

**Key factors for positive safety culture**
The following factors were raised during the interviews as critical to positive safety culture. Based on the previous interview responses, the factors have been organised into three categories: Organisational Factors; Leadership Factors; and Workforce Factors.

Organisational Factors
3. In your opinion, which three (3) of the following are the most important organisational factors for positive safety culture in the organisation? (Please select 3 checkboxes.)

☐ The organisation has a clear stance on safety
☐ The organisation’s systems and frameworks support the desired safety culture
☐ Safety roles and accountabilities are clearly defined
☐ Safety is fully integrated in organisational documents, processes and systems
☐ The organisation has a system for reporting on and learning from safety experiences
☐ The organisation’s business operating structure (eg. Divisions) supports safety goals

☐ Communication channels are effective for safety messages
☐ Safety policies are consistently applied across business units in the organisation
☐ Business units customise safety policies to meet the needs of their business

Leadership Factors
4. In your opinion, which three (3) of the following are the most important leadership factors for positive safety culture in the organisation? (Please select 3 checkboxes.)

☐ Leaders have a clear understanding of safety culture
☐ Leaders can articulate a clear vision and shared values around safety
☐ Leaders demonstrate commitment to safety
☐ Leaders encourage personal accountability in relation to safety
☐ Leaders listen to workers’ ideas and concerns about safety
☐ Leaders support workers to “take safety on” in difficult situations
☐ Leaders provide practical support for safety

Workforce Factors
5. In your opinion, which three (3) of the following are the most important workforce factors for positive safety culture in the organisation? (Please select 3 checkboxes.)

☐ Workers understand what safety culture is about
☐ Workers understand what safety means for them personally
☐ Workers are involved in decisions about safety
☐ Workers are involved in improving safety processes
☐ Workers receive formal off-the-job safety training
☐ Workers receive on-the-job safety training
☐ Workers “look out for each other” on the job

Evidence of key factors in the organisation
6. In your opinion, currently, how evident are the following Organisational Factors in your organisation?

<table>
<thead>
<tr>
<th>The organisation has a clear stance on safety</th>
<th>Neve r evident</th>
<th>Rarely evident</th>
<th>Occasionally evident</th>
<th>Sometimes evident</th>
<th>Often evident</th>
<th>Mostly evident</th>
<th>Always evident</th>
</tr>
</thead>
<tbody>
<tr>
<td>The organisation’s systems and frameworks support the desired safety culture</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Safety roles and accountabilities are clearly defined</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Safety is fully integrated in organisational documents, processes and systems</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>The organisation has a system for reporting on and learning from safety experiences</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>The organisation’s business operating structure (eg. Divisions) supports safety goals</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Communication channels are effective for safety messages</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td>Safety policies are consistently applied across business units in the organisation</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Business units customise safety policies to meet the needs of their business</td>
<td>1</td>
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<td>6</td>
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</tbody>
</table>

7. In your opinion, currently, how evident are the following Leadership Factors in your organisation?

<table>
<thead>
<tr>
<th>Leaders have a clear understanding of safety culture</th>
<th>Neve r evident</th>
<th>Rarely evident</th>
<th>Occasionally evident</th>
<th>Sometimes evident</th>
<th>Often evident</th>
<th>Mostly evident</th>
<th>Always evident</th>
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</thead>
<tbody>
<tr>
<td>Leaders can articulate a clear vision and shared values around safety</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>7</td>
</tr>
<tr>
<td>Leaders demonstrate commitment to safety</td>
<td>1</td>
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<td>7</td>
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<tr>
<td>Leaders encourage personal accountability in relation to safety</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<td>7</td>
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<tr>
<td>Leaders listen to workers’ ideas and concerns about safety</td>
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Leaders support workers to “take safety on” in difficult situations  

<table>
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<th>Never evident</th>
<th>Rarely evident</th>
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Leaders provide practical support for safety  

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<th>Never evident</th>
<th>Rarely evident</th>
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</table>

8. In your opinion, currently, how evident are the following Workforce Factors in your organisation?

<table>
<thead>
<tr>
<th>Workers understand what safety culture is about</th>
<th>Never evident</th>
<th>Rarely evident</th>
<th>Occasionally evident</th>
<th>Sometimes evident</th>
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<table>
<thead>
<tr>
<th>Workers understand what safety means for them personally</th>
<th>Never evident</th>
<th>Rarely evident</th>
<th>Occasionally evident</th>
<th>Sometimes evident</th>
<th>Often evident</th>
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<tr>
<th>Workers are involved in decisions about safety</th>
<th>Never evident</th>
<th>Rarely evident</th>
<th>Occasionally evident</th>
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<tr>
<th>Workers are involved in improving safety processes</th>
<th>Never evident</th>
<th>Rarely evident</th>
<th>Occasionally evident</th>
<th>Sometimes evident</th>
<th>Often evident</th>
<th>Mostly evident</th>
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<tr>
<th>Workers receive formal off-the-job safety training</th>
<th>Never evident</th>
<th>Rarely evident</th>
<th>Occasionally evident</th>
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<th>Workers receive on-the-job safety training</th>
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<table>
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<tr>
<th>Workers “look out for each other” on the job</th>
<th>Never evident</th>
<th>Rarely evident</th>
<th>Occasionally evident</th>
<th>Sometimes evident</th>
<th>Often evident</th>
<th>Mostly evident</th>
<th>Always evident</th>
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**Barriers to Safety Culture**

The following barriers to creating and maintaining safety culture were raised during the interviews.

9. In your opinion, which five (5) of the following are the most significant barriers to safety culture in the organisation? (Please select 5 checkboxes.)

- Competitive nature of the industry
- Complexity of safety legislation
- Poor regulatory system for industry
- Competing business priorities eg. production versus safety
- Financial costs associated with safety
- The challenge of “Keeping it fresh”
- Difficulties with subcontractor management and operations
- Not enough safety resources
- Maintaining a high level of safety awareness even when incidents aren’t occurring
- Low levels of competency in safety leadership roles
- Too much change too quickly
- Transiency of the workforce
- Excessive workload
- “Bad attitudes” about safety
- Too much paperwork

**Enhancing safety culture in the organisation**
Several suggestions were made during the interviews about what the organisation should do in the future to enhance safety culture in the organisation.

10. In your opinion, which of the following are most important to enhancing safety culture in the organisation in the next few years? (Please select no more than 3 checkboxes.)

- Managing safety culture as a change process
- Making sure the business is ready for relevant safety culture initiatives
- Identifying and supporting change agents/ champions across the organisation
- Having clear and simple safety messages
- Communicating organisational safety priorities
- Defining safety leadership roles and accountabilities
- Having a framework for enforcing safety accountabilities
- Ensuring the systems support the desired safety culture

11. Please provide any further comments here.
Appendix E
Comparison of survey respondents

Note: The previous organisational survey used as comparison was called the ‘Your Say’ survey, and included measures of general organisational culture and employee attitudes. This survey was conducted in 2010 is not connected to the current research in any way – it only serves as a comparison.

Gender of Survey Respondents

The majority of respondents were male (86%) which is similar to the 2010 Your Say respondent profile (80%).

Age of Survey Respondents

The majority of survey respondents were between 30 and 50 years of age, with an average age of 39 years. Age distribution was very similar to the 2010 Your Say respondents.
The majority of survey respondents were wages employees (40%) and ‘other’ managers (15%). Subcontractors accounted for 7% of the sample. Thirty-four senior managers completed the survey – representing just over 1% of the sample. Sample percentages were very similar to the 2010 Your Say sample, however a greater proportion of Your Say respondents were ‘other salaried employees’.

The great majority of survey respondents worked full-time, with 47% working shifts, and 44% working standard hours. Part-timers and casuals accounted for 1% and 4% of the sample respectively. Sample percentages were similar to the 2010 Your Say sample; however more of the Your Say respondents were non-shift workers.
### Tenure (Length of Service)

<table>
<thead>
<tr>
<th>Type of Tenure</th>
<th>Number of responses</th>
<th>Average</th>
<th>Lowest</th>
<th>Highest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role Tenure</td>
<td>1175</td>
<td>3.36</td>
<td>0*</td>
<td>40.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3 years, 4 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organisational Tenure</td>
<td>1274</td>
<td>3.85</td>
<td>0*</td>
<td>34.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3 years, 10 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry Tenure</td>
<td>905^</td>
<td>7.80</td>
<td>0*</td>
<td>51.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(7 years, 10 months)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The data here include subcontractors, which is why the lowest reported tenure is zero.

^ It should be noted that many respondents chose not to provide tenure details. For example, a third did not provide details of industry tenure.

### Role Tenure – all respondents

![Bar chart showing tenure distribution](chart.png)

Average role tenure was just over 3 years, with 67% of respondents having been in their current role between 1-5 years. (Note, this data was not collected in the Your Say survey, so cannot be compared).
Organisational Tenure – all respondents

Average organisational tenure was just over almost 4 years, with 37% of respondents having been in the organisation between 2-5 years. The tenure profile of the 2010 Your Say respondents was slightly different, with respondents on average having had less time with the organisation (21% less than 12 months).

Industry Tenure – all respondents

Average industry tenure was almost 8 years, with half of the respondents having been in the industry between 2-10 years. (Note, this data was not collected in the Your Say survey, so cannot be compared).
Appendix F
Participant information sheet for Study Two survey—managers

PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT

Reducing workplace incidents: Bridging the gap between safety culture theory and practice
(Study 2 – Quantitative Safety Culture Survey)

Research Team Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Centre for Accident Research and Road Safety</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sarah Biggs</td>
<td>PhD Candidate</td>
<td></td>
<td>(07) 3138 4583</td>
<td><a href="mailto:s2.biggs@student.qut.edu.au">s2.biggs@student.qut.edu.au</a></td>
</tr>
<tr>
<td>Tamara Banks</td>
<td>Post-Doctoral Fellow</td>
<td></td>
<td>(07) 3138 4963</td>
<td><a href="mailto:t.banks@qut.edu.au">t.banks@qut.edu.au</a></td>
</tr>
</tbody>
</table>

DESCRIPTION
This project is being undertaken as part of a PhD project for Sarah Biggs. The project is funded by [the organisation]. The funding body will not have access to individual data obtained during the project, but will receive results in group form.

The purpose of this project is to explore individuals’ experiences of safety culture in the organisation, with a view to identifying the key factors that assist in creating and maintaining a positive safety culture, and providing guidelines on what sorts of programs or other interventions might be useful for this. This particular study is looking at how perceptions of safety are related to safety behaviour and other organisational and leadership factors.

The research team requests your assistance because it is important to gain as many views as possible from various parts of the organisation to explore how safety culture is viewed in the organisation.

PARTICIPATION
Your participation in this project is voluntary. If you do agree to participate, you can withdraw from participation during the project without comment or penalty. Your decision to participate will in no way impact upon your current or future relationship with QUT or with [the organisation]. This project involves the submission of anonymous (non-identifiable) information in the form of a survey. Because there is no way for us to identify you by your completed survey it should be noted that it will not be possible to withdraw, once you have submitted (as we will not know which survey was yours).

Your participation will involve completion of a survey to be completed in your own time and returned via an online mechanism or a self-addressed envelope to QUT. The survey will take approximately 25 minutes to complete. The survey includes questions about your work role, your perceptions of the organisation and safety at your workplace, and your safety behaviour. An example statement about your perceptions of safety is “management considers safety to be important” (rate level of agreement from 1-5).

EXPECTED BENEFITS
It is expected that this project will not directly benefit you in the short term. However, it may benefit you indirectly through the development of guidelines to assist in improving safety culture programs and initiatives and potentially safety outcomes in your workplace.

RISKS
There are no risks beyond normal day-to-day living associated with your participation in this project. You will be asked to share your thoughts and opinions about safety in your workplace, and your specific responses will not be seen by anyone in the organisation.

CONFIDENTIALITY
All comments and responses are anonymous and will be treated confidentially. The names of individual
CONSENT TO PARTICIPATE
The return of the completed survey is accepted as an indication of your consent to participate in this project.

QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT
Please contact the research team members named above if you would like further information about the project.

CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT
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Thank you for helping with this research project. Please keep this sheet for your information.
Appendix G
Participant information sheet for Study Two survey – workers

### PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT

**Reducing workplace incidents: Bridging the gap between safety culture theory and practice**  
*(Study 2 – Quantitative Safety Culture Survey)*

<table>
<thead>
<tr>
<th>Research Team Contacts</th>
<th>Centre for Accident Research and Road Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sarah Biggs – PhD Candidate</td>
<td>Centre for Accident Research and Road Safety</td>
</tr>
<tr>
<td>Tamara Banks – Post-Doctoral Fellow</td>
<td>Phone (07) 3138 4583</td>
</tr>
<tr>
<td>Phone (07) 3138 4963</td>
<td>Email <a href="mailto:s2.biggs@student.qut.edu.au">s2.biggs@student.qut.edu.au</a></td>
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<td>Phone (07) 3138 4963</td>
</tr>
</tbody>
</table>

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The purpose of this project is to explore individuals’ experiences of safety culture in the organisation, with a view to identifying the key factors that assist in creating and maintaining a positive safety culture, and providing guidelines on what sorts of programs or other interventions might be useful for this. This particular study is looking at how perceptions of safety are related to safety behaviour and other organisational and leadership factors.

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**PARTICIPATION**

Your participation in this project is voluntary. If you do agree to participate, you can withdraw from participation during the project without comment or penalty. Your decision to participate will in no way impact upon your current or future relationship with QUT or with [the organisation]. This project involves the submission of anonymous (non-identifiable) information in the form of a survey. Because there is no way for us to identify you by your completed survey it should be noted that it will not be possible to withdraw, once you have submitted (as we will not know which survey was yours).

Your participation will involve completion of a survey to be completed in your own time and returned via an online mechanism or via a self-addressed envelope to QUT. The survey will take approximately 15 minutes to complete. The survey includes questions about your work role, your perceptions of the organisation and safety at your workplace, and your safety behaviour. An example statement about your perceptions of safety is “management considers safety to be important” (rate level of agreement from 1-5).

**EXPECTED BENEFITS**

It is expected that this project will not directly benefit you in the short term. However, it may benefit you indirectly through the development of guidelines to assist in improving safety culture programs and initiatives and potentially safety outcomes in your workplace.

**RISKS**

There are no risks beyond normal day-to-day living associated with your participation in this project. You will be asked to share your thoughts and opinions about safety in your workplace, and your specific responses will not be seen by anyone in the organisation.

**CONFIDENTIALITY**
All comments and responses are anonymous and will be treated confidentially. The names of individual persons are not required in any of the responses.

CONSENT TO PARTICIPATE
The return of the completed survey is accepted as an indication of your consent to participate in this project.

QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT
Please contact the research team members named above if you would like further information about the project.

CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT
QUT is committed to researcher integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Unit on +61 7 3138 5123 or email ethicscontact@qut.edu.au. The Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

Thank you for helping with this research project. Please keep this sheet for your information.
Appendix H
Email invitation for Study Two survey – managers

Welcome to the 2011 [organisation name] Safety Culture Survey.

As you all know “Safety & Health above all else” is our number one value at [the organisation]. We are continually looking for ways to improve our performance. Safety Culture Surveys give us an opportunity to understand the shared attitudes and beliefs of our people; they provide a baseline for ongoing cultural development.

An independent research team from the Queensland University of Technology (QUT) is helping us conduct the [Organisation name] Safety Culture Survey.

**What is the survey about?**

The survey asks about your opinions, perceptions and experiences of safety at work. An information sheet is attached to this email, and it explains the survey and your participation in more detail.

**Why is it important?**

The survey will help to identify what is working and what is not working, so that we know where to target our safety initiatives.

**How do I complete the survey?**

You can complete the survey by clicking on the link below:


We look forward to receiving your thoughts and opinions and encourage everyone to participate and play an active role in shaping our future.

**Who should I contact if I have any questions or concerns?**

Please contact one of the QUT research team members if you have any questions or concerns about your participation in this survey.

Sarah Biggs – PhD Candidate
Centre for Accident Research and Road Safety
Phone (07) 3138 4583
Email s2.biggs@student.qut.edu.au

Tamara Banks – Post-Doctoral Fellow
Centre for Accident Research and Road Safety
Phone (07) 3138 4963
Email t.banks@qut.edu.au
Appendix I
Email invitation for Study Two survey – workers

Welcome to the 2011 [organisation name] Safety Culture Survey.

As you all know “Safety & Health above all else” is our number one value at Leighton Contractors. We are continually looking for ways to improve our performance. Safety Culture Surveys give us an opportunity to understand the shared attitudes and beliefs of our people; they provide a baseline for ongoing cultural development.

An independent research team from the Queensland University of Technology (QUT) is helping us conduct the [organisation name] Safety Culture Survey.

What is the survey about?

The survey asks about your opinions, perceptions and experiences of safety at work. An information sheet is attached to this email, and it explains the survey and your participation in more detail.

Why is it important?

The survey will help to identify what is working and what is not working, so that we know where to target our safety initiatives.

How do I complete the survey?

An electronic version of the survey is attached to this email. Please answer all questions in the survey and return the completed survey to your Divisional Safety Manager in the internal mail or directly to Sarah Biggs via post to the address below.

If you prefer, you can also complete an online version of the survey by clicking on the link below:

http://survey.qut.edu.au/survey/173066/1cbc/

We look forward to receiving your thoughts and opinions and encourage everyone to participate and play an active role in shaping our future.

Who should I contact if I have any questions or concerns?

Please contact one of the QUT research team members if you have any questions or concerns about your participation in this survey.

Sarah Biggs – PhD Candidate
Centre for Accident Research and Road Safety
Phone (07) 3138 4583
Email s2.biggs@student.qut.edu.au

Tamara Banks – Post-Doctoral Fellow
Centre for Accident Research and Road Safety
Phone (07) 3138 4963
Email t.banks@qut.edu.au
Appendix J

Hardcopy version of Study Two survey

Safety Culture Survey 2011

Welcome to the 2011 Safety Culture Survey.

As you all know “Safety & Health above all else” is our number one value at [redacted]. We are continually looking for ways to improve our performance. Safety Culture Surveys give us an opportunity to understand the shared attitudes and beliefs of our people; they provide a baseline for ongoing cultural development.

An independent research team from the Queensland University of Technology (QUT) is helping us conduct the Corporation Safety Culture Survey.

What is the survey about?

The survey asks about your opinions, perceptions and experiences of safety at work. An information sheet is attached to this email, and it explains the survey and your participation in more detail.

Why is it important?

The survey will help to identify what is working and what is not working, so that we know where to target our safety initiatives.

How do I complete the survey?

Please answer all questions in the survey. There are no right or wrong answers to the questions. The survey will take approximately 15 minutes to complete. The survey includes questions about your work role, your perceptions of the organisation and safety at your workplace, and your safety behaviour.

Please return all completed surveys to your Divisional Safety Manager in the internal mail or directly to Sarah Biggs via post to the address below.

We look forward to receiving your thoughts and opinions and encourage everyone to participate and play an active role in shaping our future.

Who should I contact if I have any questions or concerns?

Please contact one of the QUT research team members if you have any questions or concerns about your participation in this survey.

Sarah Biggs – PhD Candidate
Centre for Accident Research and Road Safety
Phone (07) 3138 4583
Email s2.biggs@student.qut.edu.au

Tamara Banks – Post-Doctoral Fellow
Centre for Accident Research and Road Safety
Phone (07) 3138 4963
Email t.banks@qut.edu.au
**PART ONE:**
This section asks for some demographic and background information, which will assist in drawing more meaningful conclusions from the survey results. Your responses will remain strictly confidential and anonymous.

1. What is your gender? [ ] Male  [ ] Female
2. What is your age? ___________ years ___________ months
3. What is your current employment status?
   [ ] Full Time – Shift worker
   [ ] Full Time – Non-Shift worker
   [ ] Part Time
   [ ] Casual
4. How long have you worked in your current role?
   ___________ years ___________ months
5. How long have you been employed at Leighton Contractors?
   ___________ years ___________ months
6. How long have you been employed in the industry?
   ___________ years ___________ months
7. Which of the following best describes your position? (please select one box only)
   [ ] Graduate Engineer (with no direct people management responsibilities)
   [ ] Engineer/ Senior Engineer
   [ ] Team Leader/ Supervisor/ Foreperson
   [ ] Senior Manager – Managing Director, Deputy Managing Director, Executive General Manager or General Manager
   [ ] Functional/Divisional Manager – Direct report to General Manager or Executive General Manager
   [ ] Other Manager (“Manager” in your position title and/or you have employees reporting to you
   [ ] All other salaried employees (monthly paid)
   [ ] All other wages employees (hourly paid)
   OR [ ] Are you a subcontractor?

8. What is your work location? (Leighton Contractors Employees Only)

   **- Construction Division -**
   [ ] NSW/ACT Construction
   [ ] NSW/ACT Construction – Joint Ventures
   [ ] NSW/ACT Construction – Alliances
   [ ] Northern Region Construction
   [ ] Northern Region Construction – Joint Ventures
   [ ] Northern Region Construction – Alliances
   [ ] Southern Region Construction
   [ ] Southern Region Construction – Joint Ventures
   [ ] Southern Region Construction – Alliances
   [ ] Western Region Construction
   [ ] Western Region Construction – Joint Ventures
   [ ] Western Region Construction – Alliances
   [ ] New Zealand Construction
   [ ] New Zealand Construction – Joint Ventures
   [ ] New Zealand Construction – Alliances

   If relevant, please specify the project that you work on: ...........................................................

   **- Industrial and Energy Division-**
   [ ] Support Services (Pre Contracts, SHE, Legal, Finance, HR, Communincations, Business Systems & Strategy)
   [ ] Emerging Technologies
   [ ] Thermal Power
   [ ] Energy
   [ ] Process Industries
   [ ] Mayfield
   [ ] Transport & Wind Power
   [ ] Industry

   If relevant, please specify the project that you work on: ...........................................................

   **- Resources Division -**
   [ ] Site
   [ ] Please specify site:
   OR [ ] Service Department
   [ ] Please specify location/unit:

   Please specify group:

   Please specify group:

   If relevant, please specify the project that you work on:

   **- Investment and Facility Management –**
   [ ] Infrastructure Investment
   [ ] Facility Management
   [ ] Commercial and Management (includes HR, Communications, Safety, Finance)
   [ ] NSW Operations
   [ ] QLD Operations
   [ ] WA Operations
   [ ] NSW Joint Ventures
   [ ] QLD Joint Ventures
   [ ] Infrastructure Services Management/ Non-project employees

   If relevant, please specify the project that you work on:

   **- Group Services (Corporate Office, Chatswood) -**
   [ ] Group Operational Services
   [ ] Group IT
   [ ] Finance and Administration (Includes: Taxation, Treasury, Accounts, Legal, Finance, Corporate Office Services)
   [ ] Group HR and Sustainability (Includes: Payroll, HR and Sustainability)
   [ ] All Other Group Services (Includes: Safety and Health, Corporate Affairs and Communication and Strategic Development)

   **- Telecommunications -**
   [ ] Aus
   [ ] NZ
   Please specify business unit:
PART TWO

This section asks about your thoughts, feelings, attitudes and behaviours with regards to safety in your workplace. Please read each statement carefully and circle one number only per statement. There are no right or wrong answers to these questions – we are interested in your opinions.

**Note:** This question asks about your perceptions of safety in relation to senior management in your organisation. Senior management consists of the Managing Director and all divisional General Managers.

### 2.1 In terms of your view of the importance given to safety, to what extent do you disagree or agree with the following statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Senior management places a strong emphasis on workplace health and safety</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Safety is given a high priority by senior management</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Senior Management considers safety to be important.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

### 2.2 In terms of your view of workplace safety, to what extent do you disagree or agree with the following statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel that it is worthwhile to put in effort to maintain or improve my personal safety.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. I feel that it is important to maintain safety at all times</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. I believe that it is important to reduce the risk of accidents and incidents in the workplace</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. I use all the necessary safety equipment to do my job</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. I use the correct safety procedures for carrying out my job</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. I ensure the highest levels of safety when I carry out my job</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. I promote safety within the organisation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. I put in extra effort to improve the safety of the workplace</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. I voluntarily carry out tasks or activities that help improve workplace safety</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

### 2.3 On a scale of 0-100%, please indicate, on average, the percentage of time:

<table>
<thead>
<tr>
<th>Task</th>
<th>Percentage of time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I follow all of the safety procedures for the jobs that I perform</td>
<td></td>
</tr>
<tr>
<td>2. My co-workers follow all of the safety procedures for the jobs that they perform</td>
<td></td>
</tr>
</tbody>
</table>

### 2.4 In the past 12 months, please indicate how many times you have:

<table>
<thead>
<tr>
<th>Event</th>
<th>Number of times in last 12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Been directly involved in a workplace injury or near miss event in the workplace</td>
<td></td>
</tr>
<tr>
<td>2. Received a warning for not following safety procedures</td>
<td></td>
</tr>
</tbody>
</table>
PART THREE:
This section asks about your immediate supervisor— that is, the person to whom you immediately and most often report, regardless of their title or level. Please indicate the extent to which you disagree or agree with each statement by circling the most relevant response.

<table>
<thead>
<tr>
<th>3.1 My immediate supervisor ...</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Considers my personal feelings before acting</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Behaves in a manner which is thoughtful of my personal needs</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Sees that the interests of employees are given due consideration</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Commends me when I do a better than average job</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Acknowledges improvement in my quality of work</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Personally compliments me when I do outstanding work</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

PART FOUR:
This section asks about your approach to risk in your work environment. Please choose one response only.

<table>
<thead>
<tr>
<th>4.1 How would you describe your approach to work-related risks?</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ I'm not exposed to risk and I'm not considering changing my work behaviour</td>
</tr>
<tr>
<td>☐ I'm planning to take action to reduce my risk in the next six (6) months</td>
</tr>
<tr>
<td>☐ I have definite plans to reduce my risk in the next month</td>
</tr>
<tr>
<td>☐ I have already taken actions to reduce my risk</td>
</tr>
<tr>
<td>☐ I'm continuing to take actions to reduce my risk</td>
</tr>
</tbody>
</table>

- PLEASE READ BEFORE CONTINUING -

The following questions ask about your thoughts to do with safety culture. Safety culture is an assembly of characteristics and attitudes in companies and individuals which establishes that safety issues receive attention as an overriding priority.
### PART FIVE:
This section asks about your perceptions of barriers to safety culture within the organisation. Please indicate the extent to which you disagree or agree with each statement by circling the most relevant response.

**5.1 The following is a significant barrier to safety culture...**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulties with subcontractor management and operations</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Too much paperwork</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>People losing enthusiasm for safety initiatives quickly</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Low levels of competency (knowledge, skills &amp; abilities) in safety leadership roles</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Workers coming and going regularly (especially subcontractors)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Too much change too quickly</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Competing business priorities (e.g., production versus safety)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Maintaining a high level of safety awareness even when incidents aren’t occurring</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Excessive workload</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Complexity of safety legislation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Not enough safety resources</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Financial costs associated with safety</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Competitive nature of the industry</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>‘Bad attitudes’ about safety amongst managers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>‘Bad attitudes’ about safety amongst workers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Poor regulatory system for the industry</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

### PART SIX:
This section asks about your opinion on ways to improve safety culture within the organisation. *Please indicate the extent to which you disagree or agree with each statement by circling the most relevant response.*

**6.1 The following is an effective way to improve safety culture...**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making the work systems support safety goals</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Having clear and simple safety messages</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Leaders knowing their responsibilities for safety</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Understanding culture change is difficult and takes time</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Everybody understanding what safety issues they are responsible for</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Matching safety programs to business needs in different areas</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Getting passionate people to speak up about safety issues</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Making sure everybody knows the most important safety issues</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

*Thank you for completing the survey. Your time and effort is greatly appreciated.*

Please return this survey to the QUT Research Team by sending it via internal mail to your Divisional Safety Manager, or by scanning and emailing to s2.biggs@student.qut.edu.au.
Appendix K
Participant information sheet for Study Three group interviews

PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT
– Interview –

Reducing workplace incidents: Bridging the gap between safety culture theory and practice (Study 3)
QUT Ethics Approval Number 1000000944

RESEARCH TEAM

Principal Researcher: Sarah Biggs, PhD Candidate, QUT
Associate Researcher: Dr Tamara Banks, Postdoctoral Research Fellow, QUT

DESCRIPTION

This project is being undertaken as part of a PhD project for Sarah Biggs.

The purpose of this project is to explore individual’s experience of safety culture in the organisation, with a view to identifying the key factors that assist in creating and maintaining a positive safety culture, and providing guidelines on what sorts of programs or other interventions might be useful for this.

The research team requests your assistance because your views on safety culture in your workplace are important to this research. This stage of the project is looking to further explore some of the issues raised in the safety culture survey just conducted in your organisation. You may have been involved in previous stages of the research program. If this is the case, your participation to date is very much appreciated, and we would also value any further input you would like to provide in this stage of the research.

PARTICIPATION

Your participation in this project is voluntary. If you do agree to participate, you can withdraw from participation during the project without comment or penalty. If you withdraw, on request any identifiable information already obtained from you will be destroyed. Your decision to participate will in no way impact upon your current or future relationship with QUT or with [the organisation].

Your participation will involve an interview that will take approximately 30 minutes of your time. The interview will include questions around your views on certain issues around safety in the organisation, and about how safety is approached in your workplace. (An example question is “What do you think motivates workers to behave safely?”) The interview will take place via telephone or in an office space, and at a time convenient to you.

EXPECTED BENEFITS

It is expected that this project will not directly benefit you in the short term. However, it may benefit you indirectly through the development of guidelines to
assist in improving safety culture programs and initiatives and potentially safety outcomes in your workplace.

RISKS

There are no risks beyond normal day-to-day living associated with your participation in this project. You may experience minor discomfort in sharing your responses, and in discussing work-related matters whilst at work.

PRIVACY AND CONFIDENTIALITY

All comments and responses will be treated confidentially. The project is funded by [the organisation]. The funding body will not have access to individual data obtained during the project, but will receive results in group form.

CONSENT TO PARTICIPATE

Due to the nature of the project a verbal consent mechanism will be used.

QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT

If have any questions or require any further information please contact one of the research team members below.

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CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT

QUT is committed to research integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Unit on 07 3138 5123 or email ethicscontact@qut.edu.au. The QUT Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

Thank you for helping with this research project.
Appendix L
Group interview schedule—frontline supervisors

Introductory statements

- Introduce self, group, and topic for the day.
- Reminders about confidentiality and voluntary participation.
- Permission to record the session.

Safety performance

1. What level of safety performance does the organisation expect of you?
2. What level of performance do you expect of your direct employees?

[Finish this section with a summary of what has been determined as the desired level of safety performance]

Effort and Expectancy

3. What do you expect employees to do to meet safety performance standards?
4. How do you communicate this to your employees?

Instrumentality, Outcome and Valence

5. What sorts of rewards are valued by your employees?
6. Do you have discretion/choice in the sorts of rewards that you can provide to employees?
7. Do you think that there is a clear link between safety performance and valued positive outcomes for employees?
8. How do you explain/communicate the outcomes associated with safety performance?
9. How does safety compare to other organisational goals such as productivity?
10. Are there rewards associated with other types of performance that are more valuable to employees?
   a. If so, how do you manage this potential conflict?
Situational facilitators/constraints

11. How does your project manager assist you in encouraging safe behaviour?
   a. Prompts: Does it work? Why/not? What else could they do?

12. How does senior management assist you in encouraging safe behaviour?
   a. Prompts: Does it work? Why/not? What else could they do?

13. How effective are the organisational safety policies in encouraging people to be safe at work?

14. What sorts of things make following safety rules and participating in safety activities difficult?
   a. How do your employees manage these?
   b. What can supervisors do to help manage these?

15. What do you think is the influence of workmates on the safety behaviour of your employees?
   a. How do you encourage or discourage this influence?

16. Are there other influences outside of work that affect your employees’ safety behaviour?
Appendix M
Group interview schedule—frontline workers

Introductory statements

- Introduce self, group, and topic for the day.
- Reminders about confidentiality and voluntary participation.
- Permission to record the session.

Safety performance

2. What is expected of employees around safety?
   a. Prompts: What does your supervisor/PM/MD expect?

3. When people talk about safety and safe behaviour, what do you think of?

4. What do you think is good safety behaviour?
   a. Prompts: Following safety rules and participating in safety activities

[Finish this section with a summary of what has been determined as the desired level of safety performance]

Effort and Expectancy

5. What kind of things do people need to do to meet that level of safety performance?
   a. Prompts: wearing PPE, attending toolbox talks etc

6. What sort of effort is involved?

7. If you do those things, will you meet safety performance expectations? Or are there exceptions?
   a. Example for clarification: you might attend every toolbox talk but this may not be monitored and rewarded by supervisors

Instrumentality, Outcome and Valence

8. What happens when you have good safety performance [use their language from above]?
   a. Prompts: are you less likely to get hurt/more likely to be promoted or rewarded?
9. What sorts of outcomes (positive or negative) are linked to that level of performance?
10. Are the outcomes/rewards valued?

11. How does safety compare to other organisational goals such as productivity?
12. Are there more valuable rewards for other types of performance?
13. Are there examples of good safety performance NOT being rewarded?

Situational facilitators/constraints

14. What do you think about your supervisor’s commitment to safety?

15. What does your immediate supervisor do to encourage you to be safe at work?
   a. Prompts: Does it work? Why/not? What else could they do?

16. What does your Project Manager do to encourage you to be safe at work?
   b. Prompts: Does it work? Why/not? What else could they do?

17. What are senior management doing to encourage you to be safe at work?
   a. Prompts: Does it work? Why/not? What else could they do?

18. Are there organisational policies that influence how you do your work safely?
   a. What aspects of those policies encourage you to be safe?
   b. What aspects of those policies don’t encourage you to be safe?

19. What makes following safety rules and participating in safety activities difficult in your work?
   a. How do you manage these?

20. How do your peers/workmates influence your safety behaviour at work?
21. Are there other influences in your life that make you want to be safe at work?