

INVESTIGATION OF SAFETY LEADERSHIP WITHIN INFRASTRUCTURE ENGINEERING CONSTRUCTION PROJECTS

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Abstract

The Infrastructure Engineering Sector of the Construction Industry is one of the high-risk sectors of work in the UK (HSE 2009), where engineering and construction activities that either enhance or maintain the rail and public highway infrastructure are undertaken in a hazardous environment. Occupational health and safety performance data is showing that the industry performance has reached a plateau; to achieve the next step change in improved performance it is necessary to tackle behaviours and culture.

The work of the Infrastructure Engineering Industry is largely delivered through a small number of Principal Contractors, with procured second and third tier contracting organisations to deliver specialist works. Through the identification of Principal Contractors as leaders of project delivery, a common project organisation structure is developed – referred to as ‘Project Delivery Organisation’. The structure of a Project Delivery Organisation may impact on safety culture for various reasons, in particular the organisation and interfaces between these different parties. Whilst there is considerable research on the characteristics of positive and negative safety cultures, research to date does not consider the interfaces and relationships between different organisations that are co-ordinated to work together for a determined period of time forming a quasi-organisation such as a Project Delivery Organisation. With recognition of a multitude of factors that can influence safety culture, the thesis evaluates the factors influencing safety on typical construction projects to understand the impact on overall safety performance and seeks ways to enhance safety through leadership programmes.

The thesis aims to investigate safety leadership within the Infrastructure Engineering Sector of the Construction Industry to determine whether safety leadership is important for improving the safety culture of a construction project. The thesis builds upon the areas identified from existing research into safety, safety leadership and safety culture, and applies these theories in specific application to better understand the components, factors and interactions that influence safety, safety culture and safety leadership within a Project Delivery Organisation, and to evaluate the effectiveness of safety leadership interventions within a Project Delivery Organisation making recommendations for industry.

This thesis investigates safety leadership within Project Delivery Organisations taking a multi-method approach across four separate studies which:

- evaluate perceptions of safety culture (Study 1)
- establish the contents of existing Safety Improvement Programmes (Study 2)
- evaluate attitudes to safety leadership (Study 3)
- deploy a safety leadership intervention tool and identify factors influencing safety leadership interventions on projects (Study 4)

Study 1 involved holding a number of workshops were held to establish perceptions of safety culture maturity amongst two groups: Principal Contractors and their Supply Chain. Participants were asked to rank their safety culture maturity and that of the other group on a maturity scale of 1-5, with 5 being the most mature. This study found that there was a significant difference in the perceived safety culture maturity of the Principal Contractor and Supply Chain, with Principal Contractors perceived as more mature than the Supply Chain.

Study 2 sought to understand what Safety Improvement Programmes were adopted within the Supply Chain. An anonymous questionnaire survey was issued to Supply Chain organisations posing questions relating to safety improvements, initiatives, their content and purpose. This study found that whilst Principal Contractors were implementing Safety Improvement Programmes on construction projects, their effectiveness was being diluted by the Supply Chain with their non-application of these programmes within their own organisation.

Study 3 focused on attitudes to safety leadership within the rail construction sector. Twenty-one in-depth interviews were undertaken with representatives from Client, Principal Contractor and Supply Chain, to identify attitudes to safety leadership and consider how this may impact on safety performance. The level of understanding of safety leadership as a topic was evaluated against how well the study participants could explain the concept, and whether they could provide any examples of real-world application. This study found that there are numerous safety leadership interventions being deployed on these projects. Half of the intervention examples provided were based around communication activities. The likely success of these leadership interventions will be influenced by five themes; context, preparation, communication, leadership behaviour and style, and action.

From Studies 1, 2 and 3 a model of a Project Delivery Organisation was established showing the relationships between the different member organisations as well as identifying potential influencing factors.

In preparation for Study 4, a Safety Leadership Intervention Tool (SLIT) was developed as part of this research based on existing safety culture, safety performance and leadership research, and the researchers experience within industry. The SLIT was designed to provide consistent resources to participating projects and each Project Management team to achieve a positive change in safety outcomes for the duration of the project, utilising techniques that demonstrate safety leadership. The SLIT design is a particular contribution from this thesis.

Study 4 investigated the implementation of a Safety Leadership Intervention Tool (SLIT) across six Project Delivery Organisations, three different Project Delivery Organisations in the Intervention Group and a further three Project Delivery Organisations in the Baseline Group for comparison purposes. A multi-methods approach was undertaken within Study 4 with data collected using interviews, surveys and a review of project safety records. A logic map was used as the evaluation framework for determining the effectiveness of the safety leadership interventions for each project. The same logic map is also used to compare findings for the two groups of case studies – baseline and intervention groups. From this study it can be concluded that Project Delivery Organisations are reluctant to implement new safety interventions as SLIT interventions were only partially implemented. Two main influencing factors have been found to affect safety performance within a Project Delivery Organisation. The influence of the Client representatives and Project Manager can have a positive or negative impact on the safety culture maturity, depending on whether they demonstrate good role model behaviours or not. Situational constraints have also been found to impact on the effectiveness of safety leadership interventions within a project environment. This was particularly evident when there was a greater focus on delivering the project to a specified timescale/deadline.

The thesis makes a number of contributions from the research that has been undertaken and builds upon existing research relating to:

- safety performance (Mearns et al 2003, DeJoy et al 2004, Grabowski et al 2007, Hale et al 2010, Walters and James 2009, Winkler and Irwin 2003)
- safety culture (Fleming 2001, Fleming and Lardner 2008, Cooper 2001, Parker et al 2006, Zohar 1980, 2002)

- safety leadership (Hopkins 2006, Fleming and Lardner 2001, Hofmann et al 1995, Shannon et al 1997)

The thesis findings are applied to construction projects, as dynamic transient environments where organisations are contracted to work together for a defined and limited period of time forming a quasi-organisation. The main findings relate to:

- The importance of safety leadership behaviours on a construction project and identification that there is still further work needed to develop individual safety leadership skills particularly relating to change efficacy. A key finding was that how an intervention is implemented is equally as important as the content of the intervention itself.
- Understanding the two main influencing factors that can impact on the effectiveness of safety leadership interventions within a Project Delivery Organisation. These are Client behaviour and situational constraints associated with increased role demands.
- Understanding the safety culture maturity within a Project Delivery Organisation, where Principal Contractors are perceived to be more mature than the Supply Chain.

The thesis adopted many well-established techniques for data collection and evaluation taking a multi-methods approach. The thesis has made a specific methodological contribution for future studies seeking to evaluate interventions through the use of a logic map for both intervention design and evaluation. A logic mapping approach can be taken to inform the data collection, collation and analysis of relationships across a wide range of data sources.

Whilst the methodological approach was a contribution, the complexity of Study 4 is also a limitation. The two different groups of projects (Intervention and Baseline) participating in Study 4 was also considered a potential limitation. The study design was to create a control (Baseline Group) for comparison with the Intervention Group projects. However, it may have been more appropriate to compare the implementation of the SLIT across more projects – all being in the Intervention Group and not have a control group. The sampling approach taken for the participating projects was a potential limitation. There was limited access and availability to the researcher for selecting projects to participate in Study 4 whilst resulted in too wide a range of different size of projects (measured via project duration, value and appointed resources) participating in the study. In future studies it is recommended that specific consideration should be given to project size when looking to compare between projects.

The thesis used perceptions to establish views towards safety, safety culture and safety leadership across several studies (1, 3, 4). However, the focused was on the relationship between Principal Contractor and the Supply Chain. The lack of Client perceptions within Studies 1 and 4 is a limitation. In future studies it would be prudent to include the Client attitudes towards safety.

This research investigated safety leadership within Infrastructure Engineering Projects in the Construction Industry. Further studies could evaluate in more depth the factors influencing safety performance within a Project Delivery Organisation including the impact of Client behaviours towards safety, identification of individuals as leaders of safety within a construction project and how this role is deployed in practice, and an evaluation of change management frameworks for the implementation of Safety Improvement Programmes.

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Previous presentations of this work

This work has been previously published or presented at the following venues:

Shelley Stiles, David Golightly and John R. Wilson (2012) Behavioural Safety amongst Construction Industry Supply Chain contractors. *Contemporary Ergonomics and Human Factors* 2012. CRC Press

Shelley Stiles, David Golightly and Brendan Ryan (2016) Evaluating the impact of leadership on Safety Culture within a construction project: a Quasi-organisation. *Human Factors in Complex Systems Conference*, Nottingham, UK

Shelley Stiles, David Golightly and Brendan Ryan (2018) Readiness to Change: Perceptions of Safety Culture up and down the Supply Chain. In *Congress of the International Ergonomics Association* (pp. 213-223). Springer, Cham.

Shelley Stiles, David Golightly and Brendan Ryan (2018) Evaluating attitudes to safety leadership within rail construction projects. *Safety Science*. Volume 110 Part B. 134-144

1. Introduction

1.1 Background

The Construction Industry contributes to more than £1billion to the UK economy and employs 4% of UK workforce across a variety of sectors (Office for National Statistics 2011). Approximately one third of the construction industry activities is within the design, construction, maintenance, enhancement, repair and demolition of transport infrastructure i.e. roads and rail. The UK Construction Industry has a workforce of over two million people working across approximately 200,000 firms (DTI 2006). The majority (almost 90%) are small to medium sized enterprises (SMEs) employing less than 10 people.

The overall safety performance of the Construction Industry is relatively poor in comparison with other UK industries (Langford et al 2000). Figure 1.1 shows the fatality rate across a number of UK sectors, with the construction sector being the worst performing with the highest number of fatalities in the period 2017/2018. In addition, Figure 1.1 also shows the annual average fatality rate across the same sectors between 2013 and 2018.

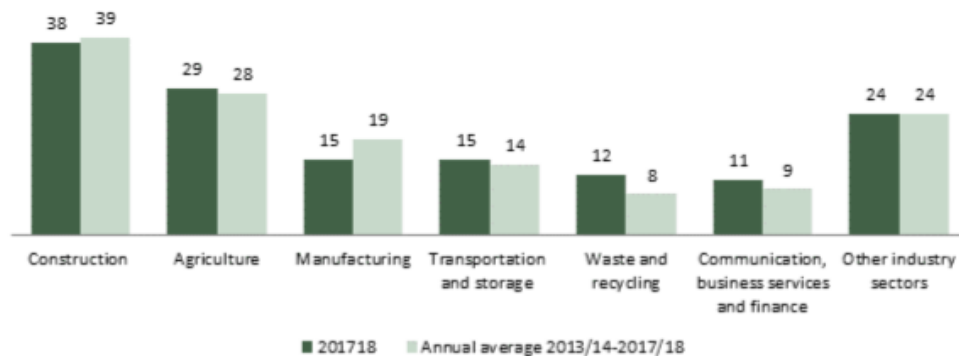


Figure 1.1 UK Industry fatality statistics (HSE 2018)

The Construction Industry is governed by the arrangements defined within Construction Design and Management Regulations which place specific duties on organisations involved in construction activities and also outline the responsibilities of these organisations at different levels in the supply chain for project delivery and the management of safety (Baxendale and Jones 2000). The interfaces and relationships between organisations are of particular interest when work is carried out on a project; co-ordinated via contractual

obligations, for a determined period of time forming a quasi-organisation. Through the identification of Principal Contractors as leaders of project delivery, a common project organisation structure is developed – referred to as ‘Project Delivery Organisation’. This thesis considers the typical interfaces and relationships between the different organisations working in this project environment.

The structure of a Project Delivery Organisation may impact on safety culture for various reasons: the power relationship (where strength lies with Principal Contractor); contractual impacts (where SMEs may be selected largely based on price); a lack of management commitment, communication and engagement; a lack of clarity of roles and responsibilities for safety; limited access to health and safety resources and formal training within SMEs. With recognition of a multitude of factors that can influence safety culture, it is necessary to evaluate the relationships and functioning of typical construction projects to understand the impact on overall safety performance.

Safety leadership is widely discussed (Zohar 2002, Zohar and Luria 2003, Flin and Yule 2004, Lekka and Healey 2012, Conchie and Moon 2010), commonly relating to improving safety performance within an occupational environment. Whilst there is considerable research on the characteristics of positive and negative safety leadership behaviours, there is limited research evaluating leadership in the context of construction projects. Existing research does not address specific consideration of the complex interfaces and challenges faced by temporary configurations of Client, Principal Contractor and Supply Chains within this sector.

This thesis investigates safety leadership interventions and the impacts on safety culture and performance within a Project Delivery Organisation. Findings are presented on the following: the nature of safety leadership activities; the type of safety support that is provided by the principal contractor and subcontractor organisations; workers’ perceptions of safety leadership activities; examples of safety leadership interventions; and the impacts of various influencing factors on safety culture and performance in the project.

1.2 Aim and Objectives

The overall aim of the thesis is to investigate safety leadership within the Infrastructure Engineering Sector of the Construction Industry to determine whether safety leadership is important for improving the safety culture of a

construction project. In order to achieve this aim to research objectives were developed. Firstly, to better understand the components, factors and interactions that influence safety, safety culture and safety leadership within a Project Delivery Organisation, and secondly to evaluates the effectiveness of safety leadership interventions within a Project Delivery Organisation and make recommendations for industry. The thesis has six research objectives:

1. Determining the current perceived level of safety culture maturity within a Project Delivery Organisation
2. Existence and the perceived effectiveness of safety improvement programmes within a Project Delivery Organisation
3. Determining the current level of understanding and application of safety leadership within a project environment
4. Understanding the effectiveness of safety leadership interventions on safety culture maturity and performance
5. Identifying the relevance of influencing factors on safety and leadership within Project Delivery Organisations
6. Establishing specific considerations for the successful implementation of Safety Improvement Programmes within this sector

The thesis builds upon the areas identified from existing research in safety leadership, safety culture, and safety performance. The research applies research findings to the construction sector to gain an understanding of how to improve safety leadership on construction projects, cognisant of the influencing factors that have potential to impact on safety.

1.3 Approach

A multi-methods approach has been taken in order to develop guidance for Project Delivery Organisations to effectively implement safety leadership interventions, making recommendations for the Construction Industry based on the analysis and results within this thesis.

The approach uses accepted methods from across research into safety performance, safety culture and safety leadership. The method of data collection includes interviews, perception surveys and workshops. The method of data evaluation includes non-parametric statistical tests, maturity ratings, thematic and comparative analysis. The thesis also applies methods for interventions such as logic mapping but develops these for the specific evaluation of factors influencing interventions within a Project Delivery

Organisation. The use of a logic map for both intervention design and evaluation is a more emerging approach.

The researcher is a Health and Safety Consultant with 18 years' experience working in the Construction Industry. This experience is a key aspect of the research methodology where tried and tested methods have been developed for specific use within a Project Delivery Organisation, due to the researcher's experience and day to day consultancy work within industry. The opportunities provided by this consultancy work have also enabled access to a wide source of data as part of this research.

1.4 Structure of Thesis

The structure of the thesis is illustrated in Figure 1.2, identifying how each chapter addresses the research objectives.

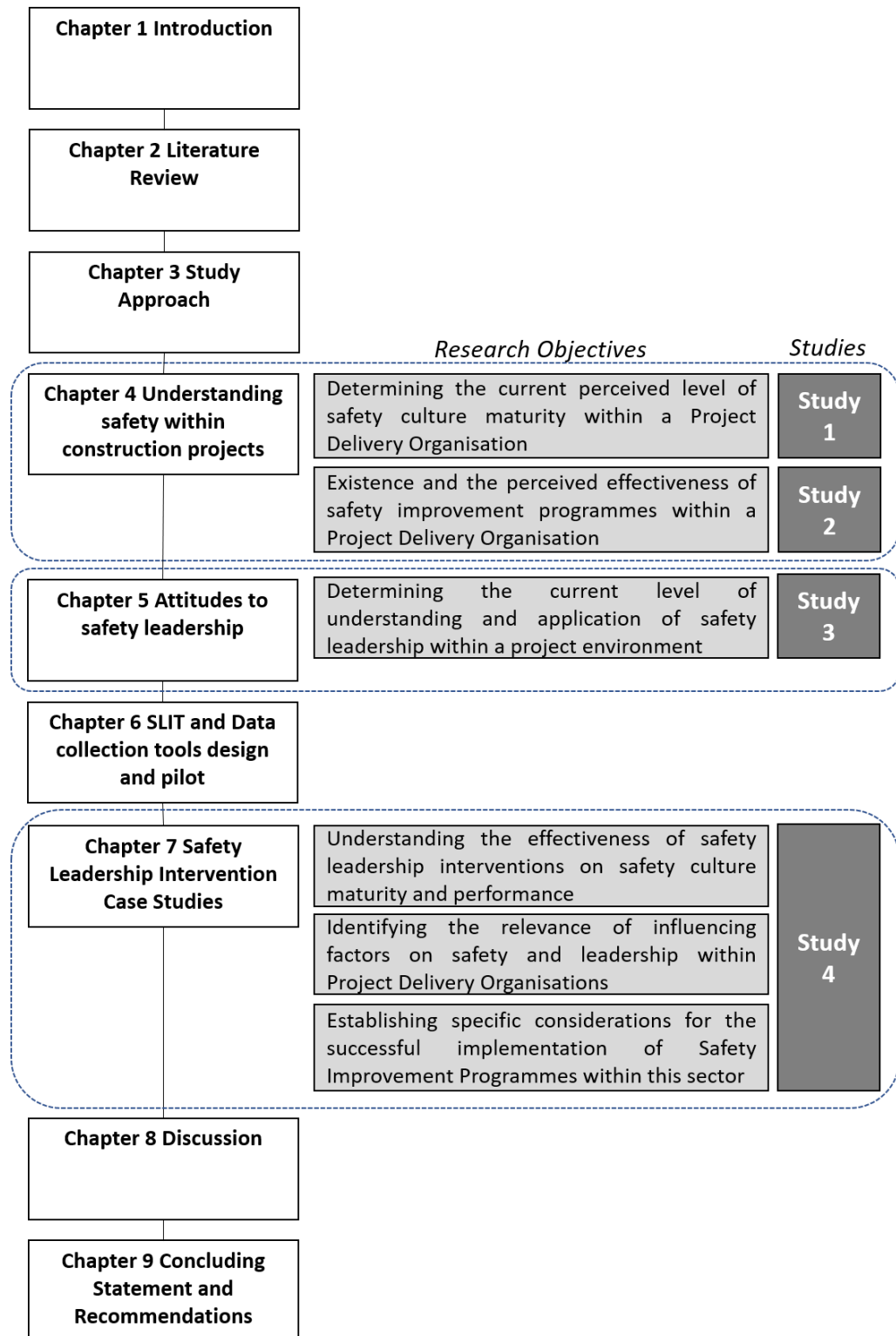


Figure 1.2 Thesis structure

1.4.1 Chapter 2 Literature Review

This chapter presents a review of the main literature findings drawing specifically from the following areas; safety within the Construction Industry

and associated influencing factors, evaluating safety performance, successful change programmes and focusing on the importance of leadership for safety.

1.4.2 Chapter 3 Study Approach

Chapter 3 outlines a multi-method approach taken across four separate studies which investigate safety leadership within Project Delivery Organisations. These include:

- Evaluation of perceptions of safety culture (Study 1)
- Establishing the contents of existing Safety Improvement Programmes (Study 2)
- Evaluating attitudes to safety leadership (Study 3)
- Deploying a safety leadership intervention tool and identify factors influencing safety leadership interventions on projects (Study 4)

The research adopted many well-established techniques for data collection (surveys, interviews, workshops etc) and data evaluation (non-parametric statistical tests, thematic and comparative analysis). In addition, the use of a logic map for both intervention design and evaluation was undertaken and found to be a valuable approach. The chapter also identifies the methodological challenges in measuring safety performance, including the findings from a pilot and how this impacted on the study design.

1.4.3 Chapter 4 Understanding Safety on Construction Projects

This chapter details the findings of Studies 1 and 2. These studies focus on two research objectives: determining the current perceived level of safety culture maturity within a Project Delivery Organisation and the existence and the perceived effectiveness of safety improvement programmes within a Project Delivery Organisation.

Study 1 focused on the understanding the interfaces and relationships between Principal Contractors and their Supply Chain, and the impact on perceptions safety culture for Project Delivery Organisations in the Construction Industry. This study explored whether there is a difference in perception between project members, and the potential implications for a project implementing a safety improvement programme within the sector.

Study 2 identified the existing Safety Improvement Programmes deployed in the industry to obtain an understanding of where safety leadership is

addressed, and whether such programmes are considered to be effective at improving safety performance.

The relevance of the findings from both studies are then discussed in the chapter summary for the context of the wider PhD research.

1.4.4 Chapter 5 Attitudes to Safety Leadership

Study 3 evaluates attitudes towards safety leadership culture within Project Delivery Organisations. Whilst key aspects of safety leadership are clearly identified within literature (Fleming 2001, Mearns et al 2003, Zohar 1980, Geller 1994, Conchie and Moon 2010), there is limited research into the effective application of safety leadership within a complex Project Delivery Organisation. A method based around interviews determined the level of understanding of safety leadership as a topic, and whether leaders could provide any examples of real-world application of safety leadership interventions within a Project Delivery Organisation.

1.4.5 Chapter 6 Safety Leadership Intervention Tool

This chapter details how the Safety Leadership Intervention Tool (SLIT) was developed based on existing safety culture, safety performance and leadership research. The contents of the SLIT is split into four parts: Vision and goals, Transformational leadership, Transactional leadership, and Monitoring and review. The details of each aspect of the tool are also explained. This chapter also details the development of the data collection materials that were used in Intervention Case Studies (Study 4 – Chapter 7). Once initially developed, the data collection materials were piloted, and subsequent refinements made which is also detailed within this chapter.

1.4.6 Chapter 7 Safety Leadership Intervention Case Studies

Chapter 7 focuses on an investigation of the implementation of safety leadership interventions across six Project Delivery Organisations (completed as Study 4). Three research objectives were addressed in Study 4: understanding the effectiveness of safety leadership interventions on safety culture maturity and performance, identifying the relevance of influencing factors on safety and leadership within Project Delivery Organisations, and establishing specific considerations for the successful implementation of Safety Improvement Programmes within this sector.

Study 4 involved deploying safety leadership interventions across three different Project Delivery Organisations. A further three Project Delivery Organisations Case Studies were undertaken as a baseline group for comparison purposes.

A multi-methods approach was undertaken within Study 4 with data collected using interviews, surveys and a review of project safety records. A logic map was used as the evaluation framework for determining the effectiveness of the safety leadership interventions for each project. The same logic map is also used to compare findings for the two groups of case studies – baseline and intervention groups.

1.4.7 Chapter 8 Discussion

This chapter presents findings of the separate studies from across the research and identifies how these meet the research aim and objectives. The research draws on a number of different areas identified within the literature relating to safety culture, safety performance and leadership. Findings from across the four studies are discussed in relation to:

- Safety culture maturity within a Project Delivery Organisation
- The role of safety leadership
- Understanding the influencing factors affecting safety within construction projects

This chapter also discussed the methodological approach as well as specific challenges and limitations of the research.

1.4.8 Chapter 9 Concluding Statement and Recommendations

Chapter 9 summarises the main findings of this research and identifies where the research makes a contribution in obtaining a greater understanding of the influencing factors that have potential to impact on safety within a project environment and with this knowledge determine how safety leadership interventions can contribute to improved safety culture and performance. Recommendations for areas of further research are also identified.

2. Literature Review

2.1 Introduction to Chapter

This chapter presents a review of literature which has informed for the research within this thesis. This research draws from the following areas;

- **Safety within the Construction Industry and associated influencing factors**
Construction is one of the highest risk industries in the UK, with safety performance at a plateau. Complex project organisations are created to deliver works largely through a small number of Principal Contractors, with procured second and third tier contracting delivering specialist disciplines. The organisation and interfaces between these parties has potential to affect safety performance. These factors are explored within this section.
- **Understanding safety performance**
Techniques for evaluating safety performance are discussed within this section focusing on safety culture as an indication of safety performance.
- **Making changes to improve safety**
This section reviews change management theories and considers the relevance for organisational changes, particularly in the context of safety.
- **Focus on the importance of leadership for safety**
Leadership is widely recognised as important for effective change management, as well as a characteristic of an organisation with a high performing safety record. Leadership theories and their application for safety are discussed within this section.

2.2 Safety in the Construction Industry

The UK Construction Industry has a workforce of over two million people working across 200,000 firms (DTI 2006). The Construction Industry has one of the highest accident rates of all industries in the UK (HSE 2009). In the 2017/2018 period there were 38 fatal injuries in the UK Construction Industry (26% of all UK fatal injuries). This compares with

- agriculture - 7.73 fatalities per 100,000 workers
- waste - 5.71 fatalities per 100,000 workers
- construction - 1.94 fatalities per 100,000 workers
- manufacturing - 0.29 fatalities per 100,000 workers
- service industries - 0.15 fatalities per 100,000 workers

- all industry average - 0.46 per 100,000 workers

Between 2012 and 2015 there was an average of around 65,000 construction workers who sustained an injury whilst undertaking construction work. 60% of all reported injuries in the Construction sector are due to either falls from a height or slip, trip or fall on the same level. This equates to 3.1% of all workers within the Construction Industry sustaining a workplace injury. Within the industry there has been little improvement on safety performance since 2008, with performance reaching a plateau there is recognition across industry of the need to change and improve safety (HSE 2015b).

Within the Construction Industry there are several different sectors; commercial and domestic building, civil engineering, mechanical and electrical engineering as well as specialist activities such as demolition and asbestos removal etc. This study focuses on the Infrastructure Engineering Sector where activities that either enhance or maintain the rail and public highway infrastructure are undertaken. Such activities are undertaken in a hazardous environment where there are not only the hazards from the construction activities themselves but also the works are undertaken within metres of motor vehicles and/or trains travelling at high speed.

2.2.1 The Rail Infrastructure Engineering Sector

According to Railway Safety and Standards Board (RSSB 2005), *'track work is a relatively high-risk occupation'*. The same report also states *'track workers have a similar level of risk to road construction operatives'*. From the RSSB Annual Safety Performance Reports, the risk to track workers undertaking construction activities track-side is 3 times the rail industry average (RSSB 2005). The fatality weighted injury rate 2015/16 is 0.7:1000 (RSSB 2016).

2.2.2 The Road Infrastructure Engineering Sector

The Highways Agency (2009) is similar with the fatality weighted injury rate in this sector around 1:1000. A significant risk to this workforce is the behaviour of the travelling public adjacent to their place of work. Unlike trains, motor vehicles cannot be guaranteed to consistently travel in predetermined straight lines. The New Roads and Street Works Act 1991, updated in April 2010, governs all work to roads that is undertaken. This is supported by a Code of Practice which detail the accepted safe systems of work for working on the highway.

2.2.3 Improving Industry-Wide Safety Performance

Following a number of major disasters in the 1970s and 1980s there was an increased focus on high hazard industries and the organisations that work in them to have an auditable safety management system, as robustness of safety management arrangements were found to be a factor in each of these events (Flixborough 1975, Zeebrugge 1987, Kings Cross 1988, Clapham Junction 1989, Piper Alpha 1990). Following further studies and development in the 1990s it became standard practice across high hazard industries for safety management systems to become formalised and accredited by a third-party organisation. The purpose of this is to provide assurance that the safety management system meets a minimum standard; being fit for purpose and implemented within an organisation (Hale et al 1997). HSG65 Successful Health and safety Management was first produced by the HSE in 1991 a framework for which duty holders and use to develop their safety management system beyond legal compliance requirements. The document was updated by the HSE in 2003.

Over the years the traditional measures of occupational safety performance have indicated that the sector has reached a plateau (Network Rail 2007, Highways Term Maintenance Association 2009). In general, the sector has extensive engineering and standards, processes, procedures and also an advanced competence management system, yet the next step change in occupational safety performance has not been achieved. According to Fleming and Lardner (2008) this is an indication of the safety maturity of the industry and therefore to achieve the desired step change focus should be on improving behaviour and culture.

In June 2000 the Government implemented 'Revitalising Health and safety' Strategy document (HSE 2000) which sought to improve health and safety performance across all industries by 2010, with the aim of:

- creating new momentum for health and safety
- identifying new approaches to reduce rates of accidents and ill health caused by work, especially approaches relevant to small firms;
- ensuring that the approach to health and safety regulation remains relevant for the changing world of work over the next 25 years

During the period up to 2010 there was a reduction from the baseline measure of safety data in all areas: fatalities, major injuries and number of working days lost with three exceptions (long latency methothelioma cases rose, and there was no clear change in the data for reported cases of stress and hearing loss).

This strategy has been subsequently replaced by 'Helping Great Britain Work Well – A new health and safety system strategy' in 2016; which refreshes the previous strategy document. This identifies what are the UK health and safety regulator's main priorities for all businesses. These focus on six strategic themes:

- **Acting together:** Promoting broader ownership of health and safety in Great Britain
- **Tackling ill health:** Highlighting and tackling the costs of work-related ill health
- **Managing risk well:** Simplifying risk management and helping business to grow
- **Supporting small employers:** Giving SMEs simple advice so they know what they have to do
- **Keeping pace with change:** Anticipating and tackling new health and safety challenges
- **Sharing our success:** Promoting the benefits of Great Britain's world-class health and safety system

'Acting together', 'Supporting small employers' and 'Keeping pace with change' are particularly relevant to this research project.

Whilst it has been recognised that there has been significant improvement in health and safety within the construction sector, the Health and Safety Executive (2016) have identified concerns over the lack of co-ordinated response across the whole industry, attributed to the different priorities and agendas of organisation's within the sector. The HSE found that the diverse nature of the industry contributed in a status quo and a lack of continual improvement in safety performance. The 'Helping Great Britain Work Well' Strategy is therefore focusing on specific areas of the Construction Industry in response to the known challenges within the industry (refer to Table 2.1). The specific areas that will be explored further within this study are:

- the extensive reliance on subcontracting, with the associated complex relationships
- corporate and project leadership amongst the Principal Contractor and supply chain
- the impact of key decisions (design, procurement and cost) on safety

	Small projects <15 people	Larger projects >15 people
Characteristics	Those running and working on small sites: • significantly underestimate the risks to themselves • fail to recognise when their standards are poor (even in high-risk areas like work at height) and that improvement could prevent accidents and ill health • do not belong to a trade association • do not seek health and safety information or attend training courses • avoid contact with officialdom • are unaware of, or disregard, required standards and even basic obligations • lack competence and awareness of the actions required to effectively manage health and safety • are often overwhelmed and confused by the health and safety goal-based system – they simply want consistent information telling them what to do • may cut corners to reduce costs, often at the expense of health and safety • often take on complex projects (including structural alterations and excavations) without being aware of the risks or potential for a catastrophic event	Issues relating to larger sites/organisations: • Potential for catastrophic event that could create multiple fatalities affecting both workers and the public off site, e.g. scaffold collapse • Extensive reliance on subcontracting due to the nature of construction projects and specialist nature of many firms: - Complex subcontract relationships may lead to the breakdown of communications and a lack of co-operation between workers and / or teams • Poor on-site supervision – high competence at managerial level is not always mirrored at supervisory level on site • Progress on safety risk management on large sites has not been matched by equivalent progress on health risk management: - Health risk management not integral - Although the need to prevent disease and ill health is increasingly recognised, those running and working on larger sites / projects often lack knowledge and ability to implement the required standards - The peripatetic / transient nature of the workforce makes consistent exposure control and monitoring difficult • Corporate leadership and supply chain / project integration: - Although many larger companies provide internal leadership, it often fails to link to health and safety management through their supply chains - Little vertical integration and influence over key decisions such as design, procurement and cost – with knock-on effects for health and safety - Missed opportunities for early risk reduction – it is not necessarily on site where the most effective risk control measures (such as design, planning, procurement) can be introduced. Once on site, contractors' options may be limited to reducing or mitigating risk • Impact of recession including; restructuring, acquisition and coming out of recession, with rapid growth and associated challenges such as skills shortages.

	Small projects <15 people	Larger projects >15 people
Strategic Aims	<i>Creating healthier, safer workplaces</i> - To increase the number of those running and working on smaller sites / projects who are aware of their health and safety obligations and take positive, proportionate steps towards achieving compliance. <i>Building competence</i> - To increase the competence of those running and working on smaller sites / projects in identifying, understanding and proactively / proportionately managing health and safety risks. <i>Securing justice</i> - To attain immediate and sustained compliance with the law by those running and working on smaller sites / projects.	<i>Creating healthier, safer workplaces</i> - To create healthier and safer workplaces on larger sites / projects <i>Building competence</i> - To increase individual and organisational competence in identifying, understanding and proactively managing health and safety risks <i>The need for strong leadership</i> - Cross-industry and organisational leadership drives continuous improvement of health and safety within the construction industry <i>Securing justice</i> - To attain immediate and sustained compliance with the law by those running and working on larger sites / projects

Table 2.1 Summary of 'Helping Great Britain Work Well' Strategy

2.3 Understanding Construction Projects

Construction projects are renown for a lack of standardisation: projects undertaking the same work are rarely consistent in their methodology, the size and scale projects is hugely variable, there are often rapidly changing short duration activities, temporary work areas, a transient workforce, wholesale subcontracting and use of small firms and/or the self-employed, as identified by Duff et al (1993). As these factors may have an impact on safety within the construction industry, this study aims to gain better understanding of the significance of such factors when applied to a construction project.

The Construction Industry's safety management arrangements are governed by the Construction Design and Management Regulations 2015. These regulations outline interfaces between organisations for project delivery and the management of safety. By definition a project is 'a temporary endeavour with a defined beginning and end undertaken to meet unique goals and objectives' (Oxford Brookes 2011). A Project Delivery Organisation is established with a number of companies co-ordinated via contractual obligations, for a determined period of time (Rowlinson 2004). Through the identification of Principal Contractors as leaders of safety management for the project delivery, a common project organisation structure is developed (referred to as 'Project Delivery Organisation' for the remainder of the research, refer to Figure 2.1 Typical Structure of a Project Delivery Organisation).

A Project Delivery Organisation is made up of numerous organisations, the majority of whom are Small to Medium-sized Enterprises (SMEs) taking account of 80% of the cost of a construction project (Constructing Excellence 2004). The industry's Supply Chain is made up of 98% SMEs with less than 60 employees (DTI 2011). This is an important characteristic of the industry as research has shown that SMEs typically have less adequate control and arrangements for safety, which is exacerbated in the Construction Industry (Walters and James 2009, Winkler and Irwin 2003).

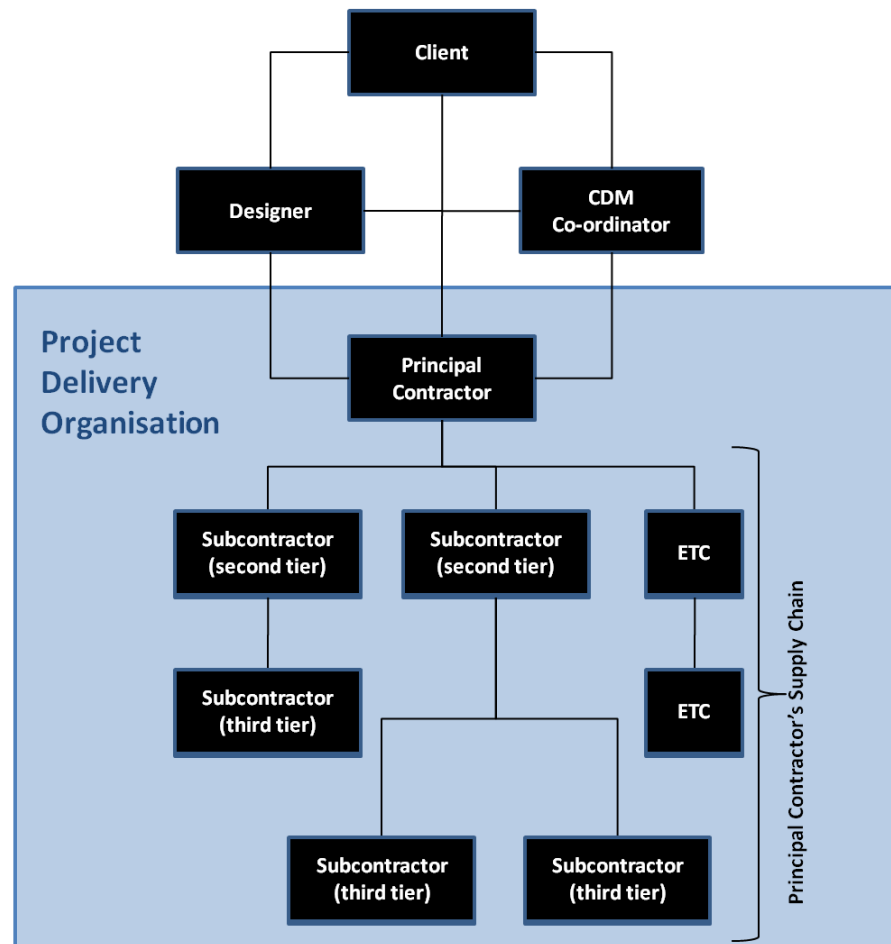


Figure 2.1 Typical structure of a Project Delivery Organisation

The temporary nature of a project becomes more significant when considering the transient nature of the workforce. Throughout the lifecycle of a project, different companies, trades and individuals will work there for varying durations, thus the workforce becomes a further temporary aspect. Such factors should be considered for the Industry, as they have the potential to affect occupational health and safety performance.

The Construction Industry has been subject to taxation changes that have generated a shift from a direct labour workforce to a predominantly self-employed workforce. This increases difficulties of controlling operations with the associated implications for occupational health and safety performance (St John Holt 1997).

Outsourcing introduces many challenges for managing safety; lack of clarity on safety responsibilities, poor co-ordination and communication, with such challenges are common across a number of industries; transport and logistics etc. However, it is the temporary nature of a construction project that introduces additional challenges for the safety within a Project Delivery Organisation. The remainder of this section discusses the key members of the

Project Delivery Organisation in the context of safety management arrangements: Clients, Principal Contractors, the Supply Chain and agency workforce.

2.3.1 Role of the Client and Safety

The Client is *'the person or company, with the controlling interest in the project'* (Health and Safety Authority 2009). The Client is usually the funder of the project and specifies the project remit. The Clients influence is far greater, and they can have a direct impact on project safety performance (Winkler and Irwin 2003).

Following the introduction of the Construction Design and Management Regulations 2015 there is an increased focus on the role of Clients, as it is recognised that *'Clients can significantly influence standards on a project / site from its inception;... where clients show leadership and promote collaborative working then health, safety and other benefits ensue'* (HSE 2016).

Studies by the Health and Safety Authority of Ireland in 2009, found that on projects where a fatality had occurred, 45% were where the client had failed to appoint competent organisations, and 25% of accidents were attributable to failures to address safety issues prior to the start of the construction stage.

Even though the Construction Design and Management Regulations 2015 do not expect that Clients have detailed safety knowledge, their impact is through the selection and appointment of competent organisations to deliver the project, the attention and importance placed upon safety and the allowance of adequate time and resources to deliver the project safely (Bednarz 2016).

There have been limited studies undertaken regarding the role of Client and their impact on safety performance on construction projects. However, there is some research focusing on Client and Contractor collaboration, and the impact of different forms of contract on relationships within the Project Delivery Organisation.

A study by Bresnen and Marshall (2000a) reviewed the impact of partnering and alliancing within the construction sector for medium to large-sized projects. They found that the internal relationships between the Client and other parties (Designer, Principal Contractor and Subcontractors) were negatively affected by the Client organisation; evident in a lack of clear and consistent project objectives between all parties. Their study particularly noted a *'diffusion of collaborative norms'* where there was fewer collaborative behaviours further down the Supply Chain. This was partly attributed to a difference in culture and expectations between the project team and the

respective 'parent' organisations. Despite a focus from the Client on collaboration for a given project, this study found that site-level relationships were often unaffected; site relationships largely being affected by individual Client behaviours that were a cause for concern.

In a further study by Bresnen and Marshall (2000b) they recognise the difficulties in trying to change organisational culture to be more collaborative, with success dependent on all parties addressing the sources of conflict that exist within their relationship, as they work towards aligned project objectives. However, tension exists for each organisation with recognition of developing trust between all parties and the need for economic certainty predisposes a more adversarial relationship and approach. This is not helped when the success of partnering is associated with long-term relationships, not typically associated with the majority of construction projects delivered in the UK.

Whilst this research does not focus on the Client–Contractor relationship specifically, it will consider the impact of the points raised here where they are appropriate to the overall research conclusions.

2.3.2 Role of the Principal Contractor and Safety

There has been considerable research within the construction industry and other industries that identify the characteristics associated with procurement strategies based on outsourcing, in relation to safety. Within other industries, such as transport and logistics, events management, food processing and health services, the Principal Contractor does not exist as a duty holder; this is replaced with a Main Client organisation in studies by Winkler and Irwin (2003) and James et al (2007). The characteristics of both the Main Client and Principal Contractor are identical as determined by previous research findings, and therefore only the Principal Contractor will be listed in the subsequent paragraphs.

A characteristic of particular significance is the power relationship between the Principal Contractor and the supply chain, with the strength and power existing with the Principal Contractor. Often this is accompanied by an adversarial attitude, where the position of power is exerted over the supply chain. The power relationship is largely governed by the reliance on the supply chain to receive payment from the Principal Contractor, as well as repeat work in the future. The power relationship negatively impacts on safety culture through the fear and uncertainty generated amongst the supply chain, emanating in a safety culture lacking in trust and openness (Cox and Ireland 2002, Briscoe et al 2001, Hinze and Gambatese 2003, and Briscoe and Dainty 2005).

The project specific procurement processes for selection of subcontractors are often largely based on price rather than safety (Arditi and Chotibhongs 2005, O'Brien et al 2002, and Vrijhoef and Koskela 2000). From the very start money is prioritised over safety; a characteristic that does not align well with a mature safety culture. This does promulgate further across the project than just contractor selection. There are often a number of different types of contract that are created following standard industry templates (e.g. fixed price, lump sum, cost plus etc). By their very nature these contracts initiate the subcontractor's approach to safety on the project. For example, a subcontractor has tendered for work on the project under a fixed price; the company is aware that price is the most important criteria when the Principal Contractor selects a subcontractor, and therefore in order to win the contract, they provide a cheap quote, sacrificing safety provisions in order to achieve this (Arditi and Chotibhongs 2005). The form of contract that is exchanged between the Principal Contractor and the supply chain members often initiates the approach to safety that will be taken. These findings support and reinforce the significance of power relationship when outsourcing.

The Principal Contractor, by definition, provides the project lead for safety. Even on a small project, the site management are usually employed by the Principal Contractor (either directly or indirectly). The site management team therefore set the project safety agenda and any desire for improving safety performance. Research by Akintoye et al (2000) found that outsourcing often leads to a lack of leadership commitment to safety due to a perceived dilution of accountability and unclear responsibilities, which negatively affects the safety culture on the project. Subsequently, outsourcing becomes a potential barrier to successful collaborative working.

The quasi-nature of the Project Delivery Organisation exacerbates a common feature of outsourcing; a lack of clarity for roles and responsibilities particularly those for discharging safety duties. A study undertaken by Arditi and Chotibhongs (2005) found that the more complex the organisational structure of the project, including many layers of sub-sub-contracting, the greater the lack of clarity regarding safety responsibilities. Assumptions, duplication and gaps were commonplace due to poor communication and lack of proactive management. Studies from other sectors by Winkler and Irwin (2003) and James et al (2007) also support these findings. Organisations with a positive safety culture have a competent workforce aware of their safety responsibilities and whom discharge these as the norm. Outsourcing negatively affects this, the significance of which increases with the complexity of project organisational structure.

A Project Delivery Organisation is known for poor communication and co-ordination, despite this being a statutory duty on the Principal Contractor under the Construction Design and Management Regulations 2015. Briscoe et al (2001) undertook a study to understand supply chain integration within the construction sector. Principal Contractors providing limited, late or poor quality communication was reported to be a significant issue by the supply chain, attributed to poor knowledge management within the Project Delivery Organisation. Open, proactive communication and engagement and an ability to learn is a key characteristic for organisations with a mature safety culture. Yet again the temporary nature of the Project Delivery Organisation structure, consisting of multiple layers of member organisations for specific durations throughout the project life cycle, is itself a contributory factor for safety culture maturity.

2.3.3 Role of the Supply Chain and Safety

It is recognised through previous research that companies employing less than 100 people have a tendency for higher accident rates, indicative of poor safety performance (Vickers et al 2003, Fairman and Yapp 2005). However, construction industry studies by HSE showed that companies within this sector employing less than 400 people have significantly poorer safety performance than a larger organisation (HSE 2011a). Traditionally a company employing less than 250 people was considered to be a small to medium enterprises (SMEs) as defined by the European Commission in 1996.

It can be concluded that whilst there is no uniform consensus on the employee thresholds for being classified as a SME, those organisations employing fewer people tend to have poorer safety performance. This issue is why this might be the case. The typical characteristics of a SME include (Walters and James 2009):

- less financial security which impacts on money allocated to safety e.g. resources, training, investment in safety equipment etc
- a lack of full time and/or internal health and safety personnel appointed by the company resulting in a reduced awareness of safety requirements and a lack of ownership and leadership to improve safety
- Informal safety arrangements opposed to formal safety management systems; which should direct the management of safety throughout day to day operations

Such characteristics reside within the supply chain, and when these organisations are procured as part of a construction project, they bring their safety behaviours and subsequent performance with them. Therefore, the

industry's reliance on outsourcing as a procurement strategy introduces additional challenges for managing safety.

SMEs typically have a lack of health and safety resource which negatively impacts on safety performance (Walters and James 2009). As the Project Delivery Organisation is made up of mostly SMEs it is understandable to expect this characteristic to also have an impact on the safety performance within the project. The lack of resource is typically where there is either no-one appointed in the role for health and safety, or these responsibilities are distributed to one or a number of individuals who work within the SME. Where suitable health and safety competence is lacking within the organisation, there is a reliance on the use of external consultants to provide expertise. The reason for this is usually due to the cost of employing a competent health and safety professional in comparison with the perceived business needs of the organisation. The lack of resource results in health and safety not being driven within the day to day operations of the SME, which again reinforces a less mature safety culture (Arditi and Chotibhongs 2005). This cultural approach and a lack of access to competent health and safety resource are then transferred to the Project Delivery Organisation for the duration of the SMEs involvement on the project.

Arditi and Chotibhongs (2005) and Briscoe et al (2001) also identified that there was a lack of formal health and safety, and technical training within SMEs. Where training is lacking, the employees may not be fully aware of the statutory health and safety responsibilities, or those of their employer. Therefore, this lack of awareness contributes to a less mature safety culture within the SME, and subsequently within the Project Delivery Organisation.

Studies have identified that SMEs typically have informal safety management arrangements in place which reflects the working practices of the organisation and also is an indication of a lack of awareness of employer's statutory duties (Walters and James 2009). This is evident with the SMEs working in the construction sector (Vickers et al 2003), giving an indication that these organisations have less mature safety arrangements than larger organisations, despite construction being a high hazard industry. The industry safety performance data indicates that present safety performance is less than desirable, which should be of no surprise when 80% of the cost of a construction project is attributed to SME's (Constructing Excellence 2004) who typically have informal safety management arrangements.

2.3.4 The Significance of a Peripatetic Workforce for Safety

According to the RITC (2002) labour supply (agency) organisations make up 27.3% of the industries workforce; employing 14.11% of the workforce. Labour supplying companies also have the highest annual turnover of staff within the industry of 36.77%. Working conditions and unsocial working hours are the main reasons for low staff retention amongst labour supply organisations. Labour supply organisations provide individuals for work throughout the country, who will be required to undertake a variety of work activities, working in accordance with other organisations management procedures. However, this group face a number of intrinsic factors that could be affecting safety performance of the workforce; low staff retention, limited capital turnover.

A study conducted by UMIST (2003) identified that as project time pressures increase there are usually resource problems, with the introduction of agency staff to fill the resource gap. As the use of agency staff increases, other risks are introduced. A competent workforce costs money to invest in training and maintenance of competency level through assessment. Appointment of less qualified individuals costs less, therefore short duration requirements lead to disproportionate costs in relation to competence requirements. The compromise is often made for business reasons. Not only is there an augmentation of risks for general health and safety performance, there are also psychosocial factors placed on the individuals hired to fill the gaps (UMIST 2003). These individuals are likely not to have the necessary skills to undertake that activity.

In addition, there may be factors intrinsic to the labour supply organisation that affects their employee behaviours (Allan 1998). Labour supply organisations tend to provide limited health and safety training, limited supervision and support to individuals whilst working for client organisations. When these factors are added to those agency staff face when working for other organisations, the potential to effect health and safety performance of individuals increases, which may become evident in measures of occupational health and safety performance.

Principal Contractors and the Supply Chain rely on labour supply organisations to provide a resource for peak workloads. Labour supply organisations also have similar organisational dynamics i.e. their workforce fluctuates dependent on demand (Forde 2001). This generates uncertainty regarding job security and future employment potential within the labour supply organisation. A REC survey (2002) found that 50% of agency staff worked on assignments of less than 6 weeks. This is an important consideration for safety. Frequent movement between assignments will result in individuals working to different

safety management arrangements and standards contributing to confusion and inconsistency in levels of compliance. This is particularly important when considering the findings of research in 2000 by the European Foundation for the Improvement of Living and Working Conditions that temporary agency workers are exposed to greater health and safety risks than individuals on other types of employment contracts, in particular increased physical hazards and higher workloads (Eurlex 2005). Allan (1998, pg 3) cites Brewster (1995) and Rothwell (1995) supporting this and identify that agency staff tend to have less psychological commitment to the organisation which leads to performance problems.

In addition, Allan (1998) identified that labour supply organisations tend to provide less 'benefits' to their employees such as company sick pay, which in turn has a quantifiable effect on absence rates. Therefore, if employees are less likely to be paid for taking time off work through ill health or accident, the reports of these conditions/incidents is likely to be affected. These individuals are also less likely to be committed to their employer and suffer from general de-motivation.

The manner in which agency staff may be managed by the client organisation (i.e. the Principal Contractor or Subcontractor) has potential to impact on the occupational health and safety performance of an individual. It is acknowledged by Lee and Hoon (1993) that there are commonly relationship difficulties between the workforce and temporary agency staff, which in turn may have significant impact on behaviours in the workplace.

As a construction project is temporary by its very nature, this introduces significant factors associated with where the workforce are sourced from, and who they work for. The reliance on labour supply agencies increases the likelihood that project safety culture will be less mature.

2.3.5 The Significance of Contractorisation on Safety

Contractorisation involves the introduction of a subcontracting supply chain for provision of specialist services/products necessary to deliver the project, also referred to as outsourcing. The move within the industry to procure goods and services from third parties generated a perception from that '*contractorisation is increasing the health and safety risks through additional contractual interfaces, particularly where small companies are involved*' (HSE 2003).

A project's safety culture is derived from a combination of each respective company's culture. Due to the hierarchical nature of a construction project can be expected that the Principal Contractor's safety culture would have greater imposition; after all they have the statutory duty to manage and control the

safety of construction work, as well as being generally larger organisations. If this is so, what contribution and significance does the Supply Chain make and what does this mean for improving safety performance?

Walters and James (2009) study showed that there was a difference in safety culture and performance for larger organisations in comparison with smaller organisations. Therefore, in relation to a construction project it can be expected that the Principal Contractor's safety culture would be more mature than their supply chain; they have the statutory duty to manage and control the safety of construction work, as well as being generally larger organisations.

According to the HSE (2012) the management of safety issues in the construction industry can largely be distinguished by the size of organisations involved, with the safety performance of SMEs working on larger projects performance aligned to the prevailing culture under that Principal Contractor. In other words, if the Principal Contractor has a positive safety culture then any organisations working on the project (SMEs) will often follow with a similar approach to safety.

Existing research by Cooper (2001) and Fleming (2001) has recognised that in order to have a positive safety culture (be more mature) an organisation needs to have:

- Visible safety leadership and commitment
- 360° communication and involvement on safety related matters
- Open and learning workplace
- Priority given to safety over productivity
- Safety training for all
- Access to competent health and safety resource
- A stable workforce
- Safety management systems/arrangements
- Hazard control and risk awareness
- Arrangements for ongoing monitoring, auditing and review of performance

However, many of these do not align with the organisational structure of a Project Delivery Organisation. Project Delivery Organisations have unclear lines of communication and responsibility (Briscoe et al 2001, Briscoe and Dainty 2005, Arditi and Chotibhongs 2005). There is an unbalanced power relationship within the Project Delivery Organisation (Akintoye et al 2000, Cox and Ireland 2002, Briscoe et al 2001, Hinze and Gambatese 2003, Briscoe and Dainty 2005). Also SMEs provide limited training to their employees and have limited access to resources including competent health and safety advice (Briscoe et al 2001, Arditi and Chotibhongs 2005).

A summary of previous research findings regarding outsourcing characteristics for both construction and other industries is shown in Table 2.2 Summary of previous research.

Characteristic	Construction Industry Studies	Other Industry Studies
Power relationship where strength lies with Principal Contractor, accompanied by adversarial attitude	Cox and Ireland (2002) Briscoe et al (2001) Hinze and Gambetese (2003) Briscoe and Dainty (2005)	Winkler and Irwin (2003) James et al (2007)
Contractual impact on relationships within PDO; selection of SME largely based on price	Arditi and Chotibhongs (2005) O'Brien et al (2002) Vrijhoef and Koskela (2000)	Winkler and Irwin (2003) James et al (2007)
Lack of leadership commitment to health and safety within SME	Akintoye et al (2000)	Winkler and Irwin (2003)
Lack of clarity of roles and responsibilities for safety within PDO	Arditi and Chotibhongs (2005)	Winkler and Irwin (2003) James et al (2007)
Poor communication and co-ordination within PDO	Briscoe et al (2001) Briscoe and Dainty (2005)	Winkler and Irwin (2003)
Lack of health and safety resource for SME	Arditi and Chotibhongs (2005)	Winkler and Irwin (2003) James et al (2007)
Lack of formal health and safety, and technical training within SME	Arditi and Chotibhongs (2005) Briscoe et al (2001)	James et al (2007)

Table 2.2 Summary of previous research

These are important characteristics of the industry as research has shown that SMEs typically have less adequate control and arrangements for health and safety, which is exacerbated in the construction industry via the structure of Project Delivery Organisation's (Walters and James 2009). Figure 2.2 demonstrates that whichever organisation is involved in the project they will also have other activities that are outside of the project. Figure 2.3 demonstrates that the impact that each of these organisation's characteristics

have on the Project Delivery Organisation is varied due to the scale of their contribution to the project. Existing research is not clear whether the activities outside of the project influence the safety arrangements within the Project Delivery Organisation, or vice versa, and therefore the impact of such factors for improving safety performance and developing safety culture maturity are not fully understood.

Reference to **Error! Reference source not found.**Figure 2.2 highlights that the commitment level of different supply chain members can be variable. Research to date does not identify whether this has significant impact on safety performance within a Project Delivery Organisation, or not.

With recognition of a multitude of such factors influencing safety culture, it is necessary to evaluate the structure of Project Delivery Organisations, in order to better understand whether the structure of a project delivery organisation has an impact on safety culture.

According to literature, safety culture is established at company level (Ostrom et al 1993, Clarke 1999). Therefore, the safety culture of each member of the project delivery organisation makes a contribution (either positive or negative) to the project's safety culture and climate (Ekvall 1983). Each member company may have varying levels of impact dependent on the size of their organisation and prevailing safety culture, the level of significance given to a project by their company in proportion to their overall turnover and workload, and their respective position in the project social structure.

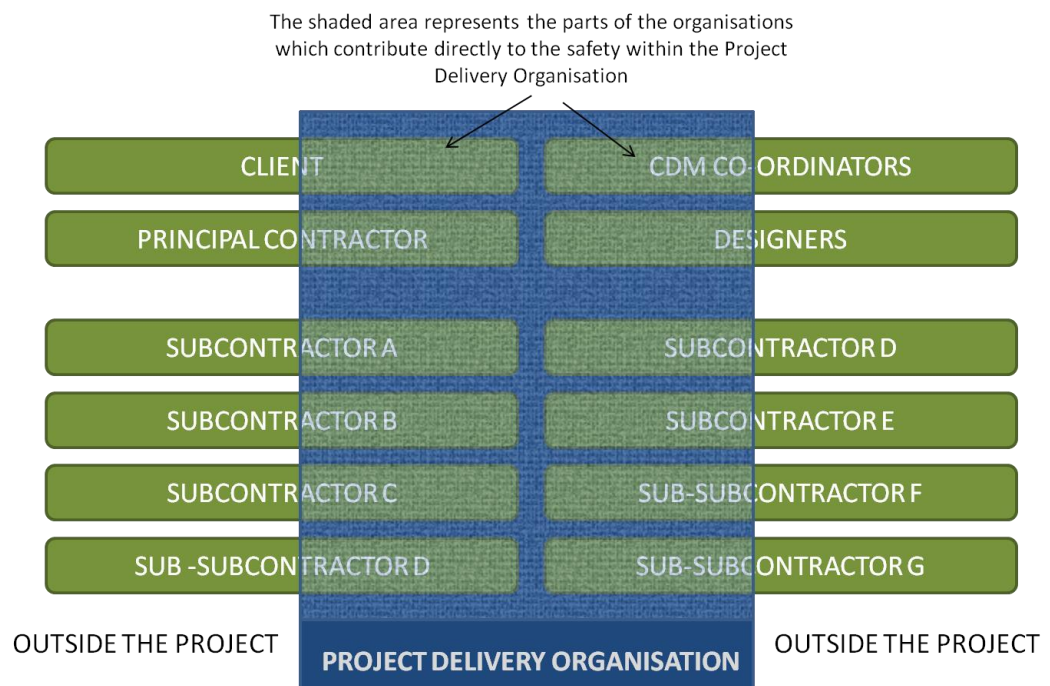


Figure 2.2 Representation of influences external or internal to the Project Delivery Organisation

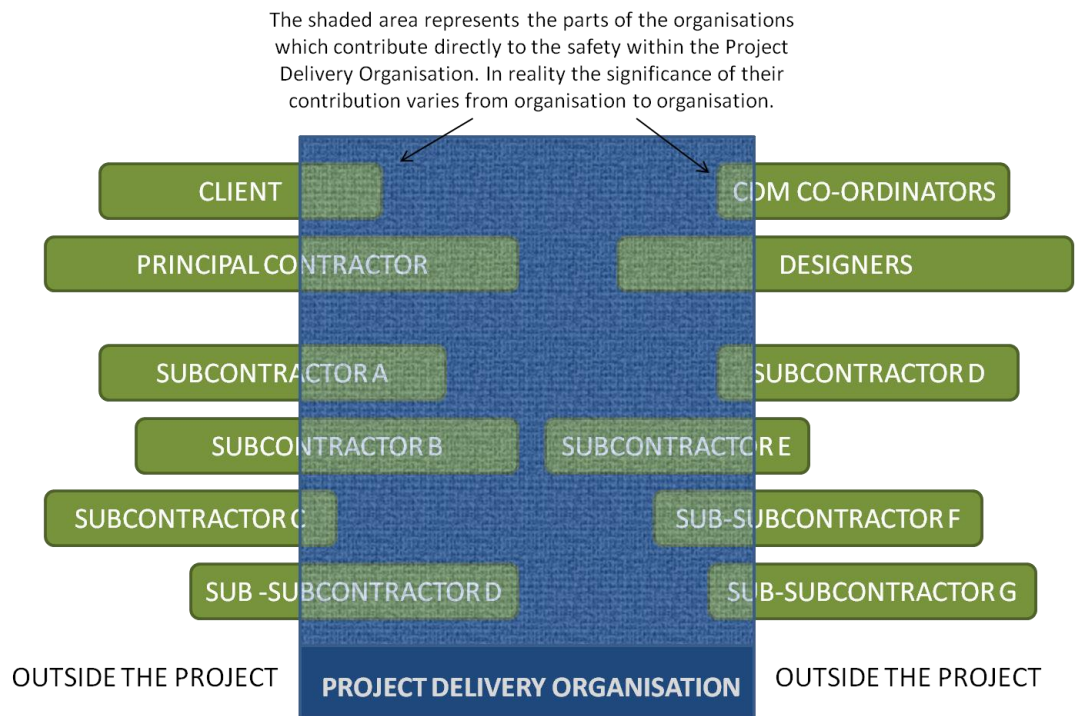


Figure 2.3 Representation of the varying scales of influences external or internal to the Project Delivery Organisation

It can be considered that a project delivery organisation's safety culture is likely to be significantly affected by the high proportion of outsourcing (i.e. subcontracting) typical within the Construction Industry due to the majority of work being delivered by SMEs as the supply chain.

2.4 Understanding Safety Performance

Safety management can be determined by the effectiveness of risk management arrangements within an organisation which results in the safety performance (Smith and Wadsworth 2009). Risk management controls include effective workplace precautions to prevent people being exposed to potential harm, the processes for ensuring these precautions are deployed and maintained, and how risk management is built into the wider safety management arrangements of policy, organisation, planning, control and monitoring of performance. The HSE (2011b) concludes that safety culture is also a measure of the effectiveness of the organisations risk management arrangements; with safety culture is often determined by the level of organisational maturity (Parker et al 2006, Fleming 2001).

2.4.1 Safety Culture Maturity

Since the 1970's there have been numerous studies to better understand the common factors associated with organisations that have high levels of safety performance (Cohen 1977, Mearns et al 2003, DeJoy et al 2004, Grabowski et al 2007). Studies have developed two concepts; safety culture and safety climate. Safety culture is often used to refer to '*what people do*', and '*what the organisation has*'. Schein (2010) states that safety culture is the output from an organisations adaptive processes in response to both internal and external factors, and that this response is steered by a leader. Whereas safety climate is used to refer to '*how people feel*', corresponding to the values, attitudes, and perceptions with regard to safety within an organisation (Cooper 2000). Nonetheless it is considered that both safety culture and safety climate provide a framework for behaviour within any organisation (Safety Research Unit 1993). The emphasis of this research is on safety culture rather than safety climate, the rationale for this is detailed further in section 3.

In relation to the challenges of measuring safety performance already discussed, and the importance of safety culture as a component part, this study is focused on what it is that people do on a construction project that can affect safety, in relation to the complex influencing factors that characteristic within this sector of industry for Project Delivery Organisations. Therefore, for the emphasis of this research the focus on is safety culture, and not safety climate.

2.4.1.1 What is safety culture?

There is no single accepted definition of safety culture, examples include '*how safety is placed as a priority within an organisation*' (Farrington-Darby et al 1997), from the Health and Safety Executive (1999) '*The safety culture of an organisation is the product of individuals and groups values, attitudes, perceptions, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of an organisations health and safety management. Organisations with a positive safety culture are characterised by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventative measures*', or Schein (2010) who 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*'.

Research has been criticised for being 'unsystematic, fragmented and in particular under-specific in theoretical terms' (Pidgeon 1998), with a lack of

clarity between the terms safety culture and safety climate within literature (Cox and Flin 1998). Nonetheless, there are common themes across many studies that identify activities/interventions associated with a good safety culture. A summary of these themes have been collated by the researcher and are shown in Table 2.3 below.

Common themes associated with safety culture interventions	Research
Genuine and consistent management commitment to safety	Geller (1994), Zohar (1980), Fleming (2001), Hudson and Parker (2001), Mearns et al (2003), Langford et al (2000), HSE (1999), Schein (2010), Clarke (1999), Ostrom et al (1993)
Prioritisation given to safety	Berends (1995), Zohar (1980), Fleming (2001), Hudson and Parker (2001), HSE (1999), Schein (2010), Clarke (1999), Ostrom et al (1993)
Communication about safety	Berends (1995), Fleming (2001), Hudson and Parker (2001), Mearns et al (2003), HSE (1999), Schein (2010), Clarke (1999), Ostrom et al (1993)
Effective safety training	Zohar (1980), Fleming (2001), HSE (1999), Schein (2010), Clarke (1999), Ostrom et al (1993)
Involvement and empowerment of employees	Fleming (2001), Hudson and Parker (2001), Mearns et al (2003), HSE (1999), Schein (2010), Clarke (1999), Ostrom et al (1993)
Norms and rules for dealing with risk	Pidgeon (1991), Langford et al (2000)
Arrangements for positive reporting of safety events	Reason (1997), Hudson and Parker (2001)

Table 2.3 Summary literature review of aspects of safety culture

2.4.1.2 Subcultures within organisations

From a study by Fleming (2001) it was identified that there were notable differences between Senior Management and frontline employees' evaluations of their organisation's level of cultural maturity. Managers reported a higher level of cultural maturity than frontline staff. Studies by Budworth (1997), Cox and Cheyne (2000), Lee and Harrison (2000), and Zohar (2000) also support this view where there was both within-group homogeneity and between-group variation in safety-related perceptions at different levels of an organisation. Therefore, it is concluded that specific consideration should be given to the social groups and hierarchy from which interview participants are taken, to provide the most accurate reflection of safety culture maturity.

This is supported further by Parker et al (2006) and Hudson (2007) who found that in large and complex organisations there are often number of sub-organisations which may potentially have their own distinct safety culture. As outlined by Zohar and Gill (2005), organisations are of a social nature which is dependent on management setting policies and procedures, supervisory levels interpreting these requirements into operational practices, and then the workforce performing these operations. Throughout this structure there is opportunity for interpretation and discretion, and therefore it is inevitable that different groups within an organisation implement the policies and procedures in their own way. This in turn fosters an environment where working practices and the associated behaviours are localised to distinctive groups within an organisation. The larger the organisation the greater the variability.

It is widely recognised that safety culture takes time to establish (Parker et al 2006). In relation to a Project Delivery Organisation this is significant; such an organisation is made up of separate companies contracted to work together for a given period of time. Therefore, understanding the complexity and influences on safety culture is important; where individuals are employed by different companies, working under the supervisory direction and managerial policies and procedures not from their employing organisation.

As safety culture is established at company level, therefore the safety culture of each member of the project delivery organisation makes a contribution (either positive or negative) to the project's safety culture and climate Ekvall (1983). Each member company will have varying levels of impact dependent on the size of their organisation and prevailing safety culture, the level of significance given to this project by their company in proportion to their overall turnover and workload, and their respective position in the project social structure. A project safety culture would be derived from a combination of each respective company's culture. Due to the hierarchical nature of a construction project can be expected that the Principal Contractors safety culture would have greater imposition; after all they have the statutory duty to manage and control the safety of construction work, as well as being generally larger organisations.

As already identified, there are several safety culture maturity models which define the levels of organisational maturity against the characteristics listed previously. All such models define their criteria for evaluation of an 'organisation' whether this is at company, divisional or departmental levels. However, a project delivery organisation is made up of numerous organisations, the majority of whom are SME's, thus introducing factors that have the potential to impact on the safety culture of the project, recognised by McDonald and Ryan (1992) and Clarke (1998b).

Risk propensity within organisations is traditionally founded in the scope of operations, the method in which activities are undertaken and the potential for individual error for those carrying out the tasks. The organisational culture can also support or fail to support risk aversion amongst its people (Grabowski et al 2007). However, within a 'virtual' organisation (one which is made up of different organisations temporarily linked together for competitive advantages) such as a Project Delivery Organisation, risk is often transferred between member organisations posing a challenge for robust risk identification, management and mitigation. In particular, it is stated that developing a culture of reliability and shared commitment to goals is difficult. This is supported by studies outlined within section 2.3, where there is often a power relationship and adversarial attitude from Principal Contractors towards their supply Chain, where strength lies with Principal Contractor (Cox and Ireland 2002, Briscoe et al 2001, Hinze and Gambatese 2003, Briscoe and Dainty (2005); plus the nature of commercial contracts and their impact on relationships where the supply chain are largely based on price (Arditi and Chotibhongs 2005, O'Brien et al 2002, Vrijhoef and Koskela 2000); accompanied by a lack of clarity of roles and responsibilities for safety (Arditi and Chotibhongs 2005) and poor communication and co-ordination (Briscoe et al 2001, Briscoe and Dainty 2005). Therefore, developing appropriate leading indicators to measure risk management practices within a Project Delivery Organisation is a challenge; common leading safety indicators alone may not be effective.

At present it is unclear whether existing diagnostic tools consider all of the relevant influencing factors that have the potential to impact on safety culture within a Project Delivery Organisation, which is worthy of further exploration as part of this study.

2.4.1.3 Measuring Safety Culture

Safety culture is an important factor to determine the effectiveness of risk management and control. The relationship between the safety management system and organisational safety culture are intrinsically linked (HSE 2011b), and therefore such aspects should be measured to provide a true indication of safety performance. However, Mohammed (2002) states that the Construction Industry continues to rely on lagging indicators to measure safety performance; with some, but limited research assessing organisational safety culture within the Construction Industry (Grubb and Swanson 1999).

The common approach to measuring safety climate is through perception and attitudinal surveys (Mearns and Flin 1999, Guldenmund 2000). Whereas methods for understanding safety culture are more qualitative, usually

undertaken through observations and interviews (Guldenmund 2000) or through audits and SCHAOP's (Safety Culture HAZOP) (Ludborz 1995, Kennedy 1997). Whilst studies have shown a number of different approaches to measuring safety culture, regardless of the method undertaken, there are a number of common areas that are recommended should be included in any evaluation. Refer to Table 2.3.

Although describing safety culture is well documented in research there is less evidence available to support those who seek to change an organisation's safety culture to improve safety performance (Hudson 2007). Studies by Rochlin et al (1987) and Weick (1987) identify a continuum of safety performance; where there are organisations that demonstrate a highly reliable safety performance and those that are less so i.e. their level of cultural maturity.

According to Westrum (1988, 1991) Parker et al (2006) and Fleming (2001) the existence and effectiveness of an organisation's safety culture can be measured by its safety culture maturity. Early work by Westrum (1988, 1991) identified three levels of safety culture maturity, which was later extended to five levels by Hudson (1991), Parker et al (2006) and Fleming (2001), characterised in the following phrases:

1. Pathological; Who cares about safety as long as we are not caught?
2. Reactive; Safety is important: we do a lot every time we have an accident.
3. Calculative; We have systems in place to manage all hazards.
4. Proactive; We try to anticipate safety problems before they arise.
5. Generative; Safety is how we do business round here.

All studies indicate that there is also a desired foundation level of maturity assumed within these models where the organisational arrangements are compliant with health and safety with an adequate Safety Management System, the purpose of safety is not the avoidance of prosecution but by the desire to prevent accidents, and the root causes of incidents are not predominantly associated with technical failures. In particular Hudson et al (2000) found that some diagnostic tools were only effective at specific times of an organisational cultural maturity.

However, Fleming (2001) states that *'while it is assumed that safety performance improves with increasing levels of maturity, there is no hard evidence to support this assumption. The assumption is based on research that compared high and low accident organisations, which revealed that lower accident organisations tended to display the features associated with higher levels of maturity'*.

These aspects identify three key points; typically, low accident rates are associated with organisations having a more mature safety culture although there is no guarantee of this; there is an assumption that to develop safety culture maturity legal compliance is an established foundation, plus the tools used to measure safety culture maturity are most effective when they are tailored to the organisation and specific circumstances. This is important in the context of this study where evaluating safety culture maturity is component of understanding the organisations safety performance, and therefore these points should be considered relevant.

2.5 Making changes to improve safety

Numerous studies have found that safety performance is affected by the social norm of beliefs and attitudes towards safety within any organisation – its safety culture (Ostrom et al 1993). In organisations with a positive and mature safety culture, the goal is for individuals to be aware of hazards and risks, and what they need to do to keep themselves and their colleagues safe. Weick (1991) describes safety as a dynamic non-event; with safety taken for granted against competing operational demands. Being safe is the absence of an outcome. If there are no accidents or incidents, people don't see anything happening, so they continue to behave in the same manner as before. This is why safety can be misleading as there are numerous factors and inputs necessary to create stable outcomes i.e. no accident or incidents.

Change is often classified as evolutionary/incremental or revolutionary, with evolutionary change reflecting organisational growth and maturity, whereas revolutionary change is associated with developing organisation where the traditional working practices are no longer fit for purpose (Burnes 2004). It is recognised that evolutionary growth takes years (Greiner 1998), opposed to revolutionary change which is characterised by an acceleration in the pace of change (Grundy 1993).

Mullins (2005) states that *'most planned organisational change is triggered by the need to respond to new challenges or opportunities presented by the external environment or in anticipation of the need to respond to future problems'*. Within the Construction Industry there is recognition of the need to improve safety culture and performance by organisations working in the industry (HSE 2015). The suggested more effective methods of managing change are discussed within this section.

2.5.1 Understanding the need to change

Organisational development theory and associated research has been developed over several decades. Lewin (1951) identified that for either an individual or a group to change it needed to understand the pressures present. However, Lewin also recognised that these pressures are inevitably unstable with an individual/group continuously adapting to their environment, and that making any change is often a balance with such factors taken into account. This is supported by other studies; Kotter (1996) developed a model with 8 steps, with 3 specific steps identified as 'creating the climate for change'. Kotter recommends putting the time and effort in before making a change to ensure leaders understand why the change is taking place, what needs to happen to make the change, how quickly it will occur, what could go wrong and plan for this, be realistic about the effort required to change etc. It is also recommended to identify people within organisation who can help promote the positive aspects of the change. When the communication comes from someone within the team, this can be a more powerful method of communicating than a manager 'selling' the change.

Dunphy and Stace (1993) challenge the traditional Organisational Development theory (Lewin 1951, Kotter 1996) stating that traditional approaches to organisational change are not effective for a contemporary organisation. Their model is based on an organisation understanding such contextual factors before embarking on any change process. Therefore, the understanding of such factors is believed to influence the speed of organisational change; incremental or transformational.

Hartley (2002) identified that there are scales to any change; minor or substantial, with the approach to each being different. Once the scope of the change is understood, it is necessary to determine whether the drivers for the change are internal or external to the organisation (as already identified by Herscovitch and Meyer (2002) above. Hartley (2002) suggest a framework for understanding change;

- **Context;** understanding the internal and external influences
- **Leadership and key change agents;** recognising the change skills and competence within the team
- **Management of change process;** strategy and vision of change, engagement of stakeholders, planning and delivering structural and cultural changes, timing and phasing of change
- **Outputs and outcomes;** both intended and unintended consequences of the change

The context is relating to the external and internal pressures, constraints, decisions and opportunities facing the organisation, where it is important for an organisation to understand their position in the wider industry. Time, leadership, designated change agents, availability of resources, and the change vision are seen to be a key consideration for how the change is addressed.

Successful organisational change is dependent on a number of factors, which includes the commitment to and perceived need for change (Burnes 2004, Weiner 2009). Bandura (1997) identified the importance of self-efficacy for achieving specific goals, which was developed further by Weiner (2009) in relation to change efficacy. According to Herscovitch and Meyer (2002) commitment to change can be in three forms; because they want to, they have to or they ought to. The first of these is most powerful level of commitment. Kotter (1996) identifies that many change programmes fail due to the lack of obtaining such commitment, amongst several other considerations. If an organisation perceives that their safety culture is poor they are more likely to be motivated to make improvement, whereas an organisation who perceives that they have an acceptable or good culture can be less likely to focus on making improvement. The temporary nature of a project may also inhibit the level of commitment to change from any member organisation; particularly when cultural change is known to take years.

The study by Dunphy and Stace (1993) also recognises that the need to change is based on perceptions of leaders, managers, supervisors and workforce; some of whom may miss the environmental cues that form the need to change. Refer to Table 2.4. Examples of where these approaches may be suitable within a Project Delivery Organisation are described in Table 2.5.

	Incremental Strategies	Transformational Strategies
Collaborative modes	Participative evolution <i>Use when an organisation is in 'fit' but needs minor adjustment, or is out of fit but time is available and key interest groups favour change</i>	Charismatic transformation <i>Use when an organisation is out of 'fit', there is little time for extensive participation, but there is support for radical change within the organisation</i>
Coercive modes	Forced evolution <i>Use when an organisation is in 'fit' but needs minor adjustment, or is out of fit but time is available; but key interest groups oppose change</i>	Dictatorial transformation <i>Use when an organisation is out of 'fit', there is no time for extensive participation and no support within the organisation for radical change, but radical change is vital to organisational survival and fulfilment of basic mission</i>

Table 2.4 Typology of change strategies and conditions for their use (Dunphy and Stace 1993)

	Example Application for Project Delivery Organisations
Participative evolution	Appropriate for minor changes, for example targeting simple behavioural compliance with safety rules amongst specific work teams from a subcontractor working on a specific project.
Forced evolution	A more substantial change is required where the subcontractor is not aligned to the Principal Contractor safety vision, goals and values.
Charismatic transformation	This can be used to implement change following an accident or incident; participants are responsive to the change being imposed or suggested.
Dictatorial transformation	This is appropriate following periods of sustained poor safety performance with a lack of action and positive output from the subcontractor. A Principal Contractor would often suspend site operations and engage with the Subcontract Senior Management to seek resolution.

Table 2.5 Change strategies within a Project Delivery Organisation

Readiness to change involves all parties being psychologically and behaviourally prepared to take action and be committed to the change for a Project Delivery Organisation. Haslam and Haslam (2000) state that interventions which are matched to an organisations stage of change are more likely to be successful. Within a Project Delivery Organisation each member organisation will have a variable motivation and degrees of commitment to improve safety (want to, have to or ought to); if the whole project safety culture is to improve, each member organisation will need to be motivated and committed to change. Whether or not this is evident can impact on the effectiveness of any organisational change programme.

In relation to initiating change within a Project Delivery Organisation, there are many internal and external contextual factors which could influence the approach taken to implementing a Safety Improvement (change) Programme. Examples of contextual factors are listed in Table 2.6.

External Factors	• Complex social and technical relationships between Client, Regulator and the Project • Project cost and budget • Project programme, key milestones and deliverables • Changes to legislation, and/or regulatory policy
Internal Factors	• Complex social and technical relationships within the Project: off-site Senior Management expectations, project management team (Principal Contractor) and the supply chain • Project vision and goals • Scope of project; complexity Project cost and budget • Project programme, key milestones and deliverables • Organisational competence and resource availability

Table 2.6 Contextual factors influencing change within a Project Delivery Organisation

There are added difficulties for initiating any change programme specifically associated with a Project Delivery Organisation: the perceptions of safety culture of all project members for themselves, other project members and for the project as a whole. Literature has shown that when individuals rate themselves they have a tendency to rate their own safety culture and performance higher than other parties; this is referred to as self-enhancement (Hoorens 1993, Sedikides and Gregg 2008). Self-enhancement is particularly relevant in the context of safety, as it makes people feel good about themselves. This may have an impact within a project environment as Principal Contractors are likely to find it difficult to obtain the necessary commitment to generate changes to improve safety performance when members of the project believe their safety performance is better than it really is.

2.5.2 The Change Process

Changing an organisations safety culture can be challenging and take considerable time; just changing a policy statement is not enough (Vredenburg 2002).

Lewin (1951) identifies three stages to change; unfreezing, changing, refreezing; firstly, understanding the performance gap, secondly making the change and finally ensuring the change is implemented. This model of change involves eliminating 'old' behaviour, processes and culture in order to successfully adopt new approaches (Bamford and Forrester 2003). This is believed to be an effective approach for planned change within a traditional organisation, but less so for continuous change (Weick and Quinn 1999).

In the next stage of Kotter's model (1996) he identifies another 3 steps for engaging the entire organisation. In this stage he recommends communicating the change plan to the whole team. There are similarities in this approach and those detailed by Kanter et al (1992) Ten Commandments for Executing Change, and Luecke's (2003) suggested Seven Steps. Clear and concise communication, backed up with the right things being done the first time, builds trust and clarity and makes change easier for everyone involved. It is important to recognise that not everyone will welcome the changes and often people react differently. Organisations who are more successful at managing change effectively should be aware of this, and listen to why the change is a problem; use this resistance to help promote communication and understanding. Providing training is important to support everyone with the correct skills for working through and with the change. It is also important to allow time for everyone to adapt and give ample opportunities for individuals experience what the changes will bring. Finally, in order to sustain any change Kotter (1996) recommends celebrating success. By celebrating the achievement, the organisation will establish a track record of success: making things easier the next time change is needed. This poses a particular problem for a Project Delivery Organisation whom collectively have no track record; the track record is as individuals and individual companies and not the members of the whole project. Therefore, how can change be maintained where it is difficult to identify and subsequently celebrate successful changes in safety performance?

Studies which evaluate successful organisational change (Hartley 2002) identify the importance of changes in attitudes, behaviours and the organisations ability to learn for any change to be sustainable over the long term. In addition to attitudes and behaviours, organisational learning is therefore considered to be a primary aspect of organisational change (Argyris and Achon 1996, Weick 1996) with arrangements for continual information gathering communicating and learning so that changes (or lack of changes) can be identified, evaluated and appropriate actions taken.

In a study Bullock and Batten (1985) decades of organisational development theory and models were reviewed; the output of which was a four-stage approach to managing change; *exploration, planning, action, and integration*. *The model identifies processes for organisation's to move from one state of change to another. Burnes (2004) supports this approach and being highly applicable to most change scenarios, but is not wholly suitable for rapid transformational change (such as following an accident or incident) and relies on the environmental conditions being stable and participants being willing* (Bamford and Forrester 2003). As already identified, one of the characteristics

of a Project Delivery Organisation is being dynamic with uncertainty regarding the level of commitment from all supply chain members across the project, therefore questioning the validity of such an approach within this sector of industry.

On one hand the traditional approach may be an appropriate framework for implementing a planned safety improvement programme, but may have limitations regarding the nature of complex organisations such as a Project Delivery Organisation.

In response to the challenges recognised within the planned approach to change, the emergent approach has gained momentum. The emergent approach is less reliant on senior management leading the change, and more engendered from the workforce – a bottom up approach (Bamford and Forrester 2003, Burnes 2004). It is widely recognised that individuals and groups are all likely to have a different reaction to change (Kotter 1996). During a period of change within an organisation, some will embrace changes and the opportunity to do something different almost immediately, but there will be others who, as soon as a change is announced, dig their heels in, complain about it, resist any kind of movement and will not see anything positive in the change. Hence, often the introduction of change leads to conflict. Taking the principles of an emergent approach whether responsibility for change is widespread across the organisation; this could result in two outcomes. Firstly, the change is perceived to be of personal interest (aligned to individual accountability and responsibility) and therefore embraced and effectively deployed; or secondly essential clarity over who is making the change happen is lost, and therefore the change is not effectively implemented. This is of particular relevance within a Project Delivery Organisation where it is stated that clarity of roles and responsibilities between members is poor Arditi and Chotibhongs (2005).

Change is viewed as a continuous process of adaption to ever changing contextual factors (Burnes 2004, Dawson 1994). Such rapid change is a challenge for management to effectively implement and control and therefore responsibilities for the effective application of change programme has become increasingly devolved (Wilson 1992). Mindful of the ever changing nature of a construction project, taking forward this approach is an important consideration for Principal Contractors who wish to implement a safety improvement programme within a project environment. However, the models to support those taking an emergent approach are less cohesive than the more established planned approach to change. It could be considered that a Project Delivery Organisation may need to combine both the planned and emergent approaches within their safety improvement programme and the associated

change strategy dependent on the type and context of the change being planned; this is supported by Dunphy and Stace (1993) who argue that *'managers and consultants need a model of change that indicates how to vary change strategies to achieve optimum fit with the changing environment'*.

For leaders of organisations, managing change is an important strategic task. Balogun and Hope Hailey (2004) identify that less than 30% of change initiatives are successful; either the objectives of the project are not achieved or the projects cannot be completed in time or on budget. This may be a reflection of the unclear, inconsistent and contradictory approaches identified within the literature; none of which take specific account of challenges facing complex quasi-organisations.

2.5.3 Successful Safety Improvement Programmes

What is clear from the research on organisational development and change management is that there are defined approaches for establishing a safety improvement programme; although none of these take specific cognisance of the challenges within a Project Delivery Organisation.

A Safety Improvement Programme (an example of change management) is a wide term for any activity focused on changing workplace behaviours that cause (or are believed to cause) accidents. Whilst there are a number of different Safety Improvement Programmes, many of them have similar principles; focusing on improving behaviours and safety culture for the elements listed below (Fleming and Lardner 2001, Vredenburg 2002).

- Visible safety leadership where senior management show their commitment to safety;
- Two-way communication throughout the organisation, and a means for obtaining feedback from the workforce;
- Engagement, involvement and inclusion of everyone in safety decision making;
- Peer observation of working practices to identify safe and unsafe behaviours during specific tasks;
- Use of coaches to promote good safety behaviour in the workplace;
- Assessment of safety culture or climate through use of attitude and perception surveys;
- Awareness training of psychological principles that describe how and why people behave in particular ways;
- Accident investigation techniques involving human factors, undertaken in a manner which avoids a desire to attribute blame.

There have been a number of papers reviewing and comparing such programmes across a breadth of industries. Whilst all of the research states that there is no one way of achieving behavioural change, they consider that using behavioural safety techniques help improve safety performance (Fleming and Lardner 2001) although no study has yet quantified its impact (Sulzer-Azaroff and Austin 2000). Some of these programmes are focused on Senior Management, others on the workforce. However there has been limited research undertaken to assess the effectiveness of behavioural safety within the UK Construction Industry (Marsh et al 1995, Duff et al 1993), although there have been studies in other countries (Glendon and Litherland 2001, and Mohammed 2002). Few studies address the impact of SME's on safety behaviour within UK construction, nor provide information the most effective approaches to take (Wirth and Sigurdur 2008). None of these studies directly identify the best approach to take to implementing such a change, being more focused on technical content of the programme. However, there were some lessons throughout these studies, as outlined in Table 2.7. It is recommended that consideration is given to these aspects for any Safety Improvement Programme, prior to any implementation.

Lesson	Source
Programmes are less successful if one-off or short-term interventions applied.	Dejoy (2005)
Programmes are more successful when leaders are perceived to be committed to safety.	Hopkins (2006), Fleming and Lardner (2001)
The organisation needs to be ready for the change.	Fleming and Lardner (2001)
Communication is a key element.	Cohen (1977), Pate-Cornell (1990)
Negative trigger events such as accidents is often a powerful catalyst.	March et al (1991), Edmondson (1996)
Perceived value of the intervention can help or hinder commitment to the change.	Fleming and Lardner (2001)
Understanding how does the planned change impact/interface with other initiatives	Fleming and Lardner (2001)
Change often viewed as imposition due to lack of engagement leading to resistance to the change.	Fleming and Lardner (2001)
Engagement plan required for the development and implementation, refinement of the programme.	Fleming and Lardner (2001)
Measurement targets could lead to unintended consequences as well as intended ones.	Fleming and Lardner (2001)
Focus should be on management behaviours and not just the workforce.	Hopkins (2006)
Programme should cover engineering, system and behavioural aspects.	Hopkins (2006)

Each application needs to be specific and tailored to the setting in question.	Dejoy (2005)
There must be trust between workers and management to share trust.	Krause (1997), Flin et al (2000), McAllister (1995)

Table 2.7 Summary of lessons for effective change management when implementing a safety improvement programme

In addition to the obstacles in effective change management, the industry characteristics of creating Project Delivery Organisations' based on outsourcing, indicate that there are many challenges to be tackled for Safety Improvement Programmes to be effective. The temporary nature of the construction project is an important consideration for developing safety culture through an improvement programme, as the existing research refers to safety culture maturity taking several years to develop (Cooper 2001, Greiner 1998). Across the industry there are some projects that will last several weeks or months, and others that last for years. Therefore, how relevant is the existing research for a Principal Contractor to consider when implementing their safety improvement strategies (a change programme)? Are there any transferable lessons that can be applied to how a change programme is implemented as well as the technical programme contents, within a temporary quasi-organisation – a construction project?

2.5.3.1 Role of Leadership

Hopkins (2006) and Fleming and Lardner (2001) identify that change programmes tend to be more successful when leaders are fully committed. Allocation of budgets, direct and indirect decisions that impact on safety, priorities, working practices and behaviours of leaders affect a host of organisational outcomes, including safety.

When change programmes are deployed, they often require personal change from individuals working throughout the organisation; senior management to the workforce.

“When a leader visits the workplace, they see the behaviours of their own people but they also see, reflected in their people, their own behaviours. That sums it up for me”. BP Manager quoted by Hopkins (2006)

According to Krause (1997) and Petersen (1999) critical leadership orientated success factors include:

- the extent of any trust-based relationship between management and workers

- the perception that leaders are committed to safety and to change
- visibility and proactive engagement and involvement of the workforce in safety related decisions
- resources allocated to develop and implement robust and effective risk controls through safety management systems and associated arrangements

It is considered that without the right leadership in place any change programmes are likely to fail.

2.6 Leadership

2.6.1 What is leadership?

There has been much research into organisational leadership since the 1950's, with a number of different definitions deriving from these studies, as selection of which are listed below:

Leadership is the process of influencing the activities of an individual or a group in efforts toward goal achievement in a given situation. (Hersey and Blanchard 1988)

Leadership is an interaction between two or more members of a group that often involves a structuring or restructuring of the situation and the perceptions and expectations of members...Leadership occurs when one group member modifies the motivation or competencies of others in the group. Any member of the group can exhibit some amount of leadership... (Bass 1990)

Leadership is that process in which one person sets the purpose or direction for one or more other persons and gets them to move along together with him or her and with each other in that direction with competence and full commitment. (Jaques and Clement 1994)

Leadership is a process of social influence that is enacted by individuals in formal positions of power or leadership positions within an organisation, such as managers and supervisors (Kelloway and Barling 2010)

In addition to leaders having an impact, either positive or negative, on the effectiveness of safety improvement programmes (Hopkins 2006, Fleming and Lardner 2001), a study by Kotter and Heskett (1992) indicated that organisational leadership is a key factor in organisational climate and

organisational performance; better leadership results in a more positive climate and therefore excellent performance. These concepts were developed further in the 1990's where a number of studies considered the relationship between management behaviours (leadership) and safety outcomes. Such studies found that organisations in which leaders take an active role in promoting occupational safety show lower accident rates and therefore better safety performance (Hofmann et al 1995, Shannon et al 1997, Zohar 1980). One component part has repeatedly identified as vital in order for any improvement in safety culture; this is safety leadership (O'Dea and Flin 2001, Zohar 2002). Therefore, this study focuses on leadership and the impact on safety. Further literature review was undertaken to gain greater understanding of safety leadership.

2.6.2 What is safety leadership?

Safety leadership is *'the process of interaction between leaders and followers, through which leaders could exert their influence on followers to achieve organizational safety goals under the circumstances of organizational and individual factors'* (Wu 2005). It is recognised that managers and supervisors have an effect on workers' behaviours, reinforcing the creation of organisational norms for working practices and procedures. This creates a particular safety culture. Leaders actions influence workers' expectations and motivation, thus influencing the likelihood of particular behaviours being repeated or suppressed; where unsafe or at risk behaviours are more likely to result in injuries to workers (Zohar 2002, Zohar and Luria 2003, Flin and Yule 2004).

Existing research identifies that leaders have control and influence over many factors that affect safety culture. Of all the elements that contribute to successful safety management, the safety commitment and action of leaders is the most important. Developing a positive safety climate therefore requires management to visibly demonstrate their clear commitment and action on a regular basis (Wu et al 2008). Safety leadership is demonstrated where leaders take their safety responsibilities seriously and lead by example to establish and reinforce expectations for peers and colleagues through effective downward communication systems, and integration of safety in company-wide decision making. Employee participation and feedback is actively sought. A strong safety leader demonstrates emotional intelligence and proactive relationship management. (Gadd and Collins 2002, Clarke and Flitcroft 2013, Cooper 2000, Farrington-Darby et al 2005, Simard and Marchand 1995, Sawacha et al 1999, O'Dea and Flin 2001, McCabe 2002, Floyd and Wooldridge 1997, Vredenburg 2002, Zohar 2002, CIOB 2008).

When a leader influences others to act on their beliefs, the group develops a shared perception of success (Schein 2010). This becomes sustainable when individuals continue to value the outcomes as successful. In relation to safety this demonstrates the importance of having a safety vision and goals which are aligned to wider corporate objectives (Clarke and Flitcroft 2013, Conchie and Moon 2010, Cooper 2000, Farrington-Darby et al 2005) with leaders' role focused on providing the energy, time and resources to realise the vision and associated safety goals (Gadd and Collins 2002, Clarke and Flitcroft 2013). A study by Cooper (2000) identified that achieving such goals was reliant on the organisation developing new behavioural norms that would deliver the safety vision and goals.

Once a safety vision is established success is dependent on leaders actively monitoring performance and taking action as appropriate, for both individual safety performance and organisational safety performance. At an individual level prompt feedback on safety performance (good and bad) should be undertaken (Vredenburg 2002), which is important for the reinforcement of behaviours. In particular prompt feedback following reports of safety concerns (e.g. near miss reporting) would support further hazard reporting (Gadd and Collins 2002, Vredenburg 2002). Organisations with a positive safety culture also include safety performance within individual appraisals and personal performance reviews (Clarke and Flitcroft 2013, McCabe 2002). At an organisational level leadership activity should include the use of safety performance data to inform ongoing improvement strategies (Sawacha et al 1999, Gadd and Collins 2002), and include the communication of safety-related lessons learned (Gadd and Collins 2002, Vredenburg 2002).

Leadership commitment towards the company safety management system and competence management system prove to be enablers for a positive safety culture. However, this can be compensated by the leaders' imposed (intentional or unintentional) pressure to deliver work and 'get the job done' (Clarke and Flitcroft 2013, Zohar 2002, Vredenburg 2002).

Research also identifies the importance of safety leadership at two levels; Senior Management (those with the authority at the top of the organisation) and front-line supervisors. The day to day opportunities for each of these groups to demonstrate their commitment to safety is different; based on their roles and day to day responsibilities (Thompson et al 1998, Marsh et al 1998). For example, a Senior Manager would demonstrate commitment through setting safety performance goals, and providing the resources to deliver these (for example people, funds and time for training etc) (Isla Díaz and Díaz Cabrera 1997). By comparison a Supervisor would demonstrate commitment by

ensuring the workforce are involved in safety decision making, and prioritising safety above production (Andriessen 1978).

O'Dea and Flin (2001) undertook a study to investigate the relationship between manager's experience and style of leadership with their safety attitudes and behaviour, as well as manager's perceptions of best practices in safety leadership. The study found that experience was not the dominant factor in determining leadership style or attitudes to safety. In addition, although managers are aware of best practice in safety leadership, they did not always act in ways consistent with this. Specific challenges that were reported include controlling safety critical workforce behaviours; reporting of near misses and taking responsibility for safety.

A study by Lekka and Healey (2012) supports wider research findings that have consistently shown that:

- Management commitment to safety is associated with a reduction in risk-taking behaviours and learning from safety events
- Where enforcement of safety procedures is associated with lower levels of incident under-reporting
- Leader's openness to safety suggestions is associated with higher levels of employee willingness to raise safety issues
- Safety communication between management and the workforce is associated with the promotion of positive safety behaviours and a reduction in the levels of risk-taking behaviours
- Active involvement in safety promotes a positive safety climate with increased levels of employee accountability and responsibility for safety

It can be concluded that leaders' commitment to safety and their subsequent actions, at both managerial and supervisory levels does have an impact on safety culture and performance. Poor safety leadership can also have a significant impact on the organisation's safety culture and performance but in a negative way, just as positive safety leadership is powerful. Therefore, if an organisation is seeking to improve safety it would be beneficial to understand what good safety leadership looks like to ensure that any necessary improvements are made in this critical area.

2.6.3 Leadership Styles

Extensive research has been undertaken on leadership behaviour since the 1930s, Table 2.8 shows a summary of this research. Note these theories are not solely applicable to safety.

Approach	References	Summary	Approach Strengths and Limitations
Trait	Zaccaro (2007)	Leaders are 'born' rather than made; focus is on innate characteristics and abilities that distinguish effective from non-effective leaders	• Simplistic view of leadership and the applicability across numerous situations and contexts • It is not possible to train individuals to become leaders • Limited studies showing application to safety
Behavioural	Yukl and Van Fleet (1992)	Focus on leader behaviour, with emphasis on task-oriented and relationship-oriented leadership behaviours	• Focus on what good leaders do • Two aspects (task or relationship focused) and need to balance both aspects • Fails to identify relationships between task and relationship behaviours and performance
Contingency	House and Mitchell (1974) Hersey and Blanchard (1988)	Leader effectiveness depends on the context; different leadership styles will be best suited in different situations	• Matches specific leadership styles to particular situations • Highly complex theories which lack practical value for managers • Limited studies showing application to safety
Leader-Member Exchange	Graen and Cashman (1975)	Leaders develop different relationships with different subordinates	• Accurately depicts how leader-member relationships actually function in the workplace • Evidence of support in context of safety • Reliance upon existing high-quality leadership skills, lacking advice on how to develop these
Transformational / Transactional	Burns (1978) Bass and Bass (2008)	Focus on leader vision and ability to inspire followers (transformational); leader clarifies performance criteria and rewards subordinates for meeting performance expectations (transactional).	• Includes a realistic interaction between leaders and followers • Strong evidence to support in the context of safety • Lacks guidance between the four key aspects of transformational leadership for ease of real-world application
Passive	Kelloway et al (2006)	Leaders turning a blind eye to safety, lack visible commitment and communication for safety and are inconsistent in their priorities (safety versus productivity).	• Negative impact of safety climate • Associated with an increase in safety related events and injuries

Table 2.8 Summary of leadership research

Transformational and transactional theories have considerable consistent support in the literature suggesting that they are effective approaches for the management of safety and are also crucial for the development of a positive safety culture (Lekka and Healey 2012). Therefore, this study focuses on transformational and transactional leadership in relation to safety and improving safety performance within a project delivery organisation.

2.6.4 Transactional and Transformational Leadership

The transactional leader creates clear expectations for what is required of their subordinates, with the associated rewards for compliance, or punishments (e.g. discipline), or rewards that are contingent upon performance. They are less concerned with inspiring employees or attending to their individual needs. By comparison the transformational leader seeks to transform an organisation by motivating and inspiring others, acting as role models, inspiring and challenging individuals. Several studies have found that transformational leadership is more often associated with a greater number of positive outcomes, including employee empowerment, increased organisational commitment, and improved performance (Howell and Avolio 1993, Avolio 1999, Bass et al 2003). Nonetheless, transactional and transformational leadership are often linked. Initial studies considered that transactional and transformational leadership were mutually exclusive, however more recent studies by Bass (1985) consider the approaches to be a continuum rather than opposites. Studies have found that transformational leadership in isolation is unlikely to be effective without a transactional relationship between leaders and subordinates. Each style is described in the following sections.

2.6.4.1 Transactional Leadership

According to Bass and Bass (2008) Transactional leadership is made up of three elements:

- **Contingent reward** – when leaders and followers agree activities, establish performance standards and the associated rewards. When the agreed performance has been achieved followers are rewarded
- **Active management by exception** – when leaders proactively monitor followers' behaviours and take action as appropriate before problems occur i.e. praise for good behaviour, discipline or disapproval for poor behaviours
- **Passive management by exception** – when leaders only react to performance issues once they have occurred

Zohar (2002) identifies that transactional leadership is typically associated with supervisors and supervisory duties; getting people to work effectively at delivering designated tasks i.e. focused on reliable performance. Effective supervisors monitor work in progress, particularly through work sampling (i.e., direct observation), and act accordingly providing timely consequences for both safe and at-risk behaviours as part of their daily routine (Komaki 1998, Zohar 2002). However, there can be a conflict between safety and work, when the work pressure increases a supervisor will adjust priorities depending on a multitude of internal (e.g. beliefs) and external (e.g. expectation from superiors) factors. Therefore, increased supervisory monitoring of safety performance may not improve safety behaviour due to inconsistent messages and enforcement.

In relation to real-world application this can be translated into the following transactional leadership practices as detailed in Table 2.9.

Transactional Safety Leadership Behaviour	References
Leaders demonstrate a fair and consistent response to incidents and undesirable behaviour	(Zohar 2002) (Conchie and Moon 2010) (McCabe 2002)
Leaders response to rule violations is consistent and they do not tolerate or accept such behaviours	(Gadd and Collins 2002) (McCabe 2002)
Leaders undertake and ensure that there is effective monitoring, reinforcement of desirable behaviours and reward in relation to good safety performance	Zohar 2002) (Conchie and Moon 2010) (McCabe 2002) (Vredenburg 2002) (O'Dea and Flin 2001)
Leaders implement a process of behavioural observations	(Gadd and Collins 2002)

Table 2.9 Summary of transactional safety leadership behaviour's in real world context

Studies by Zohar (2002), Zohar and Luria (2003) and Luria et al (2008) identified benefits of transactional leadership for reducing accident rates, improved safety behaviour and improved perceptions of safety climate. The studies, focused on supervisory roles, identified that a transactional approach is more effective when followers are easily monitored, and supervisors are more visible. The increase in interactions between supervisors and follower's improved safety behaviour.

2.6.4.2 Transformational Leadership

Each of the four components of transformational leadership is relevant to enhancing occupational safety (Barling et al 2002, Barling et al 1996, Pillai et al 1999). The four transformational leadership factors are:

- **Idealised influence** - The emphasis is on leaders becoming role models by doing what is moral or right rather than what is expedient, which encourages individuals to shift their focus away from short-term productivity goals towards improved safety performance. Leaders who are high in idealised influence convey safety as a core value through their own personal commitment, resulting in followers having higher levels of trust in management which is critical for subsequent performance.
- **Inspirational motivation** - Leaders manifest inspirational motivation when they challenge followers to perform beyond their individual needs, for the collective good of the wider organisation. They convince followers that higher safety standards can be achieved.
- **Intellectual stimulation** - Leaders challenge their followers to confront personal assumptions about safety (e.g. accidents are not preventable) and motivate them to think differently to improve safety. This results in safety risks issues being addressed and enhanced information sharing.
- **Individualised consideration** - Leaders demonstrate importance of relationships by showing an active interest in their followers' well-being and personal safety. Leaders' seek to develop practices beyond minimum statutory compliance requirements.

In relation to real-world application this can be translated into the following transformational leadership practices and detailed in Table 2.10.

Transformational Safety Leadership Behaviour	References
Increased visibility of leaders amongst workforce, in relation to routine operations and not purely in response to an accident or incident	(Gadd and Collins 2002) (Conchie and Moon 2010) (Conchie and Moon 2010) (McCabe 2002) (Simard and Marchand 1995) (Sawacha et al 1999) (O'Dea and Flin 2001)
Leaders demonstrate observable role model behaviour consistently in the context of safety e.g. wearing appropriate personal protective equipment, adherence to safety rules and stopping any at risk behaviours	(McCabe 2002)

Leaders communicate the organisations safety vision and values so that all persons understand the motivation and can commit to achieving improved safety performance	(McCabe 2002) (Sawacha et al 1999) (Floyd and Wooldridge 1997) (O'Dea and Flin 2001)
Leaders ensure sufficient participation in safety committees where performance is discussed, actions identified, and feedback given	(Gadd and Collins 2002) (Vredenburg 2002) (O'Dea and Flin 2001)
Leaders create an environment where it is acceptable for individuals and groups to challenge previous assumptions in relation to safety i.e. move their tolerability of risk	(Clarke and Flitcroft 2013)
Leaders proactively encourage the reporting of safety concerns and ensure prompt action and feedback	(Clarke and Flitcroft 2013) (O'Dea and Flin 2001)

Table 2.10 Summary of transformational safety leadership behaviour's in real world context

There are four studies which highlight the relationship between transformational leadership and safety performance.

The study by Innes et al (2010) considered supervisor transformational leadership and employee safety performance. The findings showed a positive relationship between transformational leadership and safety participation but not improved compliance with safety requirements.

A study by Mullen and Kelloway (2009) examined the impact of transformational leadership training interventions on safety outcomes. Results showed that individuals who attended safety-specific transformational leadership training had improved safety attitudes and higher levels of self-efficacy in promoting safety compared to control groups.

Clarke and Flitcroft (2008) assessed the impact of transformational leadership on employee perceptions of safety climate. The study involved enhancing managers' leadership skills and safety-related knowledge. The results showed a positive association between transformational leadership and employee perceptions of safety climate.

Conchie and Donald (2009) examined the impact of transformational leadership on group behaviour with specific consideration of trust. The results showed that safety-specific trust reduced the reliance on transformational leadership behaviours. Employees were more likely to engage in group behaviour when there were high levels of trust with the leader. However, this positive relationship and influence reduces when trust is weakened.

The majority of research shows the positive impact of transformational leadership, however a study by Maner and Mead (2009) identified that leaders can sometimes abuse their power and influence to meet personal goals. Their work showed that leaders with tendency to use power to control others were more likely to retain information from followers which excluded some individuals and negatively impacted on overall group performance.

2.6.5 Safety Leadership in the Construction Industry

The Construction Industry recognises the lack of leadership across the industry (CIOB 2008). In 2008, the Chartered Institute of Building (CIOB) surveyed 655 construction professionals, and found that there was a need to '*reassess the leadership qualities and skills required by the Construction Industry*'.

In relation to a Project Delivery Organisation, and the respective companies involved in delivering a project, there are a number of different individuals who would need to demonstrate positive safety leadership behaviours; Senior Management from both the Principal Contractor and second and third tier subcontractors, plus Supervisors from both the Principal Contractor and second and third tier subcontractors. It is worth noting that the individual contribution and time spent on the project may be variable.

Figure 2.4 summarises the typical leadership activities (both transactional and transformational) that individuals performing roles at a number of different levels may undertake when working within a Project Delivery Organisation. Therefore, any safety improvement programme focusing on leadership, should address the leadership behaviours required from all of these individuals who are involved in a Project Delivery Organisation (Conchie and Moon 2010).



Figure 2.4 Transactional and Transformational leadership for different roles within a Construction Project
(adapted from Flin and Yule 2004)

Within the Construction Industry, a range of organisational factors that have been shown to influence leadership are listed below.

- Role demands:** overload and conflict from excessive work demands, associated with a reduction in safety behaviours and safe outcomes (Hofmann and Stetzer 1996). As already stated earlier, there is often a lack of role clarity and communication with a Project Delivery Organisation, particularly between the Principal Contractor and the Supply Chain. This can increase role conflict between individuals from different organisations working on a particular project where safety responsibilities and duties are not clearly defined or understood. At a supervisory level this can have a significant impact on safety where individuals are distracted from supervisory activities and monitoring safe project delivery.

In addition, there are likely to be increased role demands from off the project; parent companies (the direct employer) making requests for information, time and resource to fulfil off site demands. One example of this would be a supervisor being requested to leave a particular site to visit the next project (yet to start) and undertake a reconnaissance visit, support a tender opportunity or attend a client meeting; thus leaving his supervisory duties on the current project. Even if the individual did not leave site, there are increased demands placed on individuals. Conchie and Moon (2010) undertook a study within the construction industry to better understand the antecedents associated with active safety leadership. The study found that supervisors who demonstrate active safety leadership were found in organisations with better safety. It is also stated that active safety leadership is often a balance between job resources (e.g. colleague support, role autonomy) and job demands (e.g. organisational constraints). When job demands are high and job resources are low, supervisors are less likely to engage in active safety leadership than when the opposite situation exists (Hofmann and Stetzer 1996).

- **Situational constraints:** characteristics of the workplace that are beyond an individual's control, but directly affect their safety performance; poor equipment, interruptions and delays, and incorrect or insufficient information (Peters and O'Connor 1980). There are many factors that affect the safe and efficient delivery of a project; lack of approved for construction design drawings, changes to design and construction methods, physical constraints at site and unplanned obstructions, the impact of undesirable weather are all typical examples of situational constraints.

Each of these can have an impact on safety due to management refocus attention on resolving such issues; affecting time spent on safety matters, reduced visibility on site engaging with the workforce, increased pressure and role demands.

- **Organisational support:** management support for safety is believed to facilitate active safety leadership among supervisors (Tucker et al 2008, Scandura and Lankau 1996). The relationship between project management staff and the supervisory levels on any project are vitally important. Supervisors are the 'eyes and ears' of the management team, their role purpose is to make sure that the project is delivered safely, on time and in budget. Supervisors have real world insight into how the project is actually being delivered, and whether the workforce are behaving safely; something that the project management team are heavily reliant upon. Therefore, if

there is a lack of trust and collaboration between project management and supervisors there is often a negative impact on safety; supervisors may work against the wishes of the project management team, and turn a blind eye to unsafe practices.

- **Subcultures:** employees' attitudes and values often differ widely within organisations i.e. subcontract and migrant workforce are known areas of difference, within the UK Construction Industry (Martin 1992). In organisations, such as a construction project, where individuals from a multitude of different backgrounds are required to work together, there is an understanding that there will be a difference in culture and approach.

Bryman et al (1988) undertook a study within the UK Construction Industry to explore management leadership styles. The findings were that safety leadership is affected by the employing company and length of tenure; directive management styles were adopted with subcontract workforce, as managers perceived that they had less personal control in this area i.e. less trust and confidence in their relationships. This differed to the style used with those employed by the Principal Contractor, where managers adopted more active styles of leadership being more focused on motivation and participation. This is understandable as subcultures within the supply chain (subcontract and agency workforce) have already been identified as having an impact on leadership behaviours. This is likely to be attributed to the different organisational factors that affect leadership and the wider characteristics within the industry.

The challenge (and opportunity) for improving safety to how these different subcultures can be aligned promptly to the project-specific vision for safe and effective delivery. Change management studies do not recommend ignorance as the best approach, and therefore leaders need to recognise different cultures and approaches within the whole project organisation, where there is a positive approach to safety and where there is a more negative stance. As already stated individual behaviours can be affected by safety culture, and therefore to promote safe outcomes, it is necessary to address the cultural precursors that lead to unsafe practices, and an acceptance that this is the norm.

- **Distance and contact:** leadership behaviours may be influenced by the physical distance and frequency of contact between supervisors and employees with increased visibility increasing the positive exchanges achieved (Luria et al 2008, Hannah et al 2009). Not all construction projects are on static sites. The infrastructure engineering and utilities sectors of the

Construction Industry are typically transient in nature, sometimes spread out over several miles. It is known that reduced visibility of supervisors and leaders has a negative impact on safe behaviour due to a weaker trust based relationship with the workforce; a particular challenge to provide the right level of supervision across a widespread location when the industry has a shortage of resources. There are just not enough people available with enough time to spend on site with the whole workforce building up relationships. This is exacerbated with reliance on a transient and agency workforce.

- **Power relationship:** The contractual relationships between organisations working on a construction project have an important influence on who holds the power within the relationship. On one hand the Principal Contractor is expected to hold the power as they contract through the procurement selection process with supply chain organisations (Cox and Ireland 2002, Briscoe et al 2001, Hinze and Gambatese 2003, Briscoe and Dainty 2005); leaders from the Principal Contractor's organisation use this 'power' to positively influence the organisations safety performance through the application of transactional and transformational techniques. However, if the Principal Contractors leadership team may exert a passive leadership style which would have a negative impact on safety performance outcomes.

On the other hand, there may be occasions where the supply chain holds more power over the Principal Contractor, particularly if the organisation is highly specialist and there is limited competition within that service/product provision. Another example may be when the supply chain organisation or their employees are only attending the project for a short period of time. On these occasions the Principal Contractors influence over safety performance may be greatly reduced and therefore there is greater reliance on the prevailing approach to leadership within the supply chain.

It can be concluded that the organisational factors that impact on leadership, are prevalent within Project Delivery Organisations; and it could be expected that safety leadership is not as well established in the Construction Industry as one would hope from an appreciation of the wealth of literature in this area.

2.7 Influencing Factors

A Project Delivery Organisation is established with a number of companies co-ordinated via contractual obligations, for a determined period of time. Across

all areas of the literature review a number of influencing factors have been identified as being particularly relevant to a Project Delivery Organisation. Each of these are identified below.

- **Client expectations and requirements:** The goals and expectations of the Client will be transferred to the Project Delivery Organisation (Bednarz 2016). Therefore, the Principal Contractor's Project Management Team will cascade these into their project delivery as key measures of success. If a Client places a priority on safety, then this will be reflected in the project safety performance. However, if programme or commercial matters are of greater importance, these will have a negative on project safety performance with less attention given to safety in comparison with saving time and/or capital expense (Bresnen and Marshall 2000a, 2000b).
- **Safety management systems:** Where an organisation has formal safety management systems that are accredited and certified to meet an international or national standard, it can be assumed that a foundation of processes, procedures and competence are in place (as these are a requirement of the international and national standards framework) i.e. there are suitable risk management arrangements deployed within an organisation which results in a positive impact on safety performance. However, where there is a lack of formal safety management systems, there is less certainty over the effectiveness of risk management controls that prevent people being exposed to potential harm (Walters and James 2009). The vast majority of Project Delivery Organisations work to the safety management system of the Principal Contractor, which will not necessarily be the same set of policies, procedures and working arrangements as the second and third tier subcontractors working on the same project (Winkler and Irwin 2003). A lack of familiarity and consistency can negatively impact on safety performance.
- **Contractorisation:** With the prevalence of using subcontractors to deliver specialist works on a construction project, a project's safety culture would be derived from a combination of each respective company's culture (Walters and James 2009). Due to the hierarchical nature of a construction project it is more likely that the Principal Contractors safety culture would have greater imposition; after all they have the statutory duty to manage and control the safety of construction work. However, this may be affected either positively or negatively, by the behaviours of the subcontract and agency workforce, which are in turn influenced by their employers prevailing safety culture (HSE 2012).

- **Duration of project:** Research identifies that a positive safety culture indicates higher levels of safety performance, but that developing safety culture maturity takes time (Parker et al 2006). Projects are a temporary endeavour with organisations working together for a specified period of time; therefore, a project with a shorter duration may not have the necessary time to develop its safety culture, and safety performance may be affected as a result.
- **Peripatetic workforce:** The industry's workforce tends to move from project to project, as frequently as every 6 weeks on average (REC 2002). This is an important consideration for safety; frequent movement between projects will result in individuals working to different safety management arrangements and standards contributing to confusion and inconsistency in levels of compliance i.e. increased risk of harm (Forde 2001, Eurlex 2005). When this is accompanied by a reliance on agency labour to resource peaks in workload and demand, the risks increase further; agency labour tend to receive limited safety training, supervision and support on safety matters (Allan 1998).
- **Size of organisation:** SMEs have a tendency for higher accident rates, indicative of poor safety performance (Walters and James 2009, HSE 2003). Typical characteristics of SMEs include; less financial security which impacts on money allocated to safety e.g. resources, training, investment in safety equipment etc; a lack of full time and/or internal health and safety personnel appointed by the company resulting in a reduced awareness of safety requirements and a lack of ownership and leadership to improve safety; and informal safety arrangements as opposed to formal safety management systems, which directs the management of safety throughout day to day operations.
- **Investment in project as a proportion of turnover:** As safety culture is established at company level, the safety culture of each member of the project delivery organisation makes a contribution (either positive or negative) to the projects safety culture and climate. Each member company will have varying levels of impact dependent on the level of significance given to this project by their company in proportion to their overall turnover and workload.
- **Contractual relationships:** The type of contract between the Client and Principal Contractor, and the Principal Contractor and Supply Chain can have an impact on safety priorities. Lump sum or fixed price contracts are often incentivised for early completion of works, this increases the

management focus on programme above safety, and is likely to lead to a culture of taking short cuts. By comparison, cost plus contracts involves costs actually being paid based on work completed, resource and material usage; there is less risk to the contracted entity and therefore any additional safety requirements would usually be paid for (O'Brien et al 2002, Vrijhoef and Koskela 2000, Arditi and Chotibhongs 2005).

- **Project safety accountabilities, communication and co-ordination:** As a project structures, interfaces, roles and responsibilities are spread across the project member organisations, there is often a diffusion of accountability for safety. This may result in safety management arrangements not being consistently or effectively deployed, or even overlooked; with a negative impact on project safety performance. Furthermore, projects typically have unclear lines of communication which affects transfer of critical safety information for the effective elimination and management of risk (Briscoe et al 2001, Briscoe and Dainty 2005, Arditi and Chotibhongs 2005).
- **Visible leadership and commitment to safety:** In relation to a project there are often a number of individuals in roles that require visible safety leadership to be evident in their day to day practices and behaviours in order to promote a positive safety culture; at senior management, middle management and supervisory levels (Akintoye et al 2000, Winkler and Irwin 2003). However, construction projects are usually a challenging environment with competing demands and priorities on individuals that subsequently may have an impact on their behaviours whereby leaders do not balance demands of delivery, programme, cost and safety. An impact on safety performance should be expected.
- **Access to health and safety resource:** Access to competent safety advice is a factor associated with good safety performance, but SME's typically have limited access to such resources (Arditi and Chotibhongs 2005). With a reliance on SMEs within the construction sector projects could be expected to have poorer safety performance.
- **Existing and previous safety performance:** Organisations that have poor safety performance are often involved in more serious accidents and incidents and receive Prohibition or Improvement Notices from the HSE (the independent Safety Regulator). An organisation may respond to such events in one of two ways; firstly, do nothing and continue with poor safety performance often resulting in further prosecutions, loss of reputation and work opportunities. Or secondly, they react in a manner whereby the

organisation focuses resources to improve safety; if an organisation recognises that their safety performance is not acceptable and wants to improve then they are more likely to be committed to making necessary changes. Therefore, existing and previous safety performance can be a factor in how successful safety improvement programmes are (Mullins 2005).

A summary of these in relation to the complexity of a Project Delivery Organisation is illustrated in Figure 2.5.

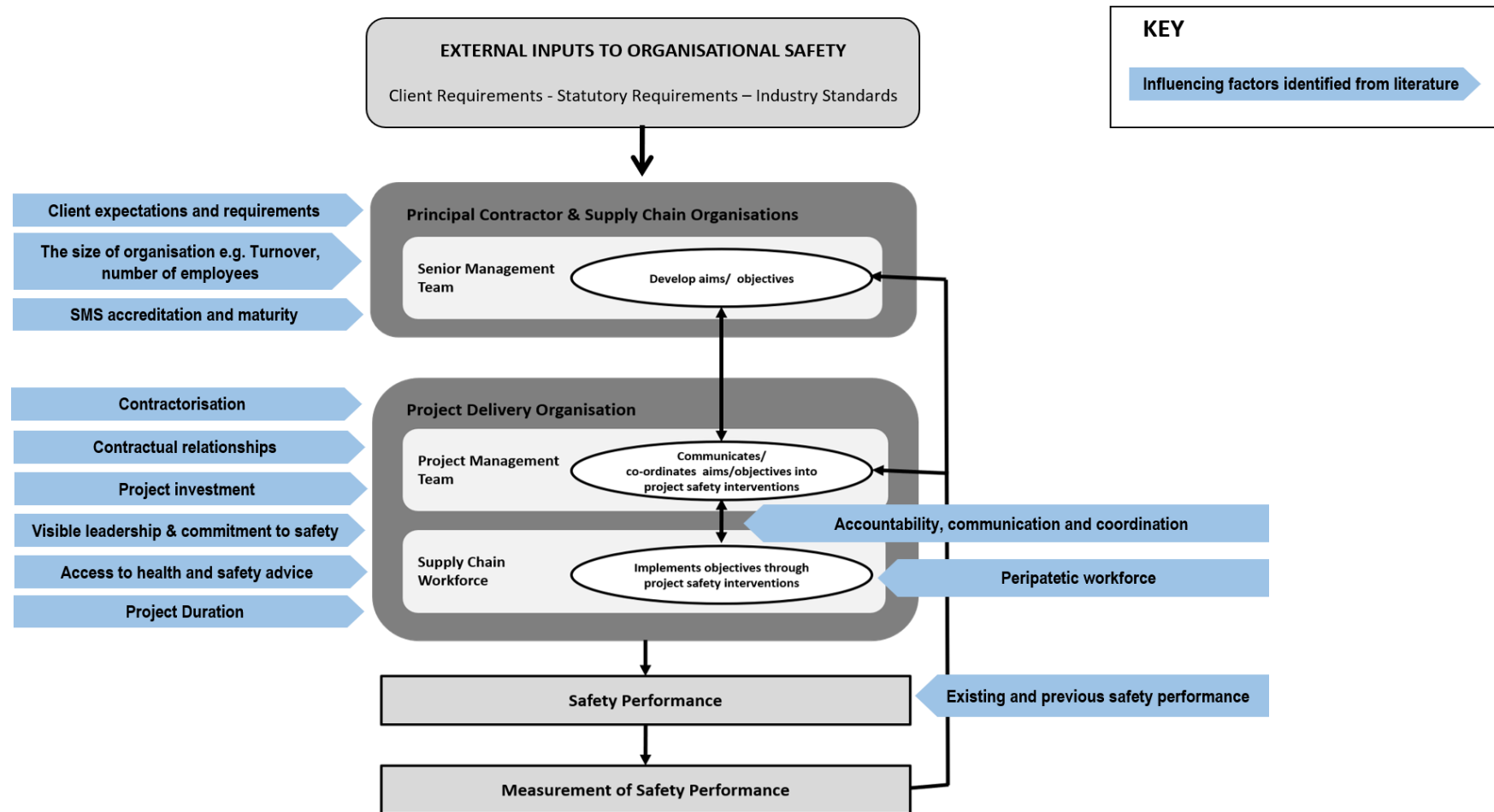


Figure 2.5 Model identifying influencing factors

2.8 Chapter Summary

In summary, a review of the literature has identified that Construction is a high-risk industry that has a less than desirable safety record, and therefore needs to improve. Over recent years, the industry has recognised this and made efforts to tackle safety with some success. However, there are a number of distinctive factors which influence how safety is managed across the industry. A summary of these influencing factors is highlighted in Figure 2.5.

Measuring safety is important for management to understand how well the organisation is performing. An approach that focuses on safety culture, will provide a balanced set of intelligence data to inform subsequent management decisions and actions. Performance data is often a catalyst for organisational change and therefore useful when seeking to implement a safety improvement programme to improve performance. Leadership maintain a critical role in any change programme, with visible commitment demonstrated by word and deed essential.

In relation to a Project Delivery Organisation, and the respective companies involved in delivering a project, there are a number of different individuals who would need to demonstrate positive safety leadership behaviours; Senior Management from both the Principal Contractor and second and third tier subcontractors, plus Supervisors from both the Principal Contractor and second and third tier subcontractors. It is worth noting that the individual contribution and time spent on the project may be variable. Therefore, any safety improvement programme should address the leadership behaviours required from all of these individuals who are involved in a Project Delivery Organisation.

Whilst there is considerable research on the characteristics of positive and negative safety cultures within an organisation, research to date does not consider how the interfaces and relationships between Principal Contractors and their Supply Chain impact on project safety culture. Furthermore, the significance of leadership for successful implementation of safety improvement programmes within a Project Delivery Organisation is not understood.

The gaps in existing research which this thesis seeks to explore are the relevance of safety culture and safety leadership theories to Project Delivery Organisations. In addition, the identification of influencing factors and their impact on project safety performance is a specific area lacking in research to date.

The thesis builds upon the areas identified from existing research and applies these theories in specific application to meet the thesis aim: to investigate how to improve safety leadership on construction projects. The aim includes to better understand the components, factors and interactions that influence safety, safety culture and safety leadership within a Project Delivery Organisation, and to evaluate the effectiveness of safety leadership interventions within a Project Delivery Organisation, cognisant of the influencing factors that have potential to impact on safety. Following on from the literature review, and in order to meet the thesis aim, a number of research objectives have been identified:

- Understanding the effectiveness of safety leadership interventions on safety culture maturity and performance
- Identifying the relevance of influencing factors on safety and leadership within Project Delivery Organisations
- Establishing specific considerations for the successful implementation of Safety Improvement Programmes within this sector
- Determining the current perceived level of safety culture maturity within a Project Delivery Organisation
- Existence and the perceived effectiveness of safety improvement programmes within a Project Delivery Organisation
- Determining the current level of understanding and application of safety leadership within a project environment

3. Study Approach

3.1 Introduction to Chapter

This chapter outlines the overall methodological approach undertaken within the thesis. Approaches undertaken during research studies relating to evaluation of safety culture, safety performance and leadership have been considered; a review of approaches is included within this chapter. The rationale for the selection of different methods deployed are also outlined within this chapter.

This thesis takes a multi-methods approach, using accepted methods from across research into safety performance, safety culture and safety leadership. These include interviews, perception surveys and maturity ratings. The thesis also applies methods for interventions such as logic mapping but develops these for the specific evaluation of factors influencing interventions within a Project Delivery Organisation.

The remainder of this chapter discusses the range of methods used structured in two parts to meet the thesis aim and objectives:

- understanding safety interventions within construction projects (Studies 1, 2, 3)
- evaluating the influencing factors and related success for safety leadership interventions (Study 4)

Details of specific implementation of the methods undertaken within this research project are provided in Chapters 4, 5 and 7.

Chapter 6 details the development of the Safety Leadership Intervention Tool (SLIT) for deployment within Chapter 7 – Study 4. The approach for the development of the SLIT was extensive and therefore warrants its own chapter.

3.1.1 Role of the Researcher

The researcher is a Chartered Health and Safety Practitioner having worked within the Construction Industry since 2001. The researcher's experience includes the management of health and safety functions for a portfolio of construction projects; with time spent both on and off site. The study approach has been influenced by years of experience across the domain, with recognition of the challenges faced within the sector regarding the management of safety

within a project-based environment. This experience is a key aspect of the research methodology where tried and tested methods have been developed for specific use within a Project Delivery Organisation, due to the researcher's experience and day to day consultancy work within industry. The opportunities provided by this consultancy work have also enabled access to a wide source of data, from a variety of different safety duty holder organisations (Clients, Principal Contractors and Supply Chain), and across all hierarchical levels of organisations.

3.2 Background

Chapter 2 explored research across a number of different fields; the impact of contractorisation on safety, safety culture, safety leadership and successful safety improvement programmes. Construction projects have shown a reliance on contractorisation and forming quasi-organisations (a Project Delivery Organisation) established from multiple subcontract organisations working under the direction of a Principal Contractor. Contractorisation has been found to have a negative impact on safety due to SMEs having limited commitment and resources available to implement safety management systems effectively. This is relevant to the Construction Industry where there is a reliance on SMEs to deliver the work under the management control of a Principal Contractor. The safety culture of the project is therefore a direct result of the different member organisations and their respective commitment and resources for safety impacting on a Project Delivery Organisation. There is, however, limited understanding of how the relationships between members of the Project Delivery Organisation affect safety culture. As the Construction Industry is focused on improving safety, research indicates that to improve safety there is a critical reliance on good safety leadership for any improvements to be effective. Research into safety leadership within a Project Delivery Organisation is again limited.

The characteristics associated with contractorisation are further exacerbated by the limited duration of a project. It has been found across a number of studies (Vredenburg 2002, Cooper 2001, Greiner 1998) that safety culture takes time to develop, but a project is by definition time-bound. This is relevant for those seeking to implement programmes that improve safety culture as there may not be sufficient time for the project to develop evolutionary change. Studies have shown that leadership is the critical aspect of any change programme, where effective leadership would usually result in positive outcomes. There lacks a thorough understanding of safety leadership and the

significance for improving safety culture across the Construction Industry. This thesis seeks to provide a greater understanding of safety leadership on projects.

This thesis has six research objectives. Table 3.1 shows the research objectives aligned to the different studies and chapters. Table 3.1 also shows the methods deployed for each of the research objectives against Studies 1 to 4.

Chapter 6 is not listed within Table 3.1 as this was not a chapter describing a specific study.

Throughout the thesis a mixed methods approach was undertaken for specific studies within the PhD research. Each of these studies enabled the research objectives to be achieved. The rationale for each of the chosen methods is provided within the remainder of this chapter.

Research Aim	Research Objectives	Methods Deployed per Study	Chapter
To investigate safety leadership within the Infrastructure Engineering Sector of the Construction Industry and determine whether safety leadership is important for improving the safety culture of a construction project.	- Determining the current perceived level of safety culture maturity within a Project Delivery Organisation - Existence and the perceived effectiveness of safety improvement programmes within a Project Delivery Organisation	Study 1 - Obtaining and collating perception rating data through workshops - Quantitative analysis of perception rating data using non-parametric statistical analysis techniques Study 2 - Use of questionnaire survey - Qualitative analysis of data through coding - Quantitative analysis through simple statistics; frequency, percentages	Chapter 4. Understanding the Safety within Construction Projects
	Determining the current level of understanding and application of safety leadership within a project environment	Study 3 - Obtaining and collating data through interviews - Qualitative analysis of data through coding and thematic analysis	Chapter 5. Evaluation of Safety Leadership
	- Understanding the effectiveness of safety leadership interventions on safety culture maturity and performance - Identifying the relevance of influencing factors on safety and leadership within Project Delivery Organisations - Establishing specific considerations for the successful implementation of Safety Improvement Programmes within this sector	Study 4 - Application of safety leadership intervention tool through multiple case studies - Data triangulation from multiple data sources; interviews, surveys, project records - Evaluation framework based on a safety leadership intervention tool logic map	Chapter 7. Safety Leadership Intervention Case Studies

Table 3.1 Summary of research aim, objectives and methods by chapter

3.3 Methodological Challenges

The evaluation of safety within a Project Delivery Organisation poses several challenges. Firstly, the measurement of safety performance is difficult as detailed within Chapter 2, and secondly it is not known how to understand the relevance of a variety of influencing factors that may be impacting on the safety performance outcomes. This was recognised in recent research by van der Molen et al (2018) who found that across 17 separate construction-orientated studies there was 'low-quality evidence' of the effectiveness of a variety of interventions to reduce the risk of injuries, with a high risk of bias.

Research states that measurement of safety performance should consider both lagging and leading indicators. Whilst it is appropriate for management to use lagging indicators to understand any safety problems (Hale 2009), reliance on safety measures that are based on the absence of an outcome rather than a presence provide no guarantee that risk management controls are being effectively deployed (HSE 2011b, Hale 2009, Grabowski et al 2007, Lindsay 1992). Some of the particular challenges include:

- under-reporting of accidents or incidents e.g. there are more accidents/incidents taking place but these are not reported.
- collation of data that does not measure the effectiveness of hazard and risk controls e.g. adherence to risk assessment mitigations and controls and compliant behaviour in the workplace.
- failure to assess the potential risk rather than actual risk in the workplace, especially for high frequency low severity events e.g. a forklift is lifting a bundle of pipes. The pipes are slung from the forklift with a sling. The sling breaks due to being overloaded. In the haste to escape a person suffers a minor injury from tripping over some materials in the workplace (actual risk). There is no other outcome. Focusing only on a minor injury, management improvements will miss the real risks associated with the lifting operation; e.g. planning and securing the load effectively (the potential risk).
- low incident rates result in fewer sources of data intelligence to base management decisions.

In contrast leading indicators are predominantly related to the adequacy of risk management processes within the safety management system. There are two broad types of leading indicators; those that are associated with measuring the precursors to an undesirable event (such as an accident or incident), and those that measure the effectiveness of proactive interventions deployed to prevent such an event (Hopkins 2009, Øien et al 2011, Dyrebourg 2009, Erikson 2009).

In a study by Hale et al (2010), more successful organisations were less focused on accident data and more focused on measures of the safety interventions. This includes measuring the key aspects of the risk assessment mitigations and controls to ensure these have been effectively implemented. For example, a risk assessment identifies the need for frontline supervisors to undertake a daily briefing to communicate tasks to the workforce. Good measures would capture whether these briefings have been undertaken (quantitative) and the engagement, style and content of the briefing (qualitative). Therefore, the thesis does not wholly rely on lagging indicators as the sole measure of safety performance. One aspect of leading indicators involves measuring safety culture (HSE 2011b).

In relation to the challenges of measuring safety performance, and the importance of safety culture as a component part, the thesis is focused on what it is that people do on a construction project that can affect safety, the situational aspects of the Project Delivery Organisation. Therefore, for the purpose of the thesis the emphasis on is safety culture maturity rather than safety climate. The common approach to measuring safety climate is through perception and attitudinal surveys (Mearns and Flin 1999, Guldenmund 2000), whereas methods for understanding safety culture are more qualitative, usually undertaken through observations and interviews (Guldenmund 2000) or through audits and SCHAOP's (Safety Culture HAZOP) (Ludborz 1995, Kennedy 1997). Taking a more qualitative approach is important to gain a greater understanding of the different types of interventions, how such interventions are being implemented, and how effective are they at improving safety culture. Measuring safety culture maturity is more than a consensus of how people feel.

Despite a lack of consensus from researchers regarding leading safety indicators (i.e. exactly what should be measured) it is agreed that measuring safety performance is complex. Safety performance data is particularly difficult to collect and subject to bias (Robson et al 2001). Hale (2009) recognises that it can be a challenge to ensure the most appropriate measures to provide safety performance data are used, specifically:

- Valid: does the data measure what it needs to measure?
- Reliable: is there consistency in measurement when used in different situations and by different people?
- Sensitive: how does the data respond to changes of variables that are being measured?

- Representative: does the set of indicators cover all of the safety aspects which are relevant?
- Openness to bias: the ease in which data can be manipulated to show better safety performance?
- Cost-effectiveness: is the cost to collect the data greater than the cost of the loss or does it outweigh the anticipated gain?

Therefore, in developing the methodological approach in this thesis the following factors have been taken into account as much as possible:

- Use of leading rather than solely lagging indicators
- Evaluation of safety culture maturity rather than safety climate
- Combining qualitative as well as quantitative methods

Chapter 2 has established that there are a multitude of factors which can affect safety; measuring safety performance requires a robust assessment of all such factors. The rest of this chapter outlines the approach taken within the research in the thesis to evaluate safety culture within a project environment, cognisant of the challenges identified above.

3.4 Overall Methodology and Ethics

A mixed methods approach using a combination of quantitative and qualitative methods, has been undertaken for two reasons; firstly, to address some of the challenges already identified earlier in this chapter and, secondly, to explore in sufficient depth the relevant factors at play within a Project Delivery Organisation. With a number of different methods being undertaken, there has been a need for data triangulation. The intent of using triangulation is to offset any deficiency of a single data strategy, thereby increasing the ability to interpret the findings.

There are two broad types of data triangulation: data source and methodological (Denzin 1978, Patton 1999). Data source triangulation examines the consistency of findings from different data sources using the same method e.g. at different points in time, at different places. Methodological data triangulation examines the consistency of findings from different data collection methods. In this thesis both ways of triangulating data have been used.

A number of studies (Cooper 2000, Jick 1979, Simard and Marchand 1994, Zohar 2002, Gadd and Collins 2002, Conchie and Moon 2010, Sawacha et al 1999) utilised a combination of different methods i.e. where the outputs of

interviews were combined with ranking data and in-company peer observations, in conjunction with a review of safety performance data (accident and incident data). A similar approach has been undertaken between the different studies in the thesis (Study 1, 2 and 3) to understand the prevailing characteristics of construction projects, specifically regarding perceptions of safety culture, safety leadership, and associated intervention programmes for Project Delivery Organisations in the Infrastructure Engineering Sector of the Construction Industry.

In this thesis, the use of multiple methods was also undertaken within the individual Case Studies in Study 4 due to the breadth of data and the scale and complex nature of data collection methods across a longitudinal timescale – for each Project Delivery Organisation. An example is given by Jick (1979) is for evaluating the effectiveness of a leader, which can be achieved by interviewing the leader, observing their behaviour and evaluating performance records. This also limits the impact of same-source bias (Conchie and Moon 2010) and social-desirability bias (Cooper 2000). The need for understanding and explaining the safety leadership interventions and the influencing factors for Project Delivery Organisations as a whole was important to achieve the thesis objectives.

Full consideration has been given to ethical issues associated with the collation of data for this research. Ethical applications and approvals were in place from the Faculty of Engineering Research Ethics Committee, University of Nottingham, for each of the studies identified within Chapter 4 Understanding the Safety within Construction Projects, Chapter 5 Attitudes to Safety Leadership and also Chapter 7 Safety Leadership Intervention Case Studies.

As the studies involve discussions and information relating to safety performance, it is foreseeable that specific safety concerns may be raised by participants with the researcher. In such occurrences the process for dealing with these will be anonymised and provided in a timely manner to the appropriate person for the company/project as identified at the initial briefing. Where the researcher identified safety concerns these were also handled in the same manner.

Research access was straightforward to obtain due to the personal contacts of the researcher within this sector of industry. Participants were selected based on a set of criteria for each of the studies undertaken at organisational, project and individual levels. In summary:

- Selection of organisations e.g. Principal Contractors – must have a behavioural safety programme in place to participate

- Selection of projects – be within the Infrastructure Engineering Sector and meet the specific criteria for Study 4 based on project duration and value
- Selection of individual participants – chosen for their role within an organisation/project

The exact criteria for each study are listed within the relevant chapters that follow.

Data collection was conducted through both primary and secondary sources. Primary data sources included interviews, surveys, workshop and audit participants. Secondary data sources mainly included company brochures and websites, safety related records (inspections, tours, audits, accident records). The secondary data helped to validate primary source information. Obtaining and collating data was undertaken using a combination of different methods, the rationale for using each of these methods are provided in Section 3.5 to 3.8 of this Chapter.

Across all data sources confidentiality was applicable at two levels:

1. Organisation/company level for the Clients, Principal Contractors and Subcontractors

Each participating organisation was allocated a unique code with all associated records identified by the code. Only the researcher has access to the register of codes.

2. Individual level for each participant

The application of interventions did not involve documented personal details outside of the project. Any personal details (name, role on project etc) were only identified in the same manner as customary for the organisation as part of every construction project delivery arrangements.

All hard copy records were provided directly to the researcher in a sealed envelope maintaining 100% confidentiality. There was no means of identifying named organisations during the analysis of the data, only project codes have been used on records.

All information collected during the course of the research was stored in a locked storage cupboard, with a secure key control managed by the researcher. Only the researcher had access to the records. All electronic data was held securely on the universities shared drive, with folders accessible only to the researcher and PhD Supervisors.

Procedures for handling, processing, storage and destruction of data were compliant with the Data Protection Act 1998. All data will be kept by the

researcher for seven years, in line with the University of Nottingham's data storage policy, after this time it will be destroyed.

Organisational safety culture and safety performance are potentially sensitive for participating organisations, in relation to maintaining company reputation. However, the research did not involve sharing of any accident data outside of an organisation. Storage of data conformed to data protection requirements as already detailed.

3.5 Study 1 Project Safety Culture Maturity Ratings (Chapter 4)

3.5.1 Measuring Safety Culture Maturity

Research by Fleming and Lardner (2001) suggests that for safety interventions to be effective they must be tailored to the level of organisational maturity. Therefore, it is necessary to understand the prevailing level of safety culture maturity within the Infrastructure Engineering Sector. The focus of Study 1 was to establish general perceptions of safety culture maturity within construction projects, and identify specific difference between Principal Contractors and their Supply Chain.

Several studies (Weick 1987, Westrum 1988, 1991, Reason 1997, Fleming 2001, Parker et al 2006) identify a continuum of safety performance; where effectiveness of an organisation's safety culture can be measured by its safety culture maturity. Different studies have the continuum ranging from three to five levels of maturity, which were used to as an indication of the organisations level safety performance.

Perception rating has been used in many studies (Zohar 1980, Williamson et al 1997, Griffin and Neal 2000) to understand the safety climate or culture of a workplace. In this thesis a 5-point maturity scale has been used based on the Hudson Maturity Model (Parker et al 2006); level 1 pathological, level 2 reactive, level 3 calculative, level 4 proactive, level 5 generative.

In this study perception ratings of safety climate were undertaken to establish the current safety culture maturity of Project Delivery Organisations meeting one of the thesis objectives.

3.5.2 Data Collection

Previous studies (Zohar 1980, Williamson et al 1997, Griffin and Neal 2000) have used a survey methodology to obtain data relating to perceptions of safety climate. These studies used an appropriate scale of measurement; e.g. a continuum of safety culture maturity levels (1 to 5), for the reported perceptions of safety climate. Data was collected via individual interviews, group interviews and discussion groups, where participants are given a document illustrating the specific safety culture maturity continuum being used and then asked to provide a rating of where they consider their organisation to be on the continuum (Pidgeon 1998, Guldenmund 2000). This approach was adapted for use within Study 1.

In this study establishing perceptions of safety climate was achieved through obtaining data from a sample that included representatives from both Principal Contractors and the Supply Chain.

Studies into safety culture and safety performance by Cooper (2000), Glendon and Stanton (2000), and Jick (1979) combined the outputs of the interviews and ranking data with in-company peer observations, in conjunction with a review of safety performance data (accident and incident data). This level of interrogation may be appropriate for determining one organisation's safety culture maturity e.g. a Principal Contractor, but it is not wholly suitable for providing a benchmark assessment of safety culture maturity for many organisations within a Project Delivery Organisation from across the Infrastructure Engineering Sector of the Construction Industry. The principles of the approach outlined above were adapted to suit a much larger sized group of participants. Therefore, the approach taken in Study 1 only considers perception ratings, and does not include further observations or comparison with actual safety performance data.

3.5.3 Analysis

The analysis needed to compare different perceptions between Principal Contractors and the Supply Chain, and to identify and relationships between the two participant groups. A quantitative approach was taken as the perception data was numeric based on a rating scale.

The data collected was based on an ordinal scale and was non-normal continuous data, without normal distribution (Hayes 2000, Spencer 2015). Therefore, it was appropriate to undertake statistical analysis using non-parametric methods, specifically Mann Whitney U Tests. These tests compare

two populations, the independent variables (Principal Contractors and the Supply Chain) and the dependent variable of the ordinal rating scale of organisational safety culture maturity.

The approach taken determined the significance of relationships between the Principal Contractor and/or the Supply Chain. Mann Whitney U Tests were used to analyse whether the means of the two groups were statistically different from each other. Other studies that evaluated perceptions of safety culture also adopted a similar analytic approach determining the mean ratings between different participant groups (Clarke 1999, Mearns et al 2003, Clarke 2000, Glendon and Litherland 2001, Zohar and Gill 2005).

The analysis was conducted using version 18 of the Statistical Package for Social Sciences (SPSS).

Details of the implementation are described in Chapter 4 Understanding Safety within in Construction Projects. This includes details of the organisations participating in the study and the results of the statistical analyses to determine the significance of relationships between perceptions of safety maturity between the Principal Contractor and their Supply Chain.

3.6 Study 2 Survey of Safety Improvement Programmes (Chapter 4)

3.6.1 Data Collection

Study 2 seeks to identify whether Safety Improvement Programmes are deployed within the Construction Industry, specifically whether safety leadership is addressed. Whilst the literature identifies specific contents for these programmes, there is limited research that assesses the effectiveness of such programmes (Marsh et al 1995, Duff et al 1993). The few studies that have taken place have each taken a similar survey-based approach (Vrendenburgh 2002, Fleming and Lardner 2001, Hopkins 2006, Wirth and Sigurdur 2008). In this study a similar approach was taken using a questionnaire distributed to organisations working on construction projects. The questionnaire was a combination of multi-choice and free text answers, covering three main areas:

- The extent of Safety Improvement Programmes within the Supply Chain
- Whether to contents of these programmes are supportive of safety culture research, including aspects of safety leadership
- The reported effectiveness of such programmes

The development of the questionnaire made reference to the work of Fleming and Lardner (2001).

The use of questionnaires provided a means to gain feedback from a broad sample of Supply Chain in a timely manner. Study 2 provided an understanding of any existing Safety Improvement Programmes that were being deployed by the Supply Chain; and helped to build a picture of the current safety interventions being deployed within the sector.

3.6.2 Analysis

Completed questionnaires were returned anonymously and analysed qualitatively by the researcher. Responses to multichoice questions were inputted into a spreadsheet for collation and qualitative review. Simple statistics (frequency, percentages) were used to analyse the data.

Free text fields and comments were coded prior to analysis for each question from each questionnaire. A code is a word or short phrase used as a summative and essence-capturing label for the data (Saldana 2009). The researcher applied codes following an initial review of the free text questions. Following a second review codifying was carried out to identify distinct categories identified within the data. These categories became the basic units of coding as part of the analysis across the whole data set. The aim of this study was to identify realistic data relating to the deployment of Safety Improvement Programmes. further development of concepts and theories were not undertaken within this study, however there was a comparison with existing research findings relating to contents of Safety Improvement Programmes.

The literature review has identified that SME's within the construction Supply Chain are less likely to have effective safety arrangements in place. Study 2 was focused on determining whether there were interventions being deployed by Supply Chain organisations within construction projects. Chapter 4 Understanding Safety within Construction Projects details the aim, method and results from Study 2.

3.7 Study 3 Leadership Interviews (Chapter 5)

3.7.1 Data Collection

Study 3 involved a more in-depth review of attitudes to safety leadership from Client, Principal Contractor and Supply Chain representatives, to consider how this may impact on safety performance. The level of understanding of safety leadership as a topic was evaluated against how well the study participants could explain the concept, and whether they could provide any examples of real-world application.

The many different studies into evaluating safety leadership and the effectiveness of safety leadership interventions (Wu et al 2008, O'Dea and Flin 2001, Clarke and Flitcroft 2013, Hopkins 2006, Fleming and Lardner 2001, Walters et al 2006) have all used similar methods of data collection; interviews, questionnaires and focus groups. In Study 3, semi-structured interviews were used as a qualitative research method best suited for obtaining more details on the interviewees' perceptions and attitudes to specific matters characteristic within a Project Delivery Organisation. A structured interview is highly standardised and formalised (Robson 2002), whereas in semi-structured interviews the interviewer has a list of themes or questions to be discussed, which allow the respondents considerable freedom in their responses. This provided the interviewer optimum flexibility to explore the research topics in a structured and consistent manner.

Each participant was chosen based on availability and willingness to participate from the researcher's contacts within the Industry. Interviews were undertaken with Senior Management representatives of the Client, Principal Contractor and Supply Chain each of the participants having leadership responsibility for safety within their particular organisation.

3.7.2 Analysis

Once the interviews had been undertaken and subsequently transcribed, they were coded and analysed using thematic analysis. Thematic analysis is a method for identifying and analysing patterns (or themes) within data, as well as helping with the interpretation of various aspects of the research topic (Boyatzis, 1998). Thematic analysis is a frequently used methodology for organising raw data from interviews (Flin et al 2000). The analysis starts with the identification of the themes that emerge from the raw data, referred to as 'open coding' (Strauss and Corbin, 1990). During open coding, the researcher will identify and name the conceptual categories into which the data would be grouped. Dey (1993) suggests that these categories become the basis for the

organisation of that data. Taking this approach provided a structured means to categorise qualitative data from the interviews and identify themes whilst doing so in a manner that was reliable and valid (Flin et al 2000, Guldenmund 2000).

Braun and Clarke (2008) detail the benefits of thematic analysis, a widely accepted qualitative analysis technique (Smith 2015, Lyons and Coyle 2016). The 15-point checklist of good thematic analysis identified by Braun and Clarke (2008) informed the analysis steps undertaken within this study. These include:

- Transcription and Data Familiarisation
- Initial Coding
- Establishing Themes
- Reviewing Themes against Literature
- Reviewing Themes and Sub Themes
- Theme Relevance and Conclusions

Chapter 5 Evaluation of Safety Leadership provides detail on Study 3 in particular the selection of participants from across the Client, Principal Contractor and Supply Chain organisations, as well as the method of coding, the coding framework and conclusions from the thematic analysis.

3.8 Development of Safety Leadership Intervention Tool and Data Collection Materials (Chapter 6)

Chapter 6 outlines the development of the SLIT for implementation in Study 4 (Chapter 7), as well as the development of a suite of data collection materials.

Section 3.1.1 refers to the researchers experience within the Construction Industry. This experience was particularly important for the design of the SLIT. An example of this is in developing the materials within the SLIT, the researcher was able to use Construction Industry standard template forms and guidance notes for inclusion within the SLIT e.g. guidance on how to prepare for and deliver a safety stand down, guidance on how to carry out a safety tour including supporting documents (forms, spreadsheet etc).

The development of data collection materials was informed by the logic map for Study 4, which identified the different sources of information needed, the type of information needed and how this was expected to be evidenced for each participating construction project. These materials were used to capture data in Study 4.

The design of Study 4, in particular the logic map, informed the approach to data collection, specifically considering the need to collect data:

- longitudinally across the lifecycle of each project
- from amongst the different hierarchical levels within the Project Delivery Organisation e.g. Principal Contractor and Supply Chain representatives
- in a consistent manner both within a project, and between all projects

3.9 Study 4 Safety Leadership Intervention Case Studies (Chapter 7)

Study 4 was undertaken to meet three research objectives:

- Understanding the effectiveness of safety leadership interventions on safety culture maturity and performance
- Identifying the relevance of influencing factors on safety and leadership within Project Delivery Organisations
- Establishing specific considerations for the successful implementation of Safety Improvement Programmes within this sector

The purpose of Study 4 was to develop and then test the implementation of a Safety Leadership Intervention Tool (SLIT) with a number of Project Delivery Organisations. In order to evaluate the effectiveness of the SLIT two groups of Project Delivery Organisations were established: those implementing the SLIT (intervention projects) and those not implementing the SLIT (baseline projects). The two groups were created based on their status in the project life cycle at the point of the research. Baseline projects had already started the construction phase and were more than 50% completed, therefore these projects were assessed at the end of the construction phase. Intervention projects had not yet started the construction phase of work and were therefore provided with the SLIT to implement. Assessment of Intervention projects was at the beginning as well as at the end of the construction phase. This provided a means of comparison to establish the effectiveness of the SLIT on safety performance. This approach was selected as it was not feasible to undertake experimental design due to the context being safety i.e. it was not appropriate to give an intervention to some projects and not others as it could be viewed as detrimental to the overall safety on the project. This was a key aspect of Study 4 – the implementation of a leadership intervention tool and the evaluation of this impact this had on safety performance within construction projects.

The study design was complex due to the high number of variables that had to be considered within the evaluation across a number of different projects

(intervention and baseline). Two methodological approaches were taken: use of case studies and evaluation using logic mapping. The remainder of this section outlines the methodological approach taken within Study 4 to evaluate the effectiveness of interventions based on implementing safety leadership tools across different Project Delivery Organisations. Key aspects of this approach include the use of case studies, and evaluation using logic mapping (Hills 2010).

3.9.1 Use of a Case Study Approach

This section outlines the case study approach undertaken to evaluate the effectiveness of safety leadership interventions within a Project Delivery Organisation, for a number of construction projects.

A Case Study is a methodological approach that involves systematically gathering sufficient information about a particular person, group or situation to effectively understand how the subject operates or functions (Berg 2004). The case study approach is useful in situations where contextual conditions of the events being studied are critical and where the researcher has no control over the events as they unfold. There are two types of case studies: explanatory and descriptive case studies (Yin 1994); the explanatory case study approach to look for reasons for 'how' and 'why', and search for theories has been chosen as the most appropriate to undertake in Study 4. In studies of multi-site interventions, purposive sampling is often used; this approach was taken in Study 4 (Yin 2009).

Case studies are useful in developing and refining concepts and can lead to generalisations across multiple case studies (Yin 1994). Study 4 seeks to make comparisons between the different case studies for transferable learning across the Construction Industry. Multiple-case studies were undertaken within Study 4 to give sufficient scope for understanding the influencing factors that impact on the effective implementation of safety leadership interventions. A case study review events in their natural setting, making use of multiple methods of data collection such as interviews, documentary reviews, and participant observations (Yin, 1994). This improves the ability to generalise findings to wider contexts and applications, one of the thesis objectives. A Case Study Protocol was developed to support the direct replication across each of the six case studies. This included defining selection-criteria for each of the participating case studies before the individual project was included within the research e.g. project duration, project value.

Studies into safety interventions and safety culture/climate (Griffin and Neal 2000, Vredenburg 2002, Fairman and Yapp 2005, van der Molen et al 2018) call for in-depth case studies between multiple organisations to compare performance. Case Studies are used for comparison between different organisations in these studies. A challenge for Study 4 was how to undertake effective analysis between (as well as within) projects to identify transferable findings.

A review of such intervention studies (Griffin and Neal 2000, Vredenburg 2002, Fairman and Yapp 2005, van der Molen et al 2018) has shown that these studies undertook analysis both quantitatively e.g. randomised controlled trials, controlled before-after (CBA) studies and interrupted time-series (ITS), and qualitatively e.g. thematic analysis. The approach taken in this thesis did not adopt randomised controlled trials or ITS design because of the limitations of data collection on each of these approaches.

Randomised controlled trials require the variables between groups of participants to be limited only to how they are exposed to the intervention. This cannot be adopted for this research as Study 4 seeks to better understand the many influencing factors (variables) that may be affecting safety interventions within the Project Delivery Organisation. Nor would an ITS approach be suitable as there is more than one population involved and there were multiple interventions being deployed (Lehtola et al 2008). An ITS approach would be better suited to studies focused on interventions applied within one specific project, rather than for comparison across a number of projects.

Study 4 followed the principles of a CBA approach where the researcher undertook data collection before safety leadership interventions were adopted onto the Intervention Group projects, as well as afterwards. Comparison was made between a set of Intervention Group and Baseline Group (Control) projects at the end of each project. However, comparison was not made before and after for each of the case studies due to ethical constraints i.e. it was deemed inappropriate to only provide some projects with intervention resources that could have a positive impact on safety performance and not others. Therefore, Baseline Group projects were projects that had already started and were near completion, so the timing of Study 4 prevented the deployment of the safety leadership interventions.

Whilst the different study types mentioned focus on between-group differences (Bernal et al 2018) these alone would not meet the aim or objectives of this thesis. Simple comparison was the most appropriate method for this study for the reasons outlined in Table 3.2.

Within each case study	Between the case studies
• there would be in-depth analysis for each case study to assess the application of interventions applied over a period of time • over the time frame of the intervention there was an opportunity for iterative data collection and analysis • understanding the project contextual factors as important as the success or failure of an intervention • seeking to compare safety leadership interventions and the impact on safety performance	• there would be a number of different safety leadership interventions being implemented across multiple projects, and with no opportunity to control the way in which the interventions were being implemented • comparison of anticipated outcomes, identified from existing research, with actual outcomes • identifying patterns across the cases and the potential causal factors for such patterns

Table 3.2 Summary of comparisons within and between projects

Undertaking this approach supports the research objectives to identify conclusions that can be applied across different situations providing a means for the classification of influencing factors that represent the relationship between leadership interventions and safety performance.

The principles of a Case Study approach informed the method used for each of the projects. However, within Study 4 the researcher was integral to how the SLIT was implemented on each project. This is different to straight forward case studies where the researcher would in this context, typically observe a project implementing safety interventions and evaluate the impact of these.

3.9.2 Evaluation Approach

The study design required evaluation to be undertaken within a project, and between all projects. The evaluation would be based on data sources obtained both longitudinally across the lifecycle of the project, and amongst the different levels within the Project Delivery Organisation. The approach taken for data triangulation was a key aspect of the evaluation process. Following on from the pilot it was recognised that reliance on solely interview or perception data would be inadequate, as the level of understanding of safety leadership as a topic was found to be poor, particularly amongst the Supply Chain. An approach was developed using different types of data sources to minimise any inadequacies from single data sources. Those with a poor understanding of

safety leadership could impact on the validity of the findings from Study 4. However, this would generate a lot of data to review. With such a vast quantity of documents, the identification of key data for each project was critical. The use of project codes on each document was implemented to help with traceability.

3.9.2.1 Logic Mapping

A logic map was developed as the evaluation framework of the SLIT, based on the work of Hills (2010) with reference to Connell and Kubisch (1998), and Wholey et al (2004). Figure 3.1 identifies the key components of a logic map. An additional step added by the researcher was to identify where influencing factors were expected to have an impact within the logic map; which was identified as relevant for inputs, outputs and outcomes. Therefore, the evaluation of the SLIT tool also needed to identify the impact of influencing factors at each point on the logic map.

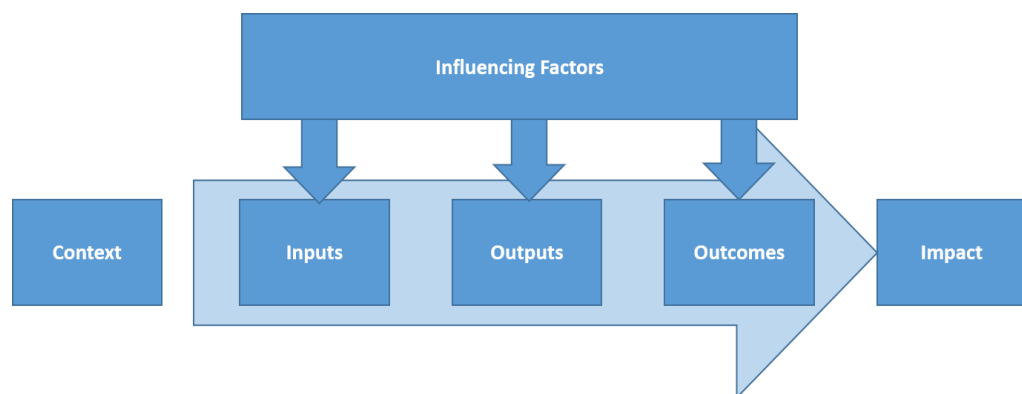


Figure 3.1 Overview of logic map

Table 3.3 identifies the high-level logic map for this study (Inputs, Outputs, Outcomes and Impact). Each of these are summarised below. Influencing factors are addressed specifically later in this section.

- Context – issues addressed and the context in which the intervention is taking place. Context of the logic map is important as it identifies potential issues that could affect validity and reliability of the study, as well as establish the context in which the interventions are taking place. This is particularly relevant on an individual case study basis, where a Project Delivery Organisation will have a range of influencing factors. The methods of data collection developed address this aspect for each case study.

- **Input** – what is invested (money, skills, people, time etc) i.e. the SLIT tool. The logic map inputs were developed on the basis of the SLIT with the four principal areas; A1 vision and goals, A2 transformational leadership, A3 transactional leadership, and A4 monitor and review. In addition, developing the logic map established the importance of defining the Project Intervention Plan at the beginning of the intervention-group projects, a document clearly defining what safety leadership interventions would be undertaken on the project (the inputs).
- **Output** – what has been produced by the intervention. The specific outputs were identified as the activities directly resulting from the interventions. This includes the level of participation and response to the interventions where the interventions are being successful. Measurement of perceptions forms part of the outputs for the case studies data collection and evaluation.
- **Outcomes** – what are the results (short/medium). The necessary outcomes to achieve the desired impact were identified with reference to literature and researcher experience. These are short/medium terms outcomes which provide intelligence to advise whether the intervention is on course for meeting the longer-term objectives and impact.
- **Impact** – what are the long-term outcomes. The expected impact of the SLIT i.e. to improve safety performance.

	Inputs (A)	Outputs (B)	Outcomes (C)	Impact (D)
When?	Planning and enabling phase prior to commencement of each project	During each project	At the end of each project	Across all projects
	A1. Safety vision and goals defined A2. Transformational leadership skills applied A3. Transactional leadership skills applied A4. Safety performance monitoring and review	B1. Belief in leadership commitment to safety B2. Role model safety leadership behaviour B3. Consistent response to incidents B4. Feedback on safety performance	C1. Reduced accidents and incidents C2. Increased visibility of safety leadership behaviours C3. Increased invoking of refusal to work C4. Increased hazard and near miss reporting	D1. Increased safety performance D2. Increased safety culture maturity scores

Table 3.3 High-level logic map

Once the components on the logic map were developed, the causal logic was articulated between the different steps on the map (A through to D). This involved considering the following questions:

- What is the reason for believing that an input (column A) will lead to output (column B) and an outcome (column C)?
- Is there any other possible explanation for the output/outcome achieved?
- Will the outputs/outcomes be consistently achieved? If not, what are the circumstances when this is not achieved?
- What might prevent the output/outcome being achieved?

In order to achieve an understanding of the causal logic, plus how the data might be collated, the following aspects were defined for each of the components on the logic map.

- **The information context** – explanation of what the criteria for each of the evidence sources was looking to address. e.g. Personal safety behaviours are defined, including personal contribution to achieving safety vision and values.
- **Source of information** – the source of evidence where this information could be expected to be found on each project e.g. Behavioural standards within site induction, and project roles and responsibilities
- **Leadership aspects** – the specific leadership behaviours required as part of the evaluation e.g. Defines behavioural standards for everyone - sets expectations.
- **Reliability and validity comments** – Points to note when undertaking data collection and evaluation for each aspect of the logic map e.g. Easy to collect (the record either exists or not), or what is the relationship with values, objectives and behaviour? Difficult to determine this.
- **Assessment method and criteria** – cross referencing to the different data collection materials used within the study to ensure that these address and collect all of the data needed as defined within the logic map.
- **General comments and considerations** – general point of reference to the researcher e.g. Could do analysis on what type of goals easily.
- **Links to other components on the logic map** – reference to the expected output from the input, or the expected outcome from the output. Identifies the different causal relationships between inputs, outputs, outcomes and impacts.

This detail was prepared for each component within the logic map, a summary of which is shown in Figure 3.2. A full copy of the logic map is included within the appendices.

The logic map was the evaluation framework for the robust evaluation of the six project case studies. The logic map formed the basis of the evaluation for each of the case studies individually, to determine the effectiveness of the SLIT on safety performance within the Project Delivery Organisation. This was achieved following the causal relationships between the different components of the logic map (Inputs, Outputs, Outcomes and Impact).

In addition, the logic map also provided a structured evaluation framework across the six case studies to determine the impact of influencing factors on the effectiveness of the SLIT as a safety leadership intervention. The framework identified whether or not there was improved safety performance across the whole sample of six case studies. This aspect of the evaluation included comparisons of:

- Which safety interventions were implemented, and which were not, plus any reasoning for this (the inputs)
- Which safety interventions worked well, and which were reported less effective for improving safety - achieved through review of outputs, outcomes and impacts
- the influencing factors across all case studies

Component from the logic map	Information Context	Source of Information	Leadership Aspects	Reliability Comments	Validity Comments	Assessment Method						Assessment Criteria	General Comments and Considerations	Links
						Fact Sheets	PC	Interview	SC	Interview Project Records	Employee Survey			
A1. Safety vision and goals defined	Defined safety goals and objectives for the project, including behavioural standards, within project documentation	Project H&S Plan, Policy Statements, Site Induction, Site Rules	Sets the vision, defines expectations for safety behaviour. How do leaders translate goals into action?	Easy to collect (i.e. whether they exist or not).	How do other people understand the integration and priority of goals with other business objectives? How are they brought to life? More difficult to understand the impact	X	X	X				How many as a proportion of wider business goals? What are they?	Could do analysis on what type of goals easily.	B1
	Personal safety behaviours are defined, including personal contribution to achieving safety vision and values.	Behavioural standards within site induction, and project roles and responsibilities	Defines behavioural standards for everyone - sets expectations.	Easy to collect (i.e. whether they exist or not).	What is the relationship with values, objectives and behaviour? Difficult to determine this.		X	X	X	X		What behaviours are defined? How are these communicated? Are these widely understood?	Current test does not include a test of identification or understanding of project safety goals within the employee survey.	B1
	There is a schedule which defines the frequency of safety tours for Senior Management.	Safety tour schedule, records of completed safety tours	Visible leadership in the workplace. Opportunity for engagement with the workforce. Walking the talk. Demonstrate role model behaviours.	Collection of number data is easy. Qualitative review of the tour records more difficult and subjective. Reliance upon others to record their tour.	Balance: paperwork reflects actual engagement. What is more important? Is the emphasis on doing the tour or demonstrating transformational leadership.		X	X	X	X		Who undertake tours at at which level in the company? How many are scheduled and completed (% planned tours completed), Quality of tour records (engagement).	Does the employee survey adequately cover this?	B1 B2 B4

Figure 3.2 Example from Safety Leadership Intervention Tool logic map

3.10 Chapter Conclusion

This chapter has outlined the approach taken in the thesis, demonstrating the selection and rationales for specific methods deployed in each of the studies (1 to 4). Throughout this research a mixed methods approach was undertaken to achieve the research objectives. Table 3.1 S summarises the methods undertaken aligned to the thesis objectives.

Part of the thesis relied on tried and tested methods:

- Study 1 – safety culture perception ratings for a Project Delivery Organisation, analysed quantitatively using parametric statistics
- Study 2 – survey of supply chain existing Safety Improvement Programmes, analysed qualitatively
- Study 3 – interviews of attitudes to safety leadership within Project Delivery Organisations, analysed qualitatively using thematic analysis

This chapter identified a new approach for evaluating safety culture on construction projects within Study 4. This included development of data collection materials based on a logic mapping approach. Whilst logic mapping is frequently used in intervention studies, there is little research of this approach being used for construction projects where the significance of influencing factors is a critical aspect to evaluation of interventions. The logic map also became the evaluation framework both within and between projects.

The use of a logic map was deemed to have potential value to the approach taken as it is a well-used approach for intervention studies. The discussion will include a reflection on the effectiveness of this approach.

The following chapters provide more details on the four different studies that have been undertaken as part of the PhD thesis:

- understanding safety interventions within construction projects
 - Study 1 Project safety culture maturity
 - Study 2 Survey of safety improvement programmes
 - Study 3 Evaluation of attitudes to safety leadership
- evaluating the influencing factors and related success for safety leadership interventions
 - Study 4 Safety Leadership Intervention case studies

4. Understanding Safety within Construction Projects

4.1 Introduction to Chapter

As has already been identified in early chapters, there is currently a lack of research into safety leadership interventions within the Infrastructure Engineering Sector. Research by Fleming and Lardner (2001) suggests that for safety interventions to be effective they must be tailored to the level of organisations maturity. Therefore, in order to meet the thesis aim and objectives it is necessary to evaluate existing safety leadership interventions and if these are found to influence, either positively or negatively, the safety culture maturity of the industry.

This chapter details the findings of two studies to better understand the following:

- Study 1 – Perceptions of safety culture maturity are important for creating a readiness to change and improve safety performance. Research to date tends to treat organisations as a single body, with less focus on understanding how perceptions vary in a multi stakeholder environment; understanding the interfaces and relationships between Principal Contractors and their Supply Chain, and the impact on perceptions safety culture for Project Delivery Organisations in the Construction Industry. This study explores whether there is a difference in perception between project members, and the potential implications for a project implementing a safety improvement programme within the sector. The conclusions of Study 1 shall identify the perceived prevailing level of cultural maturity, which is relevant for Chapter 6 where a safety leadership intervention is developed for use within a Project Delivery Organisation.
- Study 2 – This study outlines the existing Safety Improvement Programmes deployed in the industry to obtain an understanding of where safety leadership is addressed. The view that behavioural safety programmes focus amongst Principal Contractors only and are not embraced by contracting organisations within the Supply Chain is explored. Baseline surveys have been undertaken to determine the extent of such programmes within the supply chain, whether the programme contents are supportive of literature, and are considered effective at improving safety performance.

In order to understand the current state of safety leadership within the industry, the separate studies used a combination of methods as follows:

- obtaining and collating data through surveys
- quantitative analysis of perception ranking data using statistical analysis techniques

The specific research questions, methods, analysis and results for each study are provided in the rest of this chapter, firstly for Study 1 and then for Study 2. The relevance of these findings are then discussed in the chapter summary for the context of the wider thesis objectives.

4.2 Study 1 - Understanding the Current Perceptions of Project Safety Culture Maturity

This study is focused on understanding the perceptions of safety culture maturity of key members within a Project Delivery Organisation: Principal Contractor and Supply Chain, to validate whether the findings from previous research can be applied to a Project Delivery Organisation.

This study seeks to determine the perceived level of safety culture maturity across a sample of Project Delivery Organisations within the Infrastructure Engineering Sector exploring the perceptions of safety culture maturity of both Principal Contractors and the Supply Chain. This study considers four research questions as listed below:

- How do Principal Contractors and the Supply Chain rate themselves and others?
- Are there differences in these ratings?
- Is there evidence of self-enhancement, where project members do score themselves higher than they score other parties?
- Are any differences significant, and is this important for the Principal Contractor when implementing Safety Improvement Programmes?

For the purposes of this study the Client organisations have been excluded as the interface with the Project Delivery Organisation is only via the Principal Contractor (one appointment); there is no direct contractual relationship between the Client and the Supply Chain, with a complete reliance on the Principal Contractor managing their Supply Chain for the effective and safe delivery of the project.

4.2.1 Study 1 - Method

The existence and effectiveness of an organisation's safety culture can be measured by its safety culture maturity (Parker et al 2006) (Fleming 2001).

There are several safety culture maturity models which define the levels of organisational maturity against the characteristics listed previously; safety management systems, safety planning, leadership, engagement and response to incidents. All such models define their criteria for evaluation of an 'organisation'. However, a Project Delivery Organisation is made up of numerous organisations, the majority of whom are SMEs, thus introducing factors that have the potential to impact on the safety culture of the project.

4.2.1.1 Participants

To evaluate the relevant organisation's perceptions of safety culture maturity, a series of 17 workshops were undertaken across four different Principal Contractors, and their respective Supply Chains. Each Principal Contractor was representative of those undertaking the role within the Infrastructure Engineering Sector. Supply Chain members were engaged in this study through their existing communication arrangements with the Principal Contractors.

The participants included 114 Principal Contractor representatives and 253 Supply Chain representatives, a total of 367 participants.

There were a maximum number of 25 participants in each workshop; mean 21 participants per workshop. Individuals were invited to participate as part of a wider behavioural safety training course that was being undertaken on the same day delivered by the researcher. All participants were managers who worked within Project Delivery Organisations as part of the day to day activities.

Workshops were delivered to the Principal Contractor representatives only as a group, then repeated for the Supply Chain of the Principal Contractor. There were separate workshops held for the Principal Contractor and Supply Chain to minimise peer pressure. However, each Principal Contractor had requested and arranged for the Supply Chain to attend the workshops.

4.2.1.2 Procedure

For each Principal Contractor, workshops on assessing safety culture maturity were conducted using the Hudson Model (Parker et al 2006).

At each workshop participants received a brief tutorial on safety culture maturity and were provided written guidance on the characteristics associated with the different maturity levels; level 1 pathological, level 2 reactive, level 3 calculative, level 4 proactive, level 5 generative. This took the researcher 10 minutes to explain the principles of maturity models supported by a drawing of

the five levels on a flip chart. A single A4 handout was then provided to participants with a paragraph describing the characteristics for each of the different maturity levels, which they were given time to read.

For the survey aspect of the workshop, every participant was asked to rate safety culture maturity; ratings were against the five levels of maturity on the model: 1 to 5. Each participant provided two ratings;

- One for the maturity level of Principal Contractor
- One for the Supply Chain

The ratings were recorded by individuals on paper and then collated. Confidentiality and anonymity of ratings was maintained during this process. Some of the ratings that were given by some participants identified that they were between specific maturity levels as well as being rated at a specific level i.e. 3.5 maturity level was given to represent a rating between calculative (level 3) and proactive (level 4).

For each workshop the rankings for both Principal Contractor and Supply Chain were plotted anonymously on a flip chart by the researcher and shared with the group. The summary results shown on the flip chart was followed by a general discussion regarding the perceived safety culture maturity of the Principal Contractor and Supply Chain. Any conclusions were validated during the open discussion forum, where individuals confirmed that the results were what they thought as a group.

This procedure was repeated for all of the workshops for both the Principal Contractor and Supply Chain participants.

4.2.1.3 Analysis

Following each workshop, the paper records were transferred into an excel spreadsheet which identified rater group (independent variable; Principle Contractor (PC) or Supply Chain (SC)), who the score was for (independent variable) and what the score was (dependent variable). There were 114 Principal Contractor representatives who provided 228 rankings. There were 253 Supply Chain representatives who provided 506 rankings. All of the rankings collected were non-normal continuous ordinal data, based on the Hudson Model 1-5 maturity levels. Regarding the data collected from each participant, it is important to note the following:

- Each data point for a Principal Contractor represents a different individual from the Principal Contractor organisation

- Each data point for a Supply Chain represents a different organisation

Once all of the workshops had been completed, the data was collated and analysed via independent Mann Whitney U Tests using SPSS. The data was analysed to identify the significance of the following variables:

- The mean perception of safety culture maturity of Principal Contractors
- The mean perception of safety culture maturity of the Supply Chain
- Using the mean perceptions, did the Principal Contractor score themselves higher than they scored the supply chain
- Using the mean perceptions, did the Supply Chain score themselves higher than they scored the Principal Contractor

4.2.2 Study 1 - Results

4.2.2.1 Overall Ratings of Maturity

Across all ratings given (N367) the mean perceived safety culture maturity of the Principal Contractor was 3.36 (st Dev 0.750).

Across all ratings given (N367) the mean perceived safety culture of the Supply Chain was 2.78 (st Dev 0.858).

The study has found that there is a significant difference in the perceived safety culture maturity of the Principal Contractor and Supply Chain, with the Principal Contractor safety culture maturity perceived to be more mature than the Supply Chain.

4.2.2.2 How do Principal Contractors and Supply Chain rate the maturity of themselves and others?

Figure 4.1 illustrates the differences in perception between the Principal Contractor (PC) and Supply Chain (SC), whether they were giving a score for themselves or the other group.

There was no significant difference between ratings that were provided by the Principal Contractor and the Supply Chain for the Principal Contractor; mean score given by PC 3.34 – SC 3.38, was not significant.

There was a significant difference between the ratings from the Principal Contractor and the Supply Chain for the safety culture maturity of the Supply

Chain; mean score given by PC 2.25 – SC 3.11, was significant $U = 15,594.5^{**}$ $P < 0.00$.

The Principal Contractor perceives the Supply Chain cultural maturity to be much lower than their maturity level (mean score given for PC 3.34 – SC 2.25), this was significant $U = 2,276^{**}$ $P < 0.00$.

The Supply Chain perceives the Principal Contractor cultural maturity to be higher than their maturity level (mean score given for PC 3.38 – SC 3.11), this was significant $U = 12,093.5$ $P < 0.00$.

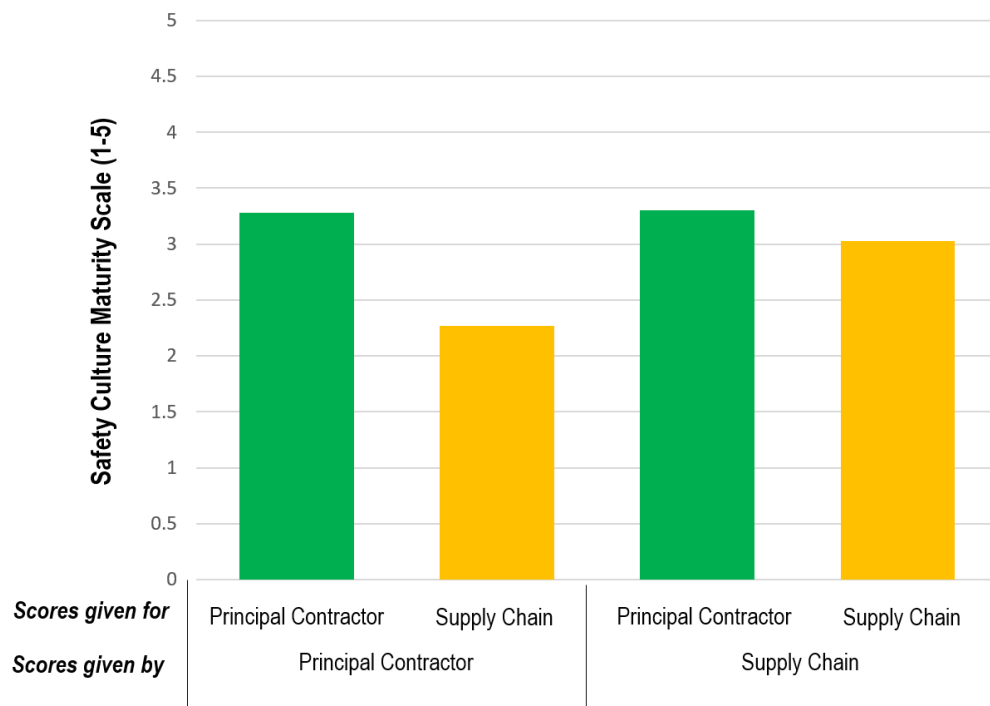


Figure 4.1 Safety Culture Maturity Perceptions within Project Delivery Organisation

4.2.3 Study 1 - Findings

This study has found significant differences in perceived safety culture maturity between Principal Contractors and their Supply Chain. Across all participants the perceived safety culture maturity of Principal Contractors was found to be higher than that of the Supply Chain. However, there was a narrower range of ratings given by the Principal Contractors for themselves, than those received from the Supply Chain (PC range 2-4.3, SC range 1-5). Therefore, it could be concluded that overall Principal Contractors have a similar view regarding their perceived safety culture maturity. By contrast the Supply Chain perceptions are less consistent.

The Principal Contractor's level of safety culture maturity was consistently found to be at level 3 calculative on the Hudson Model (Parker et al 2006) by both Principal Contractor and Supply Chain representatives. This is supportive of a study by Walters and James (2009) where larger organisations were found to have a more mature safety culture. However, the study identified that some of the Supply Chain were less mature around a level 2 reactive to 3 calculative.

This study also found that there were differences in how the Supply Chain rate themselves and how they were rated by the Principal Contractor, with the Principal Contractor perceiving the Supply Chain maturity to be lower than the Supply Chain consider themselves (2.25 and 3.34 respectively).

Literature has shown that when individuals rate themselves, they have a tendency to rate themselves higher than other parties; referred to as self-enhancement (Hoorens 1993) and is relevant in the context of safety values as it makes people feel good about themselves. This is evident within this study for Principal Contractors but not amongst the Supply Chain. Principal Contractors as the larger organisation are found to have more access to health and safety resources, provide more training and have established safety management systems (Arditi and Chotibhongs 2005, Cooper 2001) resulting in a more positive safety culture, which is recognised by all parties within the Project Delivery Organisation. From previous research, as a large number of the Supply Chain are SMEs, it is often found that SMEs have fewer safety arrangements due to lack of commitment, awareness and resources (Arditi and Chotibhongs 2005, Briscoe et al 2001, and Akintoye et al 2000), and therefore may have a less mature safety culture. The study findings therefore indicate that self-enhancement is not always evident within a Project Delivery Organisation. This may be attributable to the adversarial nature of relationships between Principal Contractors and their Supply Chain (Akintoye et al 2000, Cox and Ireland 2002, Briscoe et al 2001, Hinze and Gambatese 2003, Briscoe and Dainty 2005). Further work is required to understand this significance of this for the Infrastructure Engineering Sector of the Construction Industry.

4.3.2.1 Potential Study Limitations

Regarding potential study limitations, the main consideration is regarding the collection of data points. For each Principal Contractor, the number of data points is provided by a number of different people representing the Principal Contractor organisation. In contrast, the data points provided by the Supply Chain are from one individual per supplier/subcontractor organisation. Therefore, this means that the results for the Supply Chain are based on one

individual's perception and may not be truly representative of the whole supply chain organisation. However, this method was chosen as it is representative of the organisational structure of a Project Delivery Organisation.

Measuring safety performance has evolved in recent years to take more account of leading indicators rather than solely lagging factors. Lagging factors take account of accident frequency rates, number of lost time accidents, costs of accidents etc. Leading indicators include achievement of management objectives, effectiveness of training, climate perception surveys etc. There are validity and reliability concerns regarding both sets of indicators as an accurate measurement of safety performance within an organisation. Output measures are most commonly used for measuring safety performance i.e. accidents and events associated with failures; these indicators have not been included within this study. However, whilst research shows some evidence of inputs as measures of safety performance, including climate perception surveys, it is recognised that perceptions of safety can be subjective. The large sample size was considered representative of the diverse nature of the industry with a mix of participants from across a range of different Principal Contractors (from medium to large contractors) and subcontractor organisations from the Supply Chain (organisational size from small to large). This breadth of organisation size is typical of the member organisations working on any project, across the Construction Industry.

The tutorial addressed the potential impact of a varying level of understanding of organisational cultural maturity. All group participants completed the scoring exercise individually, reducing the likelihood of peer pressure influencing their scores. Furthermore, there was limited opportunity for discussion between delegates and whilst this may have helped inform those with less knowledge on the subject matter, it may have also led to a greater influence over individual responses.

The safety culture maturity model that has been used within the study has ratings against 5 levels. There may be a central tendency evident in the results, as the mean maturity level for all Project Delivery Organisations was 3.09, calculative level of maturity. Each participant was advised that as part of the workshop the anonymised overall group findings would be published within the workshop, which may have influenced individual responses and contributed to a central tendency. However, the standard deviation was 0.85305, indicating that there was a reasonable variance of responses amongst a high number of participants (N367).

4.3 Study 2 - Understanding Existing Safety Improvement Programmes on Construction Projects

As part of this study two surveys have been carried out within the Infrastructure Engineering Sector. The three research questions being explored are listed below:

- I. What is the extent of Behavioural Safety Programmes within the Supply Chain?
- II. Are the Supply Chain Behavioural Safety Programme contents are supportive of the literature on this subject?
- III. Are Behavioural Safety Programmes are considered by the Supply Chain to be effective at improving safety performance (a reduction in accident statistics)?

4.3.1 Study 1 - Method

Each survey was undertaken for two different Principal Contractors who work within the road and rail sectors, and their Supply Chain; identified as Supply Chain A and B. Both Principal Contractors had their own Behavioural Safety Programme in place. All of the PCs were involved in the communication of the hardcopy questionnaire survey to their Supply Chains and requested their participation.

Completed survey questionnaires were returned anonymously and analysed qualitatively by the researcher. The development of the questionnaire made reference to the work of Fleming and Lardner (2000) with questions developed based on the key aspects they identified within a Behavioural Safety Programme. For example, programme objectives clearly defined, inclusion of training, behavioural observation schemes, measurement of safe and at-risk behaviours, leadership and engagement activities. Questions were written for respondents to provide a yes/no answer. There were free text questions at the end of the survey for participant to capture any additional points as commentary.

Text fields and comments were coded as part of the analysis. Once each questionnaire had been reviewed, the responses were coded in an inductive manner, with codes being driven by the data set and not predetermined by a coding framework. The codes that were generated from across all records were listed to form a full suite of codes. The full suite of codes were used as reference criteria for reviewing the interview records again (second review), to confirm the original coding or allocate a revised code to the text. Where different or

additional codes were allocated these changes were noted on the individual questionnaire. Once codes were identified these were recorded in a table for each question within the survey.

4.3.2 Study 1 - Results

For the two questionnaire surveys the response rates were:

- Supply Chain A = 88 questionnaires issued, response rate of 56.8% (N50)
- Supply Chain B = 121 questionnaires issued, response rate 12% (N15)

Of the 209 questionnaires issued, the overall response rate was 31% (N65). It is noted that there was a lower response rate from Supply Chain B than Supply Chain A. The results therefore include a higher proportion of information from Supply Chain A, yet there are similar results across both groups as shown in Table 4.1.

Table 4.1 outlines the data collated from the surveys for each of the study research questions. Research questions one and three were calculated using N65.

A total of 13 Supply Chain Organisations stated they had a Behavioural Safety Programme in place. Therefore, data in response to objective two relating to the contents of their Behavioural Safety Programme is calculated using N13.

Study 2 Research Questions	Questions contained within the survey	All Survey Responses	Supply Chain A	Supply Chain B
i – The extent of Behavioural Safety Programmes within the Supply Chain (N65)	Do you have a Behavioural Safety Programme in place? Have you been requested to follow other Clients and Principal Contractor's Behaviour Safety Programmes?	20% (N13) 46% (N30)	16% (N8) 40% (N20)	40% (N5) 72% (N10)
ii- Are the Programme contents are supportive of the literature on this subject (N13)	Do you have specific objectives for your programme?	77% (N10)	75% (N6)	80% (N4)
	Is your programme applied to subcontractors, suppliers and or/other supply chain organisations within your business?	62% (N8)	75% (N6)	50% (N2)
	Does your company have a nominated 'champion' for behavioural safety?	77% (N10)	87.5% (N7)	75% (N3)
	Have you delivered any training for behavioural safety in your company?	77% (N10)	100% (N8)	50% (N2)
iii – Are programmes are considered by the Supply Chain to be effective at improving safety performance (N65)	Have there been any key successes of your own/another organisation's Behavioural Safety Programme?	35% (N23)	34% (N17)	40% (N6)

Table 4.1 Summary of positive responses to each question within the survey

A total of N13 participants provided 21 specific comments on the objectives of their Behavioural Safety Programme. Table 4.2 provides a more detailed breakdown on the responses given, shown as a percentage of responses for each of the respective codes, from the highest to lowest.

Code	Relevant Literature	Number of comments given per code
Improved safety culture	Zohar (1980), Fleming (2001), Copper (2001), Schein (2010), Clarke (1999),	19% (N4)
Organisational alignment	Clarke and Flitcroft (2013), Conchie and Moon (2010), Cooper (2000, Bresnen and Marshall (2000b)	14% (N3)
Personal responsibility for safety	Briscoe et al (2001), Briscoe and Dainty (2005), Arditi and Chotibhongs (2005)	14% (N3)
Engagement on safety	Fleming (2001), Hudson and Parker (2001), Mearns et al (2003), HSE (1999), Schein (2010), Clarke (1999), Ostrom et al (1993)	14% (N3)
No injuries or deaths	HSE (1999)	14% (N3)
Safety first – prioritise safety	Berends (1995), Zohar (1980), Fleming (2001), Hudson and Parker (2001), HSE (1999), Schein (2010), Clarke (1999)	10% (N2)
Visible safety leadership	Geller (1994), Zohar (1980), Fleming (2001), Hudson and Parker (2001), Mearns et al (2003), Langford et al (2000), Ostrom et al (1993)	10% (N2)
Improved safety management	Pidgeon (1991), Langford et al (2000), HSE (1999)	5% (N1)
Total number of comments		100% (N21)

Table 4.2 Breakdown showing purpose of Behavioural Safety Programmes

77% (N10) of those organisations with a Behavioural Safety Programme (N13) had appointed Behavioural Safety Champions. Table 4.3 shows the roles who were identified as Behavioural Safety Champions.

	Supply Chain Organisations with Champions						
Code	SC1	SC2	SC3	SC4	SC5	SC6	SC7
Directors	X	X				X	
Managers				X	X		
Health and Safety Reps		X	X		X		
Support functions				X		X	X
External people				X			

Table 4.3 Behavioural Safety Champions by Role Type

4.3.3 Study 2 - Findings

It is concluded that there is a small proportion of the Supply Chain that have a Behavioural Safety Programme in place, even though many had been requested to follow other Clients/Principal Contractor's Behavioural Safety Programmes (as outlined in Table 4.1).

i – The extent of Behavioural Safety Programmes within the Supply Chain (N65)	Do you have a Behavioural Safety Programme in place? Have you been requested to follow other Clients and Principal Contractor's Behaviour Safety Programmes?	20% (N13) 46% (N30)	16% (N8) 40% (N20)	40% (N5) 72% (N10)
ii- Are the Programme contents are supportive of the literature on this subject (N13)	Do you have specific objectives for your programme? Is your programme applied to subcontractors, suppliers and or/other supply chain organisations within your business?	77% (N10) 62% (N8) 77% (N10)	75% (N6) 75% (N6) 87.5% (N7)	80% (N4) 50% (N2) 75% (N3)

	Does your company have a nominated 'champion' for behavioural safety? Have you delivered any training for behavioural safety in your company?	77% (N10)	100% (N8)	50% (N2)
lii – Are programmes are considered by the Supply Chain to be effective at improving safety performance (N65)	Have there been any key successes of your own/another organisation's Behavioural Safety Programme?	35% (N23)	34% (N17)	40% (N6)

Table 4.1 Summary of positive responses to each question within the survey

From the results, the researcher concludes that the contents of Behavioural Safety Programmes within the Supply Chain are varied, and although they do focus on areas that are recommended in the literature there is not one standard approach. A qualitative analysis of the comments provided on the questionnaires has identified that the most common objectives were to improve safety culture as detailed in Table 4.2). Visible safety leadership was less prevalent in responses at 10% of respondents including leadership within their Behavioural Safety Programme.

Table 4.3 identifies the most common groups of people appointed as champions were Directors, Health and Safety Representatives and Site Support staff.

It is concluded that there is a perception amongst 35% of Supply Chain that Behavioural Safety Programmes are beneficial at improving safety performance. This remains a relatively low positive response, the possible reasons for this are explored in later studies. The main successes were noted as increased awareness of behavioural safety, increased engagement within the company and an improvement in accident statistics.

This study has found that Behavioural Safety Programmes amongst the Supply Chain are generally targeted at Directors, Health and Safety Representatives and Site Support staff engaging with the workforce and raising awareness of the impact of behaviours on safety. There was limited recognition of the importance of leadership in improving safety culture, this is despite Wu et al (2008) identifying that of all the elements that contribute to successful safety management, the safety commitment and action of leaders is the most important; where leaders demonstrate visibly the strongest commitment and action on a regular basis.

Furthermore, those identified as being Behavioural Safety Champions were Directors, Health and Safety Representatives and Site Support staff, and there was no mention of supervisors from any respondents. Whilst research identifies the importance of safety leadership at two levels; Senior Management and front-line supervisors, this study found that supervisors were not reported as championing existing Behavioural Safety Programmes. This may be attributed to the perception of the role of a champion and relating this to leadership from Senior Management. It is acknowledged that how each of these groups demonstrate their commitment to safety is different; based on their roles and day to day responsibilities (Thompson et al 1998, Marsh et al 1998). However, raising awareness of the importance of supervisors in Safety

Improvement Programmes appears to be an area of improvement. This is explored further in Study 4.

4.3.3.1 Potential Study Limitations

The sample included within the study is considered to be representative of both road and rail sectors of two medium-to-large sized Principal Contractors Principal Contractor's Supply Chain. The participants from the Supply Chain worked for a cross section of organisations of varying disciplines, sizes and geographical location, which is typical of the industry. Due to the anonymous nature of the surveys it is not possible to identify demographic trends amongst the respondents. This may be worthwhile pursuing in further studies.

The method chosen for the distribution of the survey was via letter and hard copy. Although completion of paperwork may have reduced the number of responses, the questionnaire was very short. It is also recognised that the though the sample for Supply Chain B is small in number. However, across the two surveys 209 questionnaires were issued with an overall response rate of 31% (N65). To overcome this, the study could have surveyed the Supply Chain of other Principal Contractor's.

4.4 Understanding safety within construction projects - Conclusions

Study 1 and Study 2 both provided a foundation for understanding the safety within construction projects which both informed the remainder of the thesis, following a period of reflection.

4.4.1 Perceptions of Safety Culture Maturity

Study 1 evaluated perceptions of the safety culture maturity of both Principal Contractors and the Supply Chain to establish whether or not there is a difference in perceptions of cultural maturity level for a given Project Delivery Organisation. Whilst there has been extensive research into safety culture within other industries, there is limited understanding of maturity within the Infrastructure Engineering Sector, in particular whether there is an impact from the structure of a project.

The study has identified that there is a difference in perception of safety culture maturity amongst members of a Project Delivery Organisation which may affect the successful implementation of a Safety Improvement Programme. In

particular, the Supply Chain are not perceived to be as mature as the Principal Contractors,

This study only assessed the perceptions of safety culture from Principal Contractors and the Supply Chain; no ratings were obtained from Client representatives. Whilst the Client is usually the funder of the project and specifies the project remit, it is believed that the Clients' influence is often far greater, and they can have a direct impact on project safety performance (Winkler and Irwin 2003). Therefore, it would be worthwhile including the client's perception of project safety culture in future studies; as they could provide an opportunity for triangulation of safety culture perception data between the Client, Principal Contractor and Supply Chain.

The main methodological consideration was the collection of data points. For each Principal Contractor, the number of data points is provided by a number of different people representing the Principal Contractor organisation. In contrast the data points provided by the Supply Chain are from one individual per supplier/subcontractor organisation. However, this method was chosen as it is indicative of the organisational structure of a Project Delivery Organisation and the Construction Industry (fewer larger organisations, many smaller organisations). It is recognised that there will always be intercompany differences which may not have been addressed through a purposive sampling technique undertaken within Study 1.

4.4.2 Project Safety Improvement Programmes

Study 2 identifies those Behavioural Safety Programmes that are in place within the Supply Chain are aligned to literature to a greater or lesser extent. The setting of objectives for improving safety culture, nomination of champions to lead behavioural safety in the workplace, and the delivery of behavioural safety awareness training are all included within their programmes. However, this study has found that there is not one standard approach across all of the Supply Chain.

This study identified only a small proportion of the Supply Chain had a Behavioural Safety Programme (20% of respondents), supporting the view that Behavioural Safety Programmes are yet to be embraced within the Supply Chain. As the Supply Chain are SME's, they are associated with financial insecurity, a lack of dedicated health and safety resources and informal safety arrangements (Walters and James 2009) which may be contributing factors. This would suggest that whilst there may be a requirement or desire to have a

Behavioural Safety Programme there are factors preventing application; resources, cost, time, awareness and understanding. As one of the successes was increased awareness, there may be a lack of understanding of the benefits of such a programme amongst the Supply Chain.

The depth of information achieved through Study 2 was limited. Therefore, it is recommended that further research is undertaken to confirm the significance safety leadership within a SME's Behavioural Safety Programmes in this sector of industry and to gain a greater understanding of the factors that influence such organisations to establish Behavioural Safety Programmes.

4.5 Chapter Summary

This chapter concludes that despite there being a wealth of literature relating effective leadership to positive safety performance, there seems to be a lack of leadership as a component of existing Safety Improvement Programmes within construction projects.

The questions raised as outcomes from this chapter are listed in Table 4.4 below. Those that are explored further during the thesis are identified in the right-hand column.

Topic	Questions identified for further exploration	PhD Study Reference
Project Culture	Is there a negative impact on project safety culture, from a reliance on Supply Chain SME's? Are there any reasons for this? How might a Principal Contractor overcome these issues?	The impact of Contractorisation as a factor which may influence safety culture on a project is explored further within Study 4 (Chapter 7).
	The difference in perception amongst key organisations (excluding the Client) within the Project Delivery Organisation poses a challenge to the current safety culture maturity models. Do they provide sufficient scope to assess the safety culture maturity of organisations within a project with the additional complex relationships this involves? Do existing safety culture maturity models provide sufficient guidance on how to develop project safety culture through successful improvement programmes?	Safety Culture Maturity Models inform data collection methods within Study 4 where a Project Managers Assessment is completed. This was adapted following the pilot exercise. Details are contained within Chapter 7.
Safety Improvement Programmes	If one member of the Project Delivery Organisation scores themselves high, and another low, what impact does this have on change efficacy and implementing a successful safety improvement programme? Are improvements more or less likely to be successful because member organisations want to, they have to or they ought to make changes to their organisational arrangements that improve safety culture?	Adoption of interventions initiated through Safety Improvement Programmes is investigated within Study 4 (Chapter 7). This includes a review of change efficacy relating to safety leadership interventions.
	Are there project-related barriers affecting how the Supply Chain participate in Behavioural Safety Programmes?	Study 4 investigates the relevance of influencing factors which effect the adoption of safety leadership interventions across six case study projects.
Leadership	How effective are the different safety leadership interventions within a Project Delivery Organisation? Is there evidence that effective safety leadership interventions positively impact on safety performance?	Study 3 (Chapter 5) identifies the existing safety leadership interventions common across the Infrastructure Engineering Sector. Study 4 (Chapter 7) evaluates the implementation of safety leadership interventions and establishes whether they have had an impact on safety culture and performance.

Table 4.4 Questions identified for further exploration within the thesis

5. Attitudes to Safety Leadership

5.1 Introduction to Chapter

It is recognised that leadership is important for the development of a positive safety culture. This chapter outlines a study to evaluate attitudes towards safety leadership culture Project Delivery Organisations. The leaders (directors, managers, supervisors, team leaders etc) whether they work for Clients, Principal Contractors or Supply Chain Organisations are vital in inspiring the project workforce to a higher level of safety and productivity, which means that they must apply good leadership attributes on a daily basis.

Safety leadership is widely discussed, commonly relating to improving safety performance within an occupational environment. Whilst there is considerable research on the characteristics of positive and negative safety leadership behaviours, research to date does not evaluate these in the context of rail construction projects, with no specific consideration of the complex interfaces and challenges faced by temporary configurations of Client, Principal Contractor and Supply Chains within this sector.

Within this sector of industry, challenges include the division of corporate and project leadership amongst the Principal Contractor and Supply Chain in relation to safety and the impact of corporate safety leadership and integration of the Supply Chain in project safety arrangements in relation to large projects. Whilst the larger companies tend to demonstrate safety leadership internally, this often fails to be followed through their Supply Chain (HSE 2016a). This is important for Rail Industry Construction Projects, where the majority of participating organisations are Small to Medium-sized Enterprises (SMEs), accounting for 80% of the cost of a construction project (Constructing Excellence 2004). Therefore, if safety culture in rail construction is to improve, the issue of safety leadership must be addressed across a range of stakeholders involved in construction projects.

A method based around interviews has been developed and applied to assess the level of understanding of safety leadership as a topic was evaluated against how well the study participants could explain the concept, and whether they could provide any examples of real-world application within a Project Delivery Organisation.

Interviews were reviewed using a thematic analysis approach in response to the three study research questions as detailed below.

5.2 Study 3 Attitudes to Safety Leadership

The aim of the study presented in this chapter was to investigate attitudes towards effective safety leadership interventions in rail construction projects. Whilst key aspects of safety leadership are clearly identified within literature, there is limited research into the effective application of safety leadership within a complex Project Delivery Organisation. Existing models are focused on safety leadership within a single organisation and do not consider the challenges that are characteristic of this sector. This includes complex multi-organisational interfaces with unclear roles and responsibilities, lack of health and safety resources within the Supply Chain, unknown perceptions of safety leadership within SMEs, and lack of clarity in safety leadership within the temporary nature of a project environment.

Therefore, this study seeks to evaluate attitudes of Senior Management towards safety leadership across a sample of Project Delivery Organisations within Rail Construction for Client, Principal Contractors and the Supply Chain representatives.

The study focuses on the following three research questions:

1. How well understood is the concept of safety leadership within Project Delivery Organisation in rail construction?
2. What safety leadership interventions are currently being undertaken in rail construction Project Delivery Organisations?
3. What factors are identified as influencing the effectiveness/success of safety leadership interventions?

5.3 Method

The study presents in-depth interview analysis of the current understanding and implementation of leadership at different levels of a rail construction project. Interviews were undertaken with rail industry staff to explore the research questions. The structure and content of the questions allowed some variation in the questioning, enabling collection of additional explanatory details and examples to explore the understanding of the interviewees where this was appropriate.

5.3.1 Participants

To evaluate levels of understanding of the concept of safety leadership, 21 telephone interviews were undertaken with Senior Management representatives of the Client, Principal Contractor and Supply Chain (seven from each group). Each participant was chosen based on availability and willingness to participate from the first author's contacts within the industry. Due to the opportunities that were available all seven interviews for the Client group were with Senior Management representatives from an Infrastructure Manager acting as Client for rail construction projects. The Senior Management from Principal Contractors and from Supply Chain Contractors were from different organisations covering a multitude of services within the Rail Construction sector. It is considered that the participants from the Principal Contractor and Supply Chain were representative of those undertaking the role within the Rail Construction Industry.

5.3.2 Materials

A set of interview questions was developed to structure the interviews. The interview involved two stages.

For the first stage, a definition of safety leadership was provided as detailed below:

“Safety leadership is associated with visible and active commitment from the management team. Safety responsibilities are taken seriously and leading by example to establish and reinforce expectations for peers and colleagues through effective downward communication systems, and integration of safety in company-wide decision making (Gadd and Collins 2002, Zohar 2002a).”

Participants were asked whether they understood the statement, and either agreed or disagreed with this. This allowed a general appreciation of level of understanding of the concept of safety leadership, and for any misunderstandings of the concept to be clarified before progressing to the next stage.

For the second stage, participants were asked to share any good practice examples of safety leadership from their experience, using the following questions in relation to each safety leadership example:

- Can you briefly explain how this example works and what is involved?
- Who does this involve?
- How often is this carried out?
- From your experience, what are the good points?
- From your experience, what are the lessons learned?
- Would you repeat or recommend this to others?

5.3.3 Procedure

Each participant was provided a copy of the interview questions in advance of the interview. A telephone interview was carried out at an agreed time, and this was recorded with consent from the participant. Confidentiality and anonymity of information provided was maintained during this process. No findings from previous interviews were discussed with other participants.

The explanation of safety leadership that was provided to the interviewee in advance of the interview was used to frame the concept of safety leadership for the purposes of the interview. The interviewer read the safety leadership definition and asked if the interviewee understood the definition and secondly whether they agreed or disagreed with the statement, and their reasoning for this. Secondary questioning allowed the researcher to probe enough to establish whether the participant had experience of safety leadership in practice or whether commentary was based on previous training rather than practical implementation. This was further developed with the next phase of the interview where practical experience was discussed. In the next part of the interview the interviewee was requested to share any examples of good practice regarding safety leadership with the researcher, using the prompts listed in Section 5.3.2. This procedure was repeated for all interviews for the Client, Principal Contractor and Supply Chain participants.

5.3.4 Analysis

A thematic analysis approach was taken to analyse the content from the interviews. The analysis followed the 15-point checklist of good thematic analysis identified by Braun and Clarke (2008), which informed the analysis steps undertaken. A similar approach to analysis was repeated for data, for each of the research questions. A summary of the steps in the analysis for each research question are listed in Table 5.1.

Research Questions	Step 1 – Transcription and Data Familiarisation	Step 2 – Initial Coding	Step 3 – Establishing Themes	Step 4 – Reviewing Themes against Literature	Step 5 – Analysis Conclusions	Step 6 – Reviewing Themes and Sub Themes	Step 7 – Theme Relevance and Conclusions
1 Understanding of safety leadership	X	X	X				
2 Examples of interventions	X	X	X	X	X		
3 Factors influencing effectiveness	X	X	X			X	X

Table 5.1 A summary of the steps taken during the analysis for each research question

5.3.4.1 Analysis of understanding of leadership and examples of interventions

This part of the analysis relates to data on the participants' understanding of safety leadership, and secondly their examples of interventions. For the analysis of data on understanding safety leadership only steps 1 to 3 were followed as the interview responses contained were simple and concise and it was easy to allocate responses to one of three groups; no understanding, some understanding or good understanding. For the analysis of data for examples of interventions steps 1 to 5 were applied, with the additional steps included for a review of themes against literature findings in order to form conclusions. Further explanation of the five steps in the analysis are provided below.

Step 1 – Transcription and Data Familiarisation - The interviews were transcribed from recordings. Following the transcription, two reviews of each interview record were undertaken. These were reviewed in batches (Client, Principal Contractor and Supply Chain). The first review was for familiarisation with the data set. On the second review descriptions of leadership/examples of specific leadership interventions were highlighted within each interview record.

Step 2 – Initial Coding – Once each record had been reviewed, the participants' responses (for understanding of safety leadership and also examples of interventions) were coded in an inductive manner, with codes being driven by

the data set and not predetermined by a coding framework. The codes that were generated from across all records were listed to form a full suite of codes. The full suite of codes were placed on individual cards and used as reference criteria for reviewing the interview records again (third review), to confirm the original coding or allocate a revised code to the text. Where different or additional codes were allocated these changes were noted on the individual interview record. These were reviewed in batches for Client, Principal Contractor (PC) and Supply Chain (SC) to simplify the process of administration. Once codes were identified these were recorded in a table for each batch with comments against each.

Step 3 – Establishing Themes - Themes were identified by grouping similar codes, using both the cards and notes on the codes to aid this part of the process of analysis. This allowed a definition to be developed for each theme. For example, examples of safety leadership interventions are provided in Table 5.2.

Batch	Comments	Code	Theme
Client	Briefings by management team, repeated on the project. Site stood down for a whole morning to attend the briefings.	Leadership Briefings	Engagement
PC	Tours are required to ensure key senior leaders of a business are visible to the workforce.	Safety Tours	Leader Visibility
SC	Consult with the workforce to create safety goals, and the importance of their roles when it comes to safety. Ask for workers opinions on what can be done better.	Workforce Engagement	Engagement

Table 5.2 Safety leadership interventions - examples of codes and commentary

Step 4 – Reviewing Themes against Literature – Themes from the analysis in this study were compared with literature on safety leadership interventions. A second set of cards was developed using the nine categories taken from the literature review (section 2.2 – safety as a top priority, demonstrable commitment to safety, increasing visibility around safety, enable safety reporting, workforce involvement, create an open and learning culture, provide recognition for good safety performance, ensure effective communications, maintain a safety management system), which represent good safety

leadership. The cards listing the themes of intervention examples from step 3 above were then matched to the second set of cards based on literature findings of the planned intention for each type of leadership intervention. Themes were then collated into a table; themes which were identified from both the literature and study findings, those identified within the literature but not this study, and vice versa.

Step 5 – Analysis Conclusions – Conclusions from the analysis were recorded.

5.3.4.2 Analysis of factors influencing the effectiveness/success of safety leadership interventions

A similar thematic analysis was conducted for this data relating to this third research question. This included repetition of steps 1, 2 and 3, to become familiar with the data, carry out coding and identify themes within the data, specifically for factors affecting the success of safety leadership. Due to the complexity of the data, sub-themes within each main theme were identified as detailed below.

Step 6 – Reviewing Themes and Sub Themes – For each of the main themes, the cards and table records (generated from step 3 above) were reviewed, in order to identify associated sub-themes. These were collated into a table for each main theme.

Step 7 – Theme Relevance and Conclusions – A written record of the analysis was prepared to identify factors that could influence the effectiveness or success of safety leadership interventions; either positively or negatively. Emphasis was placed on the keyness or relevance of a theme to the context identified above (i.e. the relevance of a theme for the identification of factors that affect successful safety leadership interventions). Prevalence (increased occurrence within the data) was considered as part of the analysis, though recognising that a greater prevalence does not necessarily mean increased significance or importance to the findings.

5.4 Results

5.4.1 Understanding of leadership

The interviews were analysed for the level of understanding of leadership established by the respondents' ability to provide a description of safety leadership supported by 'real world' examples. Participants were asked

whether they understood the statement, and either agreed or disagreed with this. This allowed a general gauge of level of understanding of the concept of safety leadership. Categories of response ranged from demonstrating a lack of understanding of safety leadership through to a good level of understanding, based on participant responses. Example quotations are included.

- I. 'Interviewee didn't really understand' (n = 4) - Individuals who were unable to explain what safety leadership was and couldn't provide any details or describe leadership at all, with wrong examples given that were not representative of safety leadership, but general safety management arrangements.
 - *'Company A has good workforce engagement.'*
 - *'I can't think of any examples that I have seen to be honest, it's not something we would be involved in.'*
- II. 'Interviewee showed some understanding' (n = 6) – Individual's who stated that leadership was important for safety and described the role for safety leadership in terms of setting an example in the workplace, giving one or two examples, but without further explanation or reasoning.
 - *'The Company always strives for best practice in safety leadership. We have adopted a Leadership Evaluation Tool which identifies and measures leadership behaviours.'*
- III. 'Interviewee showed a good level of understanding' (n = 11) - Individual's provided a thorough explanation of why safety leadership is important, giving several different examples of leadership interventions and provided views on those which are most successful.
 - *'Leaders must be passionate about their values and demonstrate them through behaviours consistently. They should want to do it rather than have to do it.'*
 - *'As a senior team, we have regular and visible safety tours, where we have safety discussions with operatives. Our focus is on listening to operative feedback, actioning as we need to. We will share site safety tours with senior team from other contractors, showing our willingness to learn and be open with everyone.'*

The categorisation of responses was determined by the extent of real-world examples given from each participant. Overall, almost all participants (n = 17) showed some understanding of safety leadership with 11 demonstrating a good

level of understanding of safety leadership. This was indicated by being able to spontaneously generate many examples of safety leadership activity. Principal Contractors showed the greatest level of understanding and provided more examples of safety leadership than either the Client or Supply Chain groups.

5.4.2 Examples of leadership interventions

71 references to leadership interventions were recorded from across the interviews. In total, 26 different intervention types were identified from the interviews. Table 5.3 presents the list of interventions provided for each interviewee group: Client, Principal Contractor and Supply Chain.

The three most common interventions identified from interviews were:

- Workforce engagement sessions (identified by 9 participants)
- Site safety tours (identified by 8 participants)
- Mindful leadership (identified by 7 participants)

Following a further review of the 26 intervention types, they were grouped within seven themes on the basis of the planned intention for each intervention. The seven themes and definitions are listed in Table 5.4, along with the total number of references to interventions in that theme from across all batches (Client, Principal Contractor and Supply Chain).

Theme	Example Intervention	Description	Number of Participants that gave this example			TOTAL
			CI	PC	SC	
Strategic Direction	Safety and Health Executive Leadership Team	Meeting/forum where Senior Management discuss safety matters. Usually held by the Principal Contractor, sometime with Directors of supply chain invited to attend.	1	2	0	3
	Site leaders call	Weekly call where all Project Management dial in for a discussion and briefing with the most senior leader within the organisation. Focuses on communication of significant performance issues, and sets clear expectations for the forthcoming week.	0	2	0	2
	Safety objectives in performance appraisals	Safety performance is discussed within personal appraisals and objectives set that are specific to safety.	0	1	0	1
	Policy statements	A legal requirement for organisations who employ more than 5 people. The policy defines the organisation's commitment to safety and is signed by the most senior member of the organisation.	0	1	0	1
Engagement	Step Ups	Time when everyone working on the project stops work to focus on safety. Usually led by Project Management and/or supported by Off Site Senior Management. Facilitation is commonly by the Safety Department.	1	3	1	5
	Contractors Safety Forum	Dedicated forum for the Supply Chain to attend, led by the Principal Contractor/Client to discuss safety matters.	1	1	0	2
	Supervisor forums	A forum for supervisors to discuss safety matters. Chaired by Principal Contractor/Client representative providing a direct route for feedback and communication with Senior Management.	0	2	0	2
	Workforce engagement sessions	A forum with the workforce to discuss safety matters. Chaired by Principal Contractor/Client representative providing a direct route for feedback and communication with Senior Management.	2	2	5	9

Theme	Example Intervention	Description	Number of Participants that gave this example			TOTAL
			CI	PC	SC	
Leader Visibility	Site Safety Tours	Leaders (management from on or off the project) will visit and walk around the site of work activities to review and discuss safety performance with the supervisors/workforce on that site. A report is produced.	1	7	0	8
	Back to the floor	Dedicated time where Senior Management work alongside the workforce and share their experiences in day to day activities, building relationships between management and the workforce.	0	1	0	1
	Prompt interventions	When a leader observes at risk or unsafe behaviour they immediately take action to stop an individual, make safe and correct their behaviour. The leader does not walk by the occurrence.	0	1	1	2
	Mindful leadership	Leaders demonstrate consistent role model behaviour towards safety; individuals have a high level of self-awareness and the impact of their behaviour on others.	2	3	2	7
	Follow up on investigations	Management actions in response to an incident; including the immediate response at the scene, preservation of evidence, escalation and reporting, further investigation and subsequent action. Management are present at event review meetings, provide investigation resources, participate in the investigation and ensure actions are undertaken in a timely manner.	0	1	0	1
Training and Awareness	BBS Programmes	Behavioural Based Safety Programme where individuals attend briefings and training sessions to raise awareness of personal behaviours.	1	2	2	5
	General safety training	Delivery of safety training; some of this is a statutory requirement, others a requirement of the industry, client or company to undertake specific works, including the use of plant/equipment/tools, or the placement of people in nominated roles.	0	1	3	4
	Safety briefings	Briefings of safety related information which may include risk assessments, method statements, safe systems of work, tool box talks.	0	1	0	1

Theme	Example Intervention	Description	Number of Participants that gave this example			TOTAL
			CI	PC	SC	
Reward	Reward Schemes	Defined scheme for recognition of desirable safety behaviours and performance. Rewards can vary from prize draws, donations to charity, trophies, vouchers.	1	1	1	3
Information Sharing	Leadership briefings	Leaders allocate time to deliver important safety messages via briefings. These are usually face to face.	1	1	2	5
	Safe Start Event	Akin to an open day dedicated to safety where leaders are present to discuss safety matters. Everyone is invited to attend from across a project or wider company/organisation. There is often a sharing of good practices and presentation of awards for good safety performance at these events.	0	1	0	1
	Safety moments	Safety messages are communicated; these can be via posters, emails or text messages. These are discussed at every meeting and briefing undertaken during the week of issue. Intention is to promote proactive safety communications and sharing of information.	0	1	0	1
	Observation cards	Post cards are distributed across the site so that individuals can record and report any safety concerns that they have. Project Management collate these and ensure prompt action is taken to resolve any safety concern.	0	1	0	1
	Sharing of good practices	Process for the identification, assessment and sharing of good safety practices and innovations across the project, organisation and wider industry.	0	2	0	2
	Smart safety communications	Timely and effective safety communications for raising awareness of key safety risks as well as communicating significant events and messages to everyone.	0	2	3	5

Theme	Example Intervention	Description	Number of Participants that gave this example			TOTAL
			CI	PC	SC	
Compliance Monitoring	Site safety audits	Scheduled audit/inspection of site practices. Documented record is produced and issued to site management for action. Can be undertaken by on or off site Senior Management, safety department or client representatives.	0	1	1	2
	Use of Just Culture Tools	Structured process for responding to errors and violations in a consistent manner. Also provides guidance on the application of consequences/sanctions for these behaviours.	0	1	0	1
	Worksafe procedure	Process where individuals have the right to stop work on the grounds of safety. The intention is that the individual feels confident to stop and report their concerns, and is not fearful of retribution.	0	0	1	1

Table 5.3 Details of Safety Leadership Interventions including counts from each interview group

Theme	Count	Description
Strategic Direction	7	Provide policy, governance and strategy for safety management arrangements
Leader Visibility	19	The physical presence of leaders in context of safety
Engagement	18	Time allocated for two-way discussion on safety matters with different members of the project's organisation
Information Sharing	15	The provision of safety related information using a variety of media
Training and Awareness	10	The provision of training and awareness increasing knowledge and skills to perform safety related activities
Compliance Monitoring	4	Undertake inspection, audit and assessment of compliance with minimum safety standards
Reward	3	The provision of award to recognise and reward contribution to safety

Table 5.4 Themes identifying planned intentions of safety leadership interventions

5.4.3 Factors influencing the effectiveness/success of safety leadership interventions

The analysis identified several themes that could influence the effectiveness or success of safety leadership interventions; both positively and negatively. A total of five main themes, with between two and four sub-themes were identified for each theme, presented in Table 5.5.

Main Theme	Description	Sub-Themes
Context	The environment and context in which the safety leadership interventions are being applied, including organisational and industry factors	• Leadership role as part of wider objectives is important • Organisation needs to be ready for this approach to be effective • There is a lack of consistency across the industry which undermines progress
Preparation	The focus on planning the safety leadership interventions; what needs to be considered before implementing the intervention(s)	• This is a significant commitment to do right and needs adequate resourcing • Interventions need continual refreshing • Measures of leadership behaviours are difficult; often measure the wrong thing which affects behaviours

Main Theme	Description	Sub-Themes
Communication	The importance of communications to support the implementation of safety leadership interventions	- Targeted communications are important: relevance - Balance between positive and negative messages is important
Leadership Style and Behaviour	Reliance on the individual leaders who will be undertaking the safety leadership interventions	- Leaders must engage, be visible and credible - Leaders are not consistent at walking the talk - Management often overlook why individuals behave in a certain way; they do not tackle the real problem - Very reliant on individuals, their skills and desire to change
Action	Continual delivery of commitments and promises by leaders	- Follow up on actions and commitments is essential - Leaders need to understand that this is not a quick fix!

Table 5.5 Themes and Sub-Themes outlining factors for the successful application of safety leadership interventions

Each of the themes for success can be expanded upon as follows. The theme 'context' takes account of the environmental factors in which the leadership interventions are being applied. The analysis has identified three different aspects for consideration. Cognisance of the integration of safety within wider organisational objectives is important, as well as the trigger or driver for any improvement activity; both of which are internal factors to an organisation and therefore more valuable to a Senior Manager who seeks to initiate an improvement programme implementing safety leadership interventions. However, the third sub theme identified is in relation to the wider industry and the lack of consistency therein, which an organisation may need to be aware of but is unlikely to have significant influence over.

'Preparation' was also indicated as a critical factor. Interventions should include the allocation of sufficient resource (time, money, people) to deliver leadership interventions effectively. For example, there needs to be enough of the right people with the capacity to do a Safety Leadership Tour monthly. Individuals need training prior to conducting the Safety Tour, and there is need for sufficient budget to pay for this training.

Targeted, regular and high impact formal organisational 'communication' is essential. This can be delivered through a variety of different media that balances the sharing of good news stories as well as lessons learned from accidents/incidents and other such significant events.

'Leadership style and behaviour' is heavily reliant on individual desire and ability to perform well. Success is dependent on how the workforce perceive the commitment to safety and whether it is believable from leader to leader (i.e. do they walk the talk, challenging at risk behaviours in a prompt and positive manner, each and every time such behaviour is observed).

Being seen to engage in 'action' was the final factor relevant to effective leadership. When leaders deliver on their commitments and promises, providing feedback to the wider teams to help manage their expectations, this helps to support credibility and develop trust. There is recognition that leadership is not a quick fix and will take some time to have a positive impact.

5.5 Study 3 Conclusions

This study has evaluated the attitudes to safety leadership of different stakeholder groups working within the Rail Construction Industry; for Clients, Principal Contractors and Supply Chain Senior Management representatives.

The depth of understanding of safety leadership as a topic was evaluated by considering how well the study participants could explain the concept and whether they could provide any examples of real-world application. Providing a good level of understanding of what good safety leadership looks like becomes an enabler for recognising, and potentially implementing, leadership interventions as part of a Safety Improvement Programme. It can be considered necessary to raise awareness of what good safety leadership looks within the rail construction sector for organisations that are considering implementing a safety improvement programme (Farrington-Darby et al, 2005).

Whilst there was some level of understanding across the group, the Senior Management of Principal Contractors demonstrated a greater depth of understanding than both the Client and Supply Chain groups. This may be expected as it is the statutory duty of the Principal Contractors to manage safety on a construction project. Furthermore, the Supply Chain (typically SMEs) characteristically have limited health and safety resource (Walter and James 2009, Akintoye et al 2002). A role for dedicated health and safety resources is often to increase awareness of 'what good safety looks like' within an organisation, including safety leadership. Furthermore, this study identified

safety resource as one of the main themes for effective leadership interventions. Findings highlight the importance of understanding safety leadership at all levels within a Project Delivery Organisation, supporting research by Donovan et al (2016) that emphasised the importance of vertical integration, understanding safety leadership across multiple levels of an organisation. This is of particular importance within rail sector Project Delivery Organisations that have complex organisational interfaces.

The Principal Contractor group provided more examples of interventions than the Clients and Supply Chain representatives, giving an indication that as a group they are more aware and have more experience of implementing safety leadership interventions than the other groups. Although the Chartered Institute of Building (CIOB) in 2008 found that there was a need to '*reassess the leadership qualities and skills required by the Construction Industry*', it can be concluded that there is still some work to be done to improve safety leadership particularly amongst Client and Supply Chain organisations within the rail construction sector.

This is particularly relevant for a Project Delivery Organisation intending to implement safety leadership interventions, as projects are led by Principal Contractor representatives where the level of understanding and experience of real-world application could be anticipated to be higher. Vredenburg (2000) and Gadd and Collins (2002) identify the importance of leaders creating an open and learning culture; if Principal Contractors could develop such a culture within a Project Delivery Organisation there would be an environment that enabled the sharing of lessons between all parties through open two-way communication channels for both good and bad safety related news e.g. shared leadership training, workshops and safety inspections. For any future studies, further exploration of different levels of understanding and application between the different stakeholder groups (Clients, Principal Contractors and Supply Chain), as this may have an impact on the successful implementation of safety leadership interventions for Project Delivery Organisations (i.e. some groups may need more training than another).

A total of 26 different examples of safety leadership interventions were identified from this study. These mostly aligned to the nine good safety leadership areas identified within the literature, summarised in Table 5.1 (Simard and Marchand 1995, Floyd and Wooldridge 1997, O'Dea and Flin 2001, Gadd and Collins 2002, Vredenburg 2002, Zohar 2002a, Farrington-Darby et al 2005, Lekka and Healey 2012, Clarke and Flitcroft 2013); increasing visibility around safety, enhancing workforce involvement, providing recognition for

good safety performance and ensuring effective communications. Half of the intervention examples provided were focused on communications; whether these were focused on opportunities for leader engagement or the sharing of information. Donovan et al (2016) has reported on the importance of communication for effective safety leadership. Several previous studies have identified critical leadership orientated success factors (Zohar, 2002a, Donovan et al, 2016, Lekka and Healey, 2012), including communication at both an organisational and individual level for successful leadership outcomes.

The leadership intervention themes identified in this study were compared against the nine areas from the literature, as shown in Table 5.6. The common areas identified between both this study and literature review are leadership visibility around safety and ensuring effective communications, workforce involvement within safety decision making and communications, and the provision of recognition for good safety performance. Each of the themes identified within this study show common areas with conclusions from Zohar (2002a); who's study from within the manufacturing industry found Senior Management expressing concern for worker well-being engendered stronger relationships between both parties with greater workforce involvement. The findings from this study also found effective safety leadership interventions targeted worker involvement with Senior Management. This aspect of leadership is common across both the manufacturing and construction industries and may be a key component of effective safety leadership in other sectors too.

Findings	Areas of Safety Leadership
Themes identified from study <u>not</u> included within literature review	• Strategic direction for safety • Provision of training and awareness • Compliance with safety standards and requirements
Themes identified within both study <u>and</u> literature review	• Increasing visibility around safety • Workforce involvement • Provide recognition for good safety performance • Ensure effective communications
Themes identified within literature review <u>only</u>	• Safety as a top priority • Demonstrable commitment to safety • Enable safety reporting • Create an open and learning culture • Effective safety management system

Table 5.6 Mapping of key aspects of leadership intervention outputs from study against the literature review

There were themes identified from safety leadership literature that were not evident in this study. Overall, there was less focus on leaders creating an open and learning culture to improve safety performance. The examples of safety leadership interventions were more transactional (e.g. award schemes, dedicated safety forums). Some of the examples of interventions were more aligned to leadership at supervisory level rather than Senior Management; similar to findings in earlier studies by Thompson et al (1998), Marsh et al (1998), and Wu et al (2008). This may be an indication that there is a greater awareness and prevalence of safety leadership interventions that can be applied at a supervisory level, more so than at a Senior Management level. Zohar (2002a) previously identified the importance of supervisory leadership in developing positive relationships with the workforce that, when supported by Senior Management commitment, was an enabler for improvements in safety climate within the manufacturing sector.

The current study has found that some factors influencing effective deployment of safety leadership interventions are around context (impact of internal and external influencing factors), preparation and planning prior to deployment, and the continual delivery of commitments made by leaders. Therefore, it can be concluded that the value of some interventions is recognised, although these are not specifically identified as leadership interventions.

The study found some examples of leadership interventions that included provision of strategic direction for safety management arrangements, provision of training and awareness, and compliance monitoring. These areas were not identified within safety leadership previous research, but are more commonly cited as good general safety management (Hale et al 1997). Further studies may be required to evaluate the relevance of these aspects as constituents of good safety leadership, whether these examples are more relevant to Senior Management than Supervisory safety leadership, and to determine whether these aspects are transferable beyond the rail construction sector of the industry.

The study identified five main themes for effective safety leadership interventions; which were; context, preparation, communication, leadership behaviour and style, and action. Each of these themes have been identified within literature as potentially having an impact on leadership interventions and subsequent safety performance. Donovan et al (2016) also found that leadership style was important in the context of safety. Also recognising that there was a lack of research to understand safety interventions and outcomes

in complex socio-technical systems; a Project Delivery Organisation is such an example.

An individual's self-awareness and motivation will often affect their behaviour (Charles 2003), which in turn affects how other people perceive them. Consistency of behaviours is important for building credibility that there is a genuine commitment to safety, fundamental for good safety leadership (Lekka and Healey 2012). Another aspect that supports credibility and the development of trust, is when leaders deliver on their commitments and promises, providing feedback to the wider teams to help manage their expectations (Lekka and Healey 2012). This was also identified as a main theme. Similarly Farrington-Darby et al (2005) found that Senior Management had 'considerable influence' on safety on the track, through their role model behaviours, actions taken and dealings with Client demands.

Understanding the context in which the leadership intervention was to be implemented was considered as important. Schein (2010) commented on how it is important for an organisation to understand their position in the wider industry. Due consideration should be given to both industry and organisational factors as follows;

- other priorities and initiatives that are being implemented at the same time and the role of leaders in delivering these (safety or non-safety related), including time and resource limitations
- the trigger for implementing any improvement programme - is there a strong recognised desire and intent to improve leadership interventions? Is the organisation really ready?
- the transient nature of the industry and associated inconsistent externally-led influencing factors leads to an unstable motivation and conflicting demands, more challenging for any organisation/individual to balance the desire to change with day to day operations and project delivery

Overall this study provides support to existing safety leadership theory by Zohar (2002a), Donovan et al (2016), and Lekka and Healey (2012) as detailed subsequently within this section, and applies this to the Rail Construction Industry. Undertaking effective safety-related communication practices has been identified as being important for the sector, addressing some of the specific characteristics of delivering work through Project Delivery Organisations made up of Client, Principal Contractors and the Supply Chain representatives, and the associated challenges. Effective safety leadership at all levels of the Project Delivery Organisation is essential for positive safety outcomes.

5.5.1 Potential Study Limitations

The data set included the outputs from 21 participant interviews. Therefore, the findings are only a sample of views from within the industry. However, the individual participants interviewed within both the Principal Contractor and Supply Chain organisations were considered representative of the industry and were selected at random from opportunities that were available during the study. All of the Client interviews were undertaken with Senior Management from one organisation, wholly employed to work within the rail industry. Organisations that participated in the Principal Contractor and Supply Chain interviews may have some projects in sectors outside of rail. A broader experience may have influenced the feedback obtained during the interviews, but this is representative of the organisations working within the rail industry. Extending the sample size further would go some way to address these limitations.

5.6 Chapter Summary

This study has identified that there are numerous safety leadership interventions being deployed within the rail construction sector. Their effectiveness is reliant on a number of factors, associated with the context, preparation, communication, leadership behaviour and style, and action. This study has also found differences in perceptions and levels of engagement with the concept of safety leadership within the Project Delivery Organisation, with Principal Contractors demonstrating greater depth of understanding and real-world application when working in a rail construction environment.

For the Rail Construction Industry, the findings may help those introducing safety leadership interventions by highlighting the different types of leadership interventions that already take place, the bias towards communication-based activities, as well as providing a better appreciation of those factors that influence successful outcomes.

These results highlight the importance of understanding the application of leadership within a Project Delivery Organisation. A focus on evaluating complex relationships within the Project Delivery Organisation would be necessary to develop this study further. Particular focus should be placed on understanding the objective and motivations of each Project Delivery Organisation member (Client, Principal Contractor and Supply Chain), resources, roles and responsibilities, and contractual relationships, all in the context of safety. These influencing factors are evaluated in the next chapter within this thesis.

6. Development of a Safety Leadership Intervention Tool and Data Collection Materials

6.1 Introduction to Chapter

This chapter explains the development of the safety leadership intervention tools and data collection materials that were used in Intervention Case Studies (Study 4 – Chapter 7).

In order to achieve the thesis objectives a Safety Leadership Intervention Tool (SLIT) has been developed based on existing safety culture, safety performance and leadership research, and applies these theories to a tool for the Infrastructure Engineering Sector.

Earlier studies (refer to Chapters 4 Understanding Safety within Construction Projects and Chapter 5 Attitudes to Safety Leadership) identified that there were safety leadership interventions being deployed within the Infrastructure Engineering Sector of industry, mainly by Principal Contractors. However, the studies found that there was no consistent approach taken across the industry. Therefore, there is a need to establish a suite of interventions that can be deployed within Study 4.

The approach taken within Study 4 was developed based on the use of logic mapping as an evaluation framework across all projects. A logic map is a systematic and visual way of presenting the key steps required in order to turn a set of resources or inputs into activities that are designed to lead to a specific set of changes or outcomes (Hills 2010). A logic map was developed based on the work of Hills (2010) with reference to Connell and Kubisch (1998), and Wholey et al (2004), and proved valuable in two areas. Firstly, this informed the intervention design and determined anticipated outcomes; and secondly this informed the materials developed to collect data and the subsequent analytical framework deployed within Study 4. Reference to the logic map was essential in developing the SLIT and associated data collection materials.

This chapter details how the SLIT was developed including the associated data collection materials; the actual implementation of the SLIT for each Project Delivery Organisation will be described in Chapter 7.

6.2 Design of Safety Leadership Intervention Tool (SLIT)

The content of the SLIT was developed from a combination of literature findings (Simard and Marchand 1995, Cooper 1997, Floyd and Wooldridge 1997, Sawacha et al 1999, Cooper 2000, Vredenburg 2002, O'Dea and Flin 2001, Gadd and Collins 2002, McCabe 2002, Zohar 2002a and 2002b, Farrington-Darby et al 2005, Conchie and Moon 2010, Clarke and Flitcroft 2013) and researchers experience. This review identified four common components which were included within the SLIT are shown in Figure 6.1.

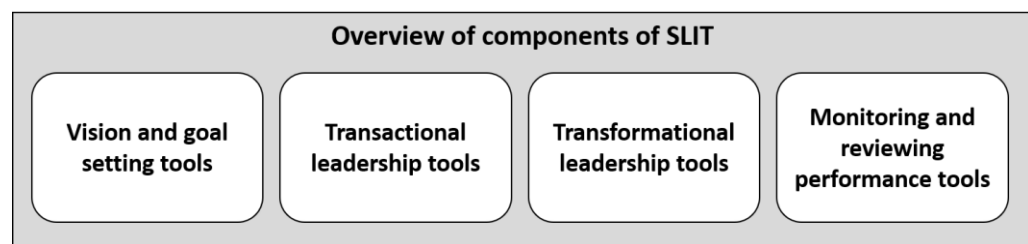


Figure 6.1 Overview of components of SLIT

As identified in Chapter 2, studies have found that there is a need for vision and goals to motivate and provide strategic direction for safety improvement and this is supported by effective transformational leadership. However, transformational leadership in isolation is unlikely to be effective without a transactional relationship between leaders and followers. As with any improvement programme there is a need to monitor and review progress against the original objectives – which is also included within the SLIT.

With reference to literature as well as researchers experience in industry, specific intervention tools were developed. The following sections identify the different tools within the SLIT for each of these four areas; vision and goal setting tools, transactional leadership tools, transformational leadership tools, and tools for monitoring and reviewing performance.

The four components of the SLIT are detailed separately. Each of these components has the following identified:

- **SLIT Section reference** within the SLIT tool e.g. vision and goals, transformational leadership etc.
- **Who** - The tools were identified for use by people in leadership roles dependent on whether they were based on or off the project.

- The **purpose of the activity** required within the SLIT i.e. the intent for each of the requirements.
- **References** to literature from where these requirements were identified.
- **Expected intervention** – what the activity looks like in the real-world i.e. how it will be implemented.
- **Resource** – the different resources that were required within the SLIT, and whether these were provided by the project (as a standard safety management system resource) or by the SLIT (developed as part of this Study).

For example, standard safety management system arrangements within the Construction Industry include the need for roles and responsibilities to be defined. Whilst this was identified as a requirement to have in place within the SLIT, the project made the relevant resources (e.g. job descriptions) available, and there was no need for the researcher to provide these resources. However, for another example of guidance on behavioural standards, no such templated document exists across the industry. The researcher has developed the guidance notes to fill in a gap in knowledge and understanding, prepared from experience within the Construction Industry as a Chartered Health and Safety Consultant.

6.2.1 Vision and goals tools

The importance of a safety vision was identified by Hartley (2002) as part of a wider management of change process. Engagement of stakeholders, planning and delivering structural and cultural changes, timing and phasing of change were also identified as important in achieving effective change. The associated positive leadership behaviours and activities were established in the context of safety:

- Time leaders allocate for safety
- Align safety and corporate objectives
- Commitment to individuals' welfare (safety and wellbeing)
- Creating behavioural norms for safety
- Workforce involvement in goal setting

Table 6.4 O details the requirements of the SLIT to address each of these aspects with reference to the literature and resource availability.

SLIT Section	Who	Purpose of SLIT Activity	References	Expected Intervention <i>(repeated evidence in italics)</i>	SLIT Resource	Project Resource
Vision & Goals	Senior Management (off site)	Time allocated for safety Leaders are defined within the project and company.	Gadd and Collins (2002), Clarke and Flitcroft (2013)	Definition of a safety leader	X	
				Company organisation chart with safety leaders identified		X
				Project organisation chart with safety leaders identified		X
		Align safety and corporate objectives Safety goals are established within wider company objectives.	Clarke and Flitcroft (2013), Conchie and Moon (2010), Cooper (2000)	Guidance and examples of safety goals (both leading and lagging)	X	
				Set safety goals and wider company goals		X
	Project team (on site managers and supervisors)	Commitment to individual's welfare Leaders clearly communicate their commitment to safety to all persons on the project.	Zohar (2002)	Personal Commitment Statements template issued and guidance on how to prepare an elevator pitch	X	
				Personal Commitment Statements issued/published		X
		Create behavioural norms Each project will have a means for developing, communicating and monitoring compliance with behavioural standards.	Cooper (2000)	Guidance on behavioural standards issued	X	
				Prepare behavioural standards		X
				Behavioural standards briefed out at induction and supported by poster materials		X
				Compliance with behavioural standards tracked through site inspections and audits		X
	Workforce	Involvement in goal setting Every company will have a stand down scheduled as part of the development of their safety objectives and action plan.	Vredenburg (2002), Conchie and Moon (2010), Cooper (2000), Zohar (2002)	Guidance on how to prepare for and deliver a safety stand down	X	
				Prepare safety stand down		X
				Deliver safety stand down		X

Table 6.1 Overview of the SLIT contents: Vision and Goals section

6.2.2 Transformational leadership tools

A transformational leader seeks to transform an organisation by motivating and inspiring others, acting as role models, inspiring and challenging individuals (Barling et al 2002, Barling et al 1996, Pillai et al 1999). Leadership visibility and role modelling of behaviours that demonstrate commitment to safety are important. With reference to literature (summarised in Table 2.10 within Chapter 2), as well as researchers experience in industry, the associated positive safety leadership behaviours and activities:

- Visibility amongst workforce
- Observable role model behaviour
- Communicate vision and values
- Participation in safety committees
- Challenge assumptions
- Encourage safety concerns

A set of tools were developed within the SLIT to address each of these aspects as detailed within Table 6.2.

SLIT Section	Who	Purpose of SLIT Activity	References	Expected Intervention	SLIT Resource	Project Resource
Transformational leadership	Senior Management (off site)	Visibility amongst workforce Every company will have a schedule which defines the frequency of safety tours for Senior Management.	Gadd and Collins (2002), Conchie and Moon (2010), Simard and Marchand (1995), Sawacha et al (1999), O'Dea and Flin (2001)	Guidance on how to carry out a safety tour including supporting documents (forms, spreadsheet etc)	X	
				Safety tour schedule prepared		X
				Safety tours undertaken and records retained		X
		Observable role model behaviour Leaders to complete behavioural leadership training and exhibit role model behaviours.	McCabe (2002)	Prepare and deliver behavioural safety training	X	
				Leaders to exhibit role model behaviour		X
		Communicate vision and values Companies will provide an explanation of personal safety behaviours as appropriate for the role, including personal contribution to achieving safety vision and values.	McCabe (2002), Floyd and Wooldridge (1997)	Guidance on behavioural standards issued	X	
				Prepare behavioural standards by role		X
				Behavioural standards briefed out at induction and supported by poster materials		X
		Participation in safety committees Health and Safety Committee Meetings will include Behavioural Safety standards. Senior management will attend all meetings.	Gadd and Collins (2002), Vredenburgh (2002), O'Dea and Flin (2001)	Prepare/update safety committee meeting agenda	X	
				Carry out safety committee meetings		X
				Senior management to attend all meetings		X

SLIT Section	Who	Purpose of SLIT Activity	References	Expected Intervention	SLIT Resource	Project Resource
Transformational leadership	Project team (on site managers and supervisors)	Visibility amongst workforce Every project will have a schedule which defines the frequency of safety tours for Project Management, Site Management, Supervisors and the Supply Chain.	Zohar (2002), Conchie and Moon (2010), Sawacha et al (1999), Simard and Marchand (1995), O'Dea and Flin (2001)	Guidance on how to carry out a safety tour including supporting documents (forms, spreadsheet etc)	X	
				Project safety tour schedule prepared		X
				Project safety tours undertaken and records retained		X
		Observable role model behaviour Leaders to completed behavioural safety leadership training and exhibit role model behaviours.	McCabe (2002)	Prepare and deliver behavioural safety training	X	
				Leaders to exhibit role model behaviour		X
		Communicate vision and values and reinforce key messages Project inductions will provide an explanation of personal safety behaviours as appropriate for the role, including personal contribution to achieving safety vision and values.	McCabe (2002), Sawacha et al (1999), Floyd and Wooldridge (1997), O'Dea and Flin (2001)	Guidance on behavioural standards issued	X	
				Prepare behavioural standards by role		X
				Behavioural standards briefed out at induction and supported by poster materials		X
		Challenge assumptions Individuals actively challenge working methods, processes, communications and behaviours where they are not in accordance with the project safety goals.	Clarke and Flitcroft (2013)	Process developed where individuals understand their right to challenge, how this should be undertaken and in what situations.	X	
				Communicate the process to the project		X
		Encourage safety concerns Each project will have a process for the reporting of safety concerns from all employees and members of the supply chain.	Clarke and Flitcroft (2013), O'Dea and Flin (2001)	Process developed for the reporting of safety concerns.	X	
				Communicate the process to the project		X

Table 6.2 Overview of the SLIT contents: Transformational Leadership section

6.2.3 Transactional leadership tools

A transactional leader creates clear expectations for what is required of their followers, with the associated rewards for compliance, or punishments (e.g. discipline), or rewards that are contingent upon performance (Bass and Bass 2008). This can be summarised as leadership behaviours around contingent reward, as well as management by exception. The following transactional leadership activities were established within the SLIT:

- Fair and consistent response to incidents
- Acceptability of rule violations
- Effective monitoring and reward
- Fair and consistent response to inappropriate behaviour
- Effective surveillance and reinforcement of desirable behaviours
- Behavioural observations

A set of tools were developed within the SLIT to address each of these aspects as detailed in Table 6.3.

SLIT Section	Who	Purpose of SLIT Activity	References	Expected Intervention <i>(repeated evidence in italics)</i>	SLIT Resource	Project Resource
Transactional leadership	Senior Management (off site)	Fair and consistent response to incidents Each company will have a process which identifies between different levels of culpability (error or violation / individual or group), and apply this process consistently when managing safety related events.	Zohar (2002), Conchie and Moon (2010), McCabe (2002)	Process developed for the identification of errors and violations with a fair play decision tree model prepared.	X	
				Individuals undertaking accident/incident/near miss investigations or those involving safety related capability/conduct investigations will use the fair play decision tree model.		X
		Acceptability of rule violations Each company will have a process which identifies between different levels of culpability (error or violation / individual or group).	Gadd and Collins (2002), McCabe (2002)	Process developed for the identification of errors and violations with a fair play decision tree model prepared.	X	
		Effective monitoring and reward Each company will have a process for recognising and rewarding individuals and teams who have made a significant contribution to safety.	Zohar (2002)	Process developed for reward and recognition.		X

SLIT Section	Who	Purpose of SLIT Activity	References	Expected Intervention	SLIT Resource	Project Resource
Transactional leadership	Project team (on site managers and supervisors)	Fair and consistent response to inappropriate behaviour Each project will have a process which identifies between different levels of culpability (error or violation / individual or group), and apply this process consistently when managing safety related events.	Zohar (2002), Conchie and Moon (2010), McCabe (2002)	Process developed for the identification of errors and violations with a fair play decision tree model prepared.	X	
				Individuals undertaking accident/incident/near miss investigations or those involving safety related capability/conduct investigations will use the fair play decision tree model.		X
		Effective surveillance and reinforcement of desirable behaviours Each project will have a process for recognising and rewarding individuals and teams who have made a significant contribution to safety.	Zohar (2002), Conchie and Moon (2010), Vredenburg (2002), O'Dea and Flin (2001)	Process developed for reward and recognition.		X
				Implement reward and recognition process		X
		Behavioural observations Individuals will be informed of the project approach for positive intervention, and actively intervene when 'at risk' behaviour is observed.	Gadd and Collins (2002)	Process developed for the positive interventions.	X	
				Communicate the process to the project		X

Table 6.3 Overview of the SLIT contents: Transactional Leadership section

6.2.4 Monitoring and review tools

Research by Cooper (2001) and Fleming (2001) states that in order to have a positive safety culture an organisation needs to have arrangements for ongoing monitoring, auditing and review of performance. Furthermore, monitoring and reviewing performance is also important when implementing safety improvement programmes, which is supported by Kanter et al (1992), Luecke (2003) and Kotter (1996) who all identify the need to monitor effectiveness of changes and take appropriate action. It can be concluded that there is a need to have suitable arrangements in place on a project in order to monitor the effectiveness of safety interventions, as well as recognising changes in safety culture and safety performance, which is why this component is included within the SLIT. The following leadership activities were established within the SLIT:

- Project performance
 - Prompt performance feedback
 - The communication of lessons learned
 - Reinforcement of hazard reporting
 - Visual performance metrics
 - Use of data to inform strategy
- Individual performance
 - Appraisals and personal performance reviews for directly employed staff
 - Provide and receive performance feedback and information on lessons learned for those working on the project

A set of tools were developed within the SLIT to address each of these aspects as detailed in Table 6.4.

SLIT Section	Who	Purpose of SLIT Activity	References	Expected Intervention	SLIT Resource	Project Resource
Monitor & Review	Senior Management (off site)	The communication of lessons learned Each company defines communication methods for sharing the outcomes of incident investigations amongst all levels of the business.	Gadd and Collins (2002)	Guidance for developing a learning culture issued	X	
				Communications protocol followed for all learning events		X
		Use of data to inform strategy As part of the formal management review, on a quarterly basis, companies will review safety data to identify performance trends. An action plan to address these issues will be developed.	Sawacha et al (1999), Gadd and Collins (2002)	Example management review agenda (specific for safety performance), and action plan template to be issued	X	
				Hold quarterly management review meetings		X
				Action plans developed		X
		Appraisals and personal performance reviews The Personal Development Review Process will include a review of against the behavioural standards.	Clarke and Flitcroft (2013), McCabe (2002)	Review appraisal process and documentation and include behavioural standards	X	
				Undertake appraisals to include a review of the behavioural standards		X
	Project team (on site managers and supervisors)	Reinforcement of hazard reporting Each Project will have a mechanism for the reporting of safety hazards from the workforce to Project Management.	Vredenburg (2002), Gadd and Collins (2002)	Process developed for the reporting of safety hazards.	X	
				Communicate the process to the project		X
		Prompt performance feedback Each project will have a process to provide feedback on performance for employees and members of the supply chain.	Vredenburg (2002)	Process developed for providing feedback to individuals on their safety performance.	X	
				Communicate the process to the project		X
				Process developing for providing performance information to the supply chain	X	

SLIT Section	Who	Purpose of SLIT Activity	References	Expected Intervention	SLIT Resource	Project Resource
Monitor & Review		Visual performance metrics Each project will provide visual safety performance data for employees and members of the supply chain.	Vredenburg (2002)	Guidance on visual performance data presentation and templates provides	X	
				Safety performance data to be communicated to the workforce in a visual manner		X
	Workforce	Provide and receive performance feedback and information on lessons learned Each project will have a process for the sharing of outcomes from accident, incidents and significant near miss investigations amongst all employees and members of the supply chain.	Vredenburg (2002), Gadd and Collins (2002)	Process for communicating safety event outcomes issued	X	
				Communicate safety event outcomes across the project		X

Table 6.4 Overview of the SLIT contents: Monitor and review section

6.2.5 Logistics

The contents of the project specific interventions were developed from those resources available from existing leadership studies supplemented by the researchers' available resources as detailed in Table 6.2. The SLIT was designed to identify both the existing resources available within the Principal Contractor's Safety Management System; and augment any gaps with resources provided by the researcher. Examples of resources include; guidance and examples of safety goals, guidance on how to prepare for and deliver a safety stand down (time when work stops to discuss safety matters, guidance on how to carry out a safety tour including supporting documents, safety committee meeting agenda template, process for communicating safety event outcomes etc. The tools were provided to the participating project within the intervention group by the researcher, though others were already available through the Principal Contractor's safety management system.

Each project defined their application of the SLIT in a Project Intervention Plan at the beginning of the project, which was used as part of the subsequent evaluation.

Chapter 7 covers a detailed description of the implementation of the SLIT for each of the intervention projects.

6.3 Data Collection Materials

A number of different materials were developed to obtain data for each project participating in Study 4. The design of suitable materials for the efficient and reliable collection of data was challenging for the following reasons;

- the number of participant projects within Study 4
- the 'role' of individual participant in provision of data and their physical location in relation to the project (Senior Management – off site, Project Management and workforce – on site)
- the number of participants from different organisations (Principal Contractor and Supply Chain)
- the supporting evidence requirements of SLIT deployment on the projects
- collating data across a linear timeline through the project duration
- collating data that measures safety performance
- the need to identify and evaluate influencing factors
- ensuring reliability and validity across all of these aspects

The development of the data collection materials was informed by the logic map as the evaluation framework. The data needed to answer the study

research questions were clearly defined within the logic map this the materials could be developed and cross-checked against the logic map to ensure that all aspects of data requirements had been included.

The data collection materials addressed a number of topic areas that needed to be covered during the data collection stage across multiple participants. These were;

- Understand project management safety leadership activities
- Understand support from Principal Contractor Parent Company
- Understand support from Subcontractor's Parent Companies
- Understand how the workforce feel about safety leadership activities
- Understand the application of safety leadership interventions
- Identify the impact of influencing factors

6.3.1 Development of Template Forms

A number of different template forms were developed to record data from each project, each of these are outlined below. A copy of these materials are also included in the Appendices.

- **Principal Contractor/Subcontractor/Project Fact Sheet**

For every organisation involved in the study simple data was collected once in a Fact Sheet for the Projects, Principal Contractors and Subcontractors. The Fact Sheet was a paper-based questionnaire covering a summary of organisational safety arrangements and performance as follows:

- Company size and turnover, project value and duration
- Company and project scope of operations
- Availability of dedicated health and safety resources
- Existing safety performance data and statistics, including number of accidents/incidents

- **Principal Contractor and Subcontractor Interviews**

Senior management from the Principal Contractor Project Management and Subcontractor Site Management were interviewed to identify safety management arrangements, including improvement programmes. The interviews covered ten topic areas as listed below.

- Commitment to Safety
- Management of Contractors
- Training
- Safety Performance

- Safety Resources
- Safety Procedures
- Safety Meetings
- Safe Systems of Work
- Dealing with unsafe events
- Safety Monitoring

The interviews were made up of two parts: project maturity assessment and semi-structured interview questions. These two parts were completed in that order.

Project Maturity Assessment - The Project Maturity Assessment was given to the interview participant to complete without interaction from the interviewer. The Project Maturity Assessment had descriptions for each of the ten topics (refer to the above bulleted list). Participants would tick the statements which they felt best described the Project Delivery Organisation. There was no limit on the number of statements that could be ticked off. Once completed the record was added to the interview transcription completed in part two. All of the statements were allocated to a specific safety culture maturity level based on the work of Parker et al (2006) The levels were from 1 (least mature) to 5 (most mature). This information was not shared with the participants, but the researcher held a master list of the statements and their respective maturity level. For example;

‘Managers tell everyone to work safety to avoid causing problems’ is a level 1 statement.

‘There are frequent safety initiatives’ is a level 3 statement.

Figure shows an example for the topic area ‘Commitment to Safety’.

Q1 Here is a list of statements for 10 different areas of safety management. Each area has a number of statements; please tick those that you think describes safety on your project. Tick as many as appropriate.

Commitment to Safety	
☐	Managers tell everyone to work safely to avoid causing problems.
☐	After accidents, topical safety messages are sent down from management. Management interest in these topics reduces over time.
☐	There are frequent safety initiatives.
☐	Management communicate a lot of safety information to the workforce.
☐	Management talk but do not really listen.
☐	Everyone is involved in two way safety communications.
☐	Management frequently ask about the views of the workforce.
☐	There are good levels of feedback to management on safety matters.
☐	There are appropriate and timely communications following an incident.
☐	Individuals look after themselves.
☐	Individuals take risks, but don't worry as they believe they won't get caught.
☐	Following an accident everyone declares their commitment of caring for colleagues.
☐	Individuals are aware of the costs of safety failures which is shared through the project.
☐	Individuals talk positively about safety, but do not always act safely 100% of the time.

Figure 6.2 Example of descriptions from Project Maturity Assessment within the Interviews

Semi-structured interview questions – The second part of the interview involved forty interview questions which covered all of the ten topic areas listed in the bullet points above. The interview questions were available to the interviewer in the form of hard copy sheets to guide the researcher during the interviews. Figure provides an example of the questions asked within the topic area ‘Commitment to Safety’.

Section B1: Commitment to Safety	
Q1	Please describe how you communicate to employees about safety and involve them in safety.
Q2	What information is communicated?
Q3	How often does this communication take place?
Q4	Are managers expected to visit worksites to discuss safety?
Q5	Please describe how workforce are expected to demonstrate their commitment to safety.
Q6	How would you describe typical safety behaviours in your company? E.g. adhere to rules, short cuts, attitude
Q7	What are the objectives on the company?
Q8	What are the safety objectives for the company?

Figure 6.3 Example of semi-structured interview questions

- **Employee Surveys**

Individuals working on the project provided their perceptions of safety climate through completion of a hard copy questionnaire. Obtaining feedback from the workforce on the project helped to address single-source bias by extending the participation to members of the supply chain workforce as well as the leadership teams from the Principal Contractors and Subcontractors Management. The survey was in four sections:

- Personal Information e.g. employer, Job role, time spent on the project and in the industry
- Questions about safety on the project – a combination of multichoice and free text questions
e.g. How would you describe the project’s safety performance? (answers - above average/average/below average)
e.g. If you could change one thing to improve safety on this project, what would it be?
- Questions about safety in your Company – a combination of multichoice and free text questions
e.g. How would you describe your company’s safety performance? (answers - above average/average/below average)

e.g. If you could change one thing to improve safety within your company, what would it be?

- Questions comparing safety for your company and the project – a combination of multichoice and free text questions
e.g. How would you compare safety on this project with that of your company? (answers – my company's safety is better, both about the same, this projects safety is better, other)
e.g. What are the biggest problems affecting safety on this project?

- **Project Interim Interviews**

During the project quarterly interviews were held with the designated Project Management representative. A semi-structured interview was undertaken to identify progress on implementing the SLIT, other potential inputs (e.g. safety campaigns from Principal Contractor/Client), influencing factors and safety performance. Figure 6.6.4 shows a sample of the questions covered regarding influencing factors. The full suite of questions are contained within the Appendices.

Questions	
Q1	Have there been changes to your projects main scope of work?
Q2	Have there been changes to the project duration and/or programme?
Q3	Have there been changes to how many people are working on the project?
Q4	Have there been changes to your use of subcontractors?
Q5	Have there been changes to your access to competent health and safety advice?
Q6	Have there been changes to your safety management systems accreditations to a recognised standard?
Q7	Have there been changes to your approach to improving behavioural and cultural safety?
Q8	Have there been any other changes which may have impacted on the project safety culture? (please state)

Figure 6.4 Sample of questions for the Project Interim Interviews

- **Project Intervention Plan**

A project specific intervention plan was developed for projects by the researcher with the Project Management team. The Project Intervention Plan identified the aspects of the interventions for each project to have an agreement documented of what the original plan was. This had two benefits a) the project team could refer to this to inform and remind them

of what interventions they should be doing, and b) for the researcher to use in comparison at the end of the project i.e. did the project implement all of the interventions they had planned at the beginning.

The Project Intervention Plan contained a list of agreed interventions based on the SLIT contents, the defined measures of how these interventions would be evidenced later on during the project as well as anticipated benefits to the project. Any specific training requirements were also identified. Key project dates were recorded such as programme milestones, project completion and handover dates. Anticipated constraints, risks and opportunities were discussed between the interviewer and Principal Contractor Project Manager and recorded on the plan. Key stakeholders and the arrangements for communication of the plan on the project were also defined.

The Project Intervention Plan provided the assessment criteria for that particular project to establish whether the planned interventions were deployed and if was this according to the plan or did there have to be alterations made in practice, as part of the later analysis.

- **Audits and Project Records**

The logic map identified the importance of reviewing evidence of the interventions taking place. Sample records from the project reviewed as evidence of the intervention activities taking place e.g. briefing records, safety tour inspection records, close call reports. All such records were generated by the project team as part on the ongoing site activities. These records were reviewed during interim and follow up interviews with the Project Management teams.

Table 6.5 identifies the individual data collection materials that have been designed. An overview of this is provided below. Table 6.5 Material used for the data collection by organisation and type of projectThe table lists the data collection material used and a description e.g. Principal Contractor/ Subcontractor/ Project Fact Sheet - For every organisation involved in the study simple company data was collected once in a Fact Sheet for the Projects, Principal Contractors and Subcontractors e.g. accident frequency rate, number of employees etc. The table also identifies the participants role within the organisation who was engaged in the study e.g. Health and Safety Manager and Project Manager. The Project Delivery Organisation Member was also defined e.g. Principal Contractor or Subcontractor.

A Study Information Sheet was also prepared to provide information to participants on the study purpose, what their involvement would be, as well as information on data protection and confidentiality. Consent to participate in the study was obtained at both organisational and individual levels; from the Principal Contractor/Subcontractors at company level, as well as every individual participant who were interviewed and surveyed from across all organisations.

Data Collection Material	Description of Material	Participants Role within the Organisation	Topics of information required						PDO Member		Group	
			Understand project management safety leadership activities	Understand support from Principal Contractor Parent Company	Understand support from Subcontractors Parent Companies	Understand how the workforce feel about safety leadership activities	Understand the application of safety leadership interventions	Identify the impact of influencing factors	Principal Contractor	Subcontractor	Baseline Group	Intervention Group
Principal Contractor/ Subcontractor / Project Fact Sheet	For every organisation involved in the study simple company data was collected once in a Fact Sheet for the Projects, Principal Contractors and Subcontractors e.g. accident frequency rate, number of employees etc	PC H&S Manager & PC Project Manager		X	X			X	Included	Included	Included	Included
Principal Contractor/ Subcontractor Interviews	The researcher will interview management from the Principal Contractor Project Management and Subcontractor Site Management to identify safety management arrangements, including improvement programmes. The outputs from the interviews will be evaluated on the Hudson Model maturity matrix (Parker et al 2006).	PC Project Team & SC Managers	X	X			X	X	Included	Included	Included	Included

Data Collection Material	Description of Material	Participants Role within the Organisation	Topics of information required						PDO Member		Group	
			Understand project management safety leadership activities	Understand support from Principal Contractor Parent Company	Understand support from Subcontractors Parent Companies	Understand how the workforce feel about safety leadership activities	Understand the application of safety leadership interventions	Identify the impact of influencing factors	Principal Contractor	Subcontractor	Baseline Group	Intervention Group
Employee Survey	Individuals working on the project were requested to provide their perceptions of safety culture through completion of a survey.	Workforce	X			X	X	X	Included	Not required	Included	Included
Project Intervention Plan	A project specific intervention plan was developed and applied focusing on developing safety leadership and workforce engagement. This plan identified what and how interventions will have planned to be applied, identify training requirements, the expected outputs and outcomes from the intervention and also the monitoring arrangements.	PC Project Manager	X				X		Included	Not required	Not required	Included

Data Collection Material	Description of Material	Participants Role within the Organisation	Topics of information required						PDO Member		Group	
			Understand project management safety leadership activities	Understand support from Principal Contractor Parent Company	Understand support from Subcontractors Parent Companies	Understand how the workforce feel about safety leadership activities	Understand the application of safety leadership interventions	Identify the impact of influencing factors	Principal Contractor	Subcontractor	Baseline Group	Intervention Group
Principal Contractor/ Subcontractor / Project Follow Up Interviews	Follow up assessments will identify any changes to the project scope and project safety arrangements through interview.	PC Project Team & SC Managers	X	X	X		X	X	Included	Included	Not required	Included
Follow Up Employee Survey	For intervention projects, individuals working on the project were requested to provide their perceptions of safety culture through completion of a survey, repeated as part of the follow up assessment.	Workforce	X			X	X	X	Included	Not required	Not required	Included

Table 6.5 Material used for the data collection by organisation and type of project

6.4 Pilot

Due to the complex nature and volume of data needed for a robust study, it was appropriate to undertake a pilot to test and refine the approach taken in Study 4. Two projects were involved in pilots to test the study design for effectiveness, reliability and validity. Two different projects were selected by the researcher from personal contacts within the Industry from two different Principal Contractors. Prior to any data being collected as part of the pilot, ethics approval was obtained from the University of Nottingham.

The pilot involved undertaking interviews with representatives working on the two projects amongst both the Principal Contractors and Supply Chain. The researcher made arrangements with each Principal Contractor to undertake the interviews with Project Management staff and the relevant supply chain organisations. In advance of the meetings a Study Information Sheet, Consent Form, the relevant Fact Sheet and Interview question documents were emailed to all participants to provide an overview of the study. These are explained in more detail below. A total of six interviews were undertaken across both projects. In addition, each interviewee was also requested to take away the Employee Survey template that was provided hard copy in self-addressed envelopes. They were requested to these questionnaires completed by their workforce that had been working on the project and returned via the post to the researcher. This type of data collection material is explained in more detail in section 6.3. A total of completed 36 questionnaires were returned to the researcher.

The analysis of the pilot data was focused on a) determining whether the methods of data collection provided information that was useful in the subsequent evaluation, and b) the most suitable method for collating an abundance of data to enable meaningful analysis and conclusions. In response to the pilot the researcher had a number of general findings as summarised below.

- The pilot established that there was potential for positive bias within the interviews between Principal Contractors and Subcontractors based on their relationships, with Subcontractors giving more positive feedback on the Principal Contractor due to the dependency they have on the Principal Contractors for work. Matters such as cost, resources and payment terms were reported as issues from the Subcontractor interviews carried out within the pilot. These are influencing factors in their own right and the data collection materials need to identify these as such. The importance of using

multi data sources to avoid over-reliance on single source data was identified as a key point to take forward i.e. bias from one Subcontractor-Principal Contractor relationship could affect the validity of the study. The method and materials used for data capture were updated to include feedback from more people during interview.

- The original data collection tools were too time consuming to complete during the interviews, too detailed whereby participants were unable to answer the questions and produced a large volume of data for analysis which could be streamlined in order to make the interviews easier to conduct.
- The importance of evaluation techniques for the comparison within and between the project was also noted as an area for improvement by the researcher. The volume of data that was generated from each project was significant, but also inconsistent in terms of content due to the poor understanding of safety leadership amongst the Supply Chain. The relationships and linkages between data collection and the identification of the effects of any intervention needed to be clearer; both within each case study and between all case studies. An evaluation framework was not well enough formed at the time of the pilot, which subsequently became a priority.

The conclusion of the pilot was that overall the approach, in particular the data collection tools, were appropriate to meet the thesis objectives. There were some minor changes needed to simplify the data obtained in terms of content and format.

6.5 Chapter Summary

A SLIT and data collection materials have been developed based on the literature and researcher experience, for implementation within Study 4 - Chapter 7. The SLIT was designed to provide consistent resources to Project Management to achieve a positive change in safety outcomes for the duration of the project, utilising techniques that demonstrate safety leadership. Each intervention was designed so that it could become embedded within the management arrangements on the project after an initial period of instruction and training from the researcher. Following these briefings each intervention project defined their application of the SLIT in a Project Intervention Plan, which was used as part of the evaluation to determine what was or wasn't deployed and the reasons for this.

The design of Study 4, in particular use of a logic mapping approach, provided the framework for the development of the data collection tools.

The SLIT, data collection and evaluation tools were implemented across six Project Case Studies, which is detailed in Chapter 7.

7. Study 4 - Safety Leadership Intervention Case Studies

7.1 Introduction to Chapter

This chapter details how Study 4 has been undertaken to evaluate the effectiveness of safety leadership interventions within Project Delivery Organisations in the Construction Industry. The research questions considered within this chapter are:

- How effective are safety leadership interventions for improving safety culture maturity and performance with a Project Delivery Organisation?
- What is the relevance of influencing factors on safety and leadership within Project Delivery Organisations?
- Are there any specific considerations for the successful implementation of safety improvement programmes within this sector?

The purpose of Study 4 was to test the implementation of the Safety Leadership Intervention Tool (SLIT) with a number of Project Delivery Organisations. Study 4 involved deploying safety leadership interventions across three different Project Delivery Organisations – the Intervention Group. A further three Project Delivery Organisations Case Studies were undertaken as a baseline group for comparison purposes.

A multi-methods approach was undertaken within Study 4 with data collected using interviews, surveys and a review of project safety records. A logic map was used as the evaluation framework for determining the effectiveness of the safety leadership interventions for each project. The same logic map is also used to compare findings for the two groups of case studies – baseline and intervention groups.

7.2 Background

A common element of a Safety Improvement Programmes includes visible safety leadership where senior management show their commitment to safety. Leadership is the common factor identified as critical for a Safety Improvement Programme to be effective (Hopkins 2006, Fleming and Lardner 2001, Vredenburg 2002, Kotter and Heskett 1992, Shannon et al 1997, Zohar 1980).

Existing research in organisational development and change management (Vredenburg 2002, Hartley 2002, Bamford and Forrester 2003, Burnes 2004)

identifies defined approaches for establishing a Safety Improvement Programme, although none of these take specific cognisance of the challenges within a Project Delivery Organisation. Construction projects are renowned for a lack of standardisation (Duff et al 1993) and this may have an impact on their safety performance.

Earlier work was undertaken within the thesis in Studies 1, 2 and 3 all focused on understanding the current domain. Study 1 established that the safety culture maturity within a Project Delivery Organisation was around a level 3 on the Hudson Model (Parker et al 2006). This study also identified that within a Project Delivery Organisation, Principal Contractors were perceived to have a more mature safety culture than their Supply Chain. Study 2 established the extent of Safety Improvement Programmes amongst the Supply Chain, findings were that there was not extensive implementation of such programmes amongst the Supply Chain. As part of the SLIT implementation, Study 4 further explores the contribution made by the Supply Chain to improve safety culture within a project. Study 3, details contained within Chapter 5, targeted attitudes to safety leadership from Clients, Principal Contractors and the Supply Chain. The study identified a number of interventions (26 individual activities) which were deployed in the industry, as well as the factors perceived to influence successful outcomes. Study 4 builds upon the findings of Study 3 by investigating the effectiveness of safety leadership interventions within a Project Delivery Organisation and the influencing factors which may have an impact on safety outcomes.

7.3 Method

It is recognised that the evaluation of safety interventions is difficult to carry out (Hale et al 2010). This can be due to a number of interventions being implemented which often overlap, other organisational changes such as acquisitions, redundancies and reorganisations take place, as well as existing safety initiatives and interventions that may already be in place, all of which potentially have an impact on safety performance (either positive or negative).

A multi-method approach has therefore been undertaken to address as many of the complex factors that have been identified from the literature review as well as earlier studies conducted within the thesis. Chapter 3 outlined the overall methodological approach taken, and Chapter 6 describes the contents of the SLIT whereas this Chapter provides the specific details of how the overall approach of implementing the SLIT was undertaken within Study 4. This

includes the nature of participating organisations within each of the Project Case Studies, as well as the method of how the data collection tools were used. The remainder of this section outlines the method undertaken within Study 4.

7.3.1 Participants

Two different Principal Contractors were involved in the Case Studies (X and Y), each providing data for three individual projects. This makes up the six case studies within the study. Consent to participate in the study was obtained from the Director Responsible for Safety for both Principal Contractor organisations. The six case studies were classified into two different groups: Baseline and Intervention.

- **Baseline Group** - projects were more than 50% through the project contract programme where there is not enough time to apply the interventions (3 projects)
- **Intervention Group** - projects that were new or who were less than 50% through the contract programme where there is enough time to apply the interventions (3 projects)

The projects included within the study were nominated by the Director Responsible for Safety from the Principal Contractor organisation that met the following criteria:

- The projects duration was between 44 - 60 weeks (10-14 months). Project duration was selected to give sufficient time for a project to implement the SLIT, but without being a too long that this would have a negative impact on the overall timeline for completion of the PhD.
- The projects will be representative of the infrastructure engineering scope of works e.g. civils, rail, highways. The project scope was as an infrastructure project i.e. construction of road, rail infrastructure and associated works, as it is recognised within the Construction Industry that different sectors may have different safety cultures therefore to mix the project scope would add an extra level of complexity for the evaluation which was not needed for this study.
- All Principal Contractors will have Safety Improvement Programmes in place. All projects were expected to have a Safety Improvement Programme in place as defined by their Principal Contractor parent company. This provided a minimum level of awareness of safety culture that would assist the researcher in undertaking the interviews. This was a

lesson taken forward into Study 4 from the pilot described earlier within Chapter 3.

These criteria were developed by the researcher to establish a common set of characteristics for each of the participating projects.

Table 7.1 identifies descriptors for each of the projects participating in the study. Project scope, value and duration are included in the table. The number of people working on the project (average and maximum ranges), as well as the proportion of subcontracted works is also included in. Supply Chain organisations would have deployed subcontracted workforce on the project throughout the project construction lifecycle. This information can be considered within the project evaluations and comparison within section 7.4 of this chapter to determine whether there are any common trends across the sample of projects.

	Intervention Group Projects			Baseline Group Projects		
Reference	A	B	C	A	B	C
Principal Contractor	X	Y	Y	X	X	Y
Project Scope	Rail	Civils	Civils	Rail & Civils	Rail & Civils	Civils
Project Value (millions)	£6m	£1.1m	£2.8m	£21m	£13m	£3.5m
Project Duration	35 weeks	16 weeks	56 weeks	52 weeks	48 weeks	52 weeks
Number of Site Management Team from PC on site	5	1	2	4	5	4
Number of people on site (average)	36	32	11	33	63	15
Number of people on site (peak)	52	36	18	113	104	30
Subcontracted workforce	26-50%	76-100%	0-25%	51-75%	26-50%	0-25%
Number of accidents/incidents	11	7	1	11	6	1

Table 7.1 High-level descriptions of the project case studies participating in the study

All organisations participating in the study gave their consent. This was formally undertaken by the Director of Safety for the Principal Contractor, and equivalent role within Subcontract organisations.

As well as participants being recruited at an organisational level e.g. Principal Contractor, individuals were also recruited to participate in the study. Individuals working on the six projects were requested to participate in the study based on the role they undertook, as follows:

- Principal Contractor - Project Manager, Health and Safety Manager, member of the project management team
- Subcontractor – Senior management representative
- Workforce – anyone working on the project

Whilst Project Managers were requested by the relevant Director Responsible for Safety to participate in this study, participation was voluntary. All Individual participants gave their consent to participate in the study.

Project Managers were nominated as the point of contact for the primary leadership interview and necessary data collection, for all of the projects. They are identified as leaders of the project and therefore could be expected to have suitable experience, understanding and knowledge of leadership and safety culture within industry.

Individual Project Managers identified the individuals who would be involved in the study following the initial briefings. This included subcontractor representatives involved in the projects who were also briefed and provided consent to participate in the study.

It is recognised that leaders within both the Principal Contractor and Subcontractor organisations are not always 100% project based. This study focuses on the leaders that are 100% site based i.e. Project Management Team including Subcontractor Management/Supervision. The number of individuals in the Project Management Team varies between each of the projects. Table 7.1 shows the number of individuals within the Project Management Team for each project.

7.3.2 Materials

A number of different materials were used to collect data from Project Delivery Organisation members: Principal Contractor and Subcontractors for each of the projects. The specific materials used are listed as bullet points within Figure 7.1. The method of development of each of the materials is contained within Chapter 6.

The frequency of the assessments was determined by the project timeline and which group it was within. Figure 7.1 shows the materials used within each

assessment and the timescales when these were undertaken. Further procedural aspects are listed in section 7.3.3 in this Chapter.

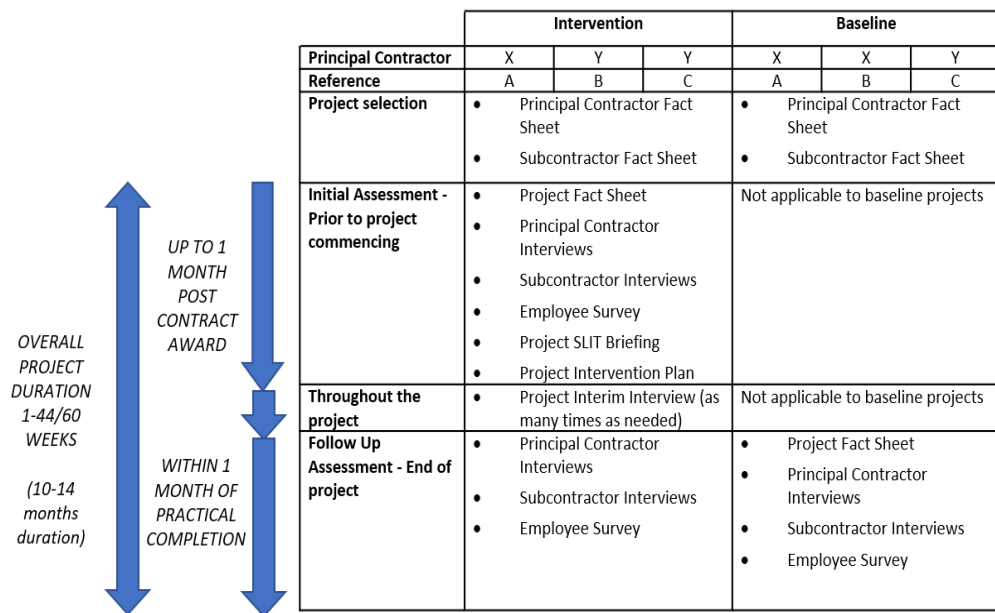


Figure 7.1 Overview of activities for each project against a project timeline

7.3.3 Procedure

Once individual projects were selected based on the criteria listed in section 7.3.1, a Parent Company Fact Sheet was completed with the Principal Contractor Head of Health and Safety, and the Senior Operations Manager from each Subcontractor participating in the study. A copy of these Fact Sheets are included within the appendices.

Assessments were undertaken at the following predetermined intervals for each project in the Intervention Group. Reference should also be made to Figure 7.1.

- I. Initial Assessment – prior to project commencement and within 1 month of project start on site (taken from F10 start date – statutory notification to Health and Safety Executive of project start). As part of the initial assessment that was conducted prior to the project commencing, each intervention project received a Project SLIT Briefing. Each Intervention Project then defined their application of the SLIT in a Project Intervention Plan at the beginning of the project, which was used as part of the subsequent evaluation.
- II. Application of intervention throughout the project – There was quarterly contact between the Project Management team and the

researcher to undertake Project Interim Interviews throughout the duration of each intervention project.

- III. Follow Up Assessment -within 1 month of practical completion. The researcher completed the relevant assessment materials with the project representatives as identified in Figure 7.1.

For projects in the Baseline Group, only the Follow Up Assessment was undertaken.

Following an initial face to face briefing with the researcher, all individuals were reminded that participation in the study was voluntary and they could withdraw at any time. Participants were provided with a Study Information Sheet, and those on Intervention Group Projects were also provided with an intervention guide as part of a Project SLIT Briefing. Documented consent was provided by all participants in accordance with the Ethics approval obtained from the Faculty of Engineering, University of Nottingham for this study.

All information which was collected during the course of the research were kept strictly confidential and the procedures for handling, processing, storage and destruction of data are compliant with the Data Protection Act 1998. All records were scanned and stored electronically. All files were allocated a specific reference number as part of the file configuration. Any findings resulting from the study were compiled in such a way that they remained anonymous and are not be traceable to any individual.

7.3.4 Analysis

Separate analysis was undertaken for each of the different materials as outlined below.

- **Principal Contractor/Subcontractor/Project Fact Sheet**

This data was retained as a record of the organisational safety arrangements and safety performance. This was used as a comparison with the outputs from interim interviews undertaken during and at the end of the project. Section 7.3.4.1 contained more detail on how this comparison was undertaken.

- **Principal Contractor and Subcontractor Interviews, and Project Interim Interviews**

As the interviews were made up of two parts, project maturity assessment and interview questions, two separate analyses were undertaken.

Project Maturity Assessments

Completed Project Maturity Assessments were transferred onto a spreadsheet using the same maturity scale detailed in Study 1 (chapter 4). Data were organised into the ten topic areas e.g. commitment to safety, management of contractors, training. A chart was created for each topic area which compared the data from the initial (start of project) and follow up assessments (end of project). Figure 7.2 shows an example of one the charts created for a particular project. This chart is for the 'Management of Contractor' scores given, and shows the levels of safety culture maturity (1 to 5) on the horizontal axis, and the percentage of statement ticked as be the participant to confirm that the statement described the organisations safety culture on the vertical axis. This particular example shows an increase in positive responses to the statements across all maturity levels from the initial assessment at the beginning of the project to the follow up assessment at the end. This chart provided a means to establish whether each Intervention Group Project had improved their safety culture maturity rating from the start to the end of the project, and whether this was across all of the ten topic areas, or limited to specific topic areas.

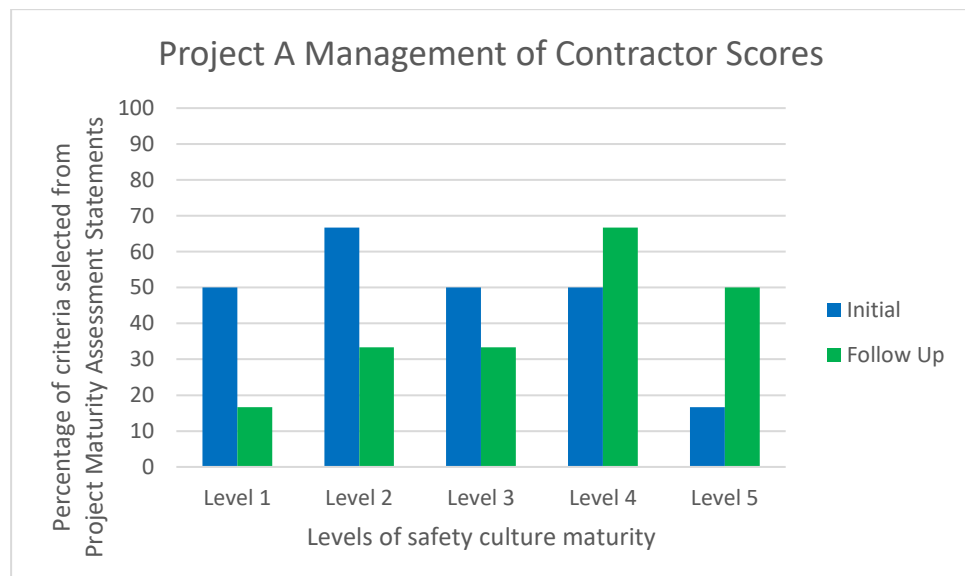


Figure 7.2 Example chart showing project maturity assessment ratings at the initial and follow up assessments for intervention projects

Interview Questions

Thematic analysis was undertaken for all of the interviews, following the principles of the 15-point checklist of good thematic analysis identified by Braun and Clarke (2008), which include:

- Transcription and Data Familiarisation
- Initial Coding
- Establishing Themes
- Reviewing Themes against Literature
- Reviewing Themes and Sub Themes
- Theme Relevance and Conclusions

Firstly, interviews were transcribed from recordings by the researcher. Following the transcription, two reviews of each record were undertaken. The first review was for familiarisation with the data set. On the second review the following descriptions were highlighted within each interview record:

- examples of safety leadership intervention deployed
- the perceived outcomes from undertaking the intervention (positive, negative, passive)
- the challenges faced in deploying the intervention, lessons learned and what could be done differently on another project
- any influencing factors

Once each record had been reviewed twice, the participants' responses (for each of the bullet points listed above) were coded in an inductive manner, with codes being driven by the data set and not predetermined by a coding framework (with the exception of influencing factors which is covered in the next paragraph). The codes that were generated from across all records were listed to form a full suite of codes. The full suite of codes were placed on individual cards and used as reference criteria for reviewing the interview records again (third review), to confirm the original coding or allocate a revised code to the text. Where different or additional codes were allocated these changes were noted on the individual interview record. Once codes were identified these were recorded in a table for each research question (refer to the bullet list above) with comments against each.

Analysing the influencing factors undertook a similar approach except that the codes were taken from Literature rather than being inductive. A total of 22 influencing factors were identified from the literature review as having potential to impact on safety within a Project Delivery Organisation. This list of influencing factors were given a code IF1 to IF22. During the review of the interview records, each influencing factor that was identified was marked with the relevant code IF1 to IF22. A second review of the interview record was undertaken to confirm that the all influencing factors had been

identified and that the correct code recorded. The codes were then recorded in a table for each project. A third review of the interview record focused on the codes and made a note whether the influencing factor was determined as having an impact on safety on the project. These notes were in three groups:

- factor identified as relevant on this project but no evidence of impact on safety
- factor identified as relevant on this project with evidence of a positive impact on safety
- factor identified as relevant on this project with evidence of a negative impact on safety

These notes were added to the table in an addition column.

- **Employee Surveys**

For all projects, data from the completed Employee Surveys were transferred into a spreadsheet. A number of charts were created for each of the questions within the survey. For Intervention Group projects, these charts were transferred into a table for comparison between the initial and follow up employee surveys. A third column was added to capture commentary on the comparison. Figure 7.3 shows an example of the table comparing the initial and follow up employee surveys for a particular project.

INITIAL (N21)	FOLLOW UP (N7)	COMMENTS
Who do you work for? 0% 48% 52% Principal Contractor Contractor Other	Who do you work for? 14% 86% Principal Contractor Contractor Other	There were more people completing the baseline questionnaire (initial) 3:1. There were more contractors who completed the post intervention questionnaire – follow up (an increase of 34%). There were 0% respondents from the 'other' category.
What is your job role? 0% 5% 10% 14% 71% Project/Site Management Site Supervisor Operative Support Function Other	What is your job role? 14% 14% 72% Project/Site Management Site Supervisor Operative Support Function Other	There were a similar number of operatives and supervisors who completed both sets of questionnaires. The baseline data set also included project management and other respondents. Other was planner/support staff but was not 100% based on site. There were 0% of Support Function respondents.

Figure 7.3 Example of analysis from Employee Surveys

- **Project Intervention Plan, Audits and Project Records**

A table was produced to identify the different types of safety interventions deployed. The table includes the following items:

Intervention source – each intervention was categorised by the source, as follows:

- the safety leadership interventions deployed from the SLIT
- the safety leadership intervention deployed – not included within the SLIT
- the non-safety leadership interventions deployed on the project

Standard Practice – whether the intervention is already a requirement within Principal Contractor company procedures, or is a new initiative introduced as part of this study.

Project Intervention Plan – the Intervention Plan produced for each project was mapped against the whole SLIT criteria to identify aspects that were agreed to be implemented at the beginning of the project, and those that were discounted by the Principal Contractor's Project Manager. The detail

of this mapping was undertaken via a separate table listing the SLIT criteria in the first column, with the second column identifying the interventions detailed in the Plan and matching these to the SLIT criteria. A 'Yes' indicates that the intervention was included in the Project Intervention Plan, and vice versa for 'no'.

Intervention Applied– whether the actual interventions were implemented on the project. This enables a comparison against those that were planned and undertaken with those that were planned but not undertaken.

Commentary – Commentary was also collated regarding how each of the intervention were implemented, as well as challenges in implementation. The researcher made reference to specific project records and noted in the commentary column. An example table is included below (Table 7.2).

Roles for Intervention	Intervention Description	Intervention Source	Standard Practice	Project Intervention Plan	Intervention applied	Commentary
Senior Management - Off Site	Leaders are defined within the project and company.	SLIT	Yes	No	Yes	Organisation charts in place with leaders clearly defined.
	Safety goals are established within wider company objectives.	SLIT	Yes	No	Yes	Company has specific safety objectives which are defined within Policy and Business Objectives Statement.
	Every company will have a schedule which defines the frequency of safety tours for Senior Management.	SLIT	Yes	No	Yes	Safety Tour Schedule in place for the Board of Directors.
	Leaders to completed behavioural safety leadership training and exhibit role model behaviours.	SLIT	Yes	No	Yes	Behavioural Safety Leadership training held. There is an awareness of role model behaviours evident at Director level.
Project Management Team – On Site	Leaders clearly communicate their commitment to safety to all persons on the project.	SLIT	No	No	N/A	Excluded from this project.
	Each project and company will have a means for developing, communicating and monitoring compliance with behavioural standards.	SLIT	No	Yes	Yes	The site safety standards are included within the project induction which clearly includes minimum standards of behaviour.
	Every project will have a schedule which defines the frequency of safety tours for Project Management, Site Management, Supervisors and the Supply Chain.	SLIT	Yes	Yes	Yes	There is a rota in place for undertaking safety tours by Project Management. Joint tours are held with Subcontractors Management as well.
	Leaders to completed behavioural safety leadership training and exhibit role model behaviours.	SLIT	Yes	Yes	Yes	Behavioural Safety Leadership training held. There is an awareness of role model behaviours evident within the Project Management team.
	Every company will have a stand down scheduled as part of the development of their safety objectives and action plan.	SLIT	No	No	N/A	Excluded from this project.

Table 7.2 Example Intervention Assessment Table from one project

7.3.4.1 *Synthesising the analysis*

The findings from each specific material analyses already described (for the Principal Contractor/Subcontractor/Project Fact Sheets, Principal Contractor and Subcontractor Interviews, and Project Interim Interviews, Employee Surveys, Project Intervention Plan, Audits and Project Records) were collated into an Overview Findings Sheet for each project which gave the findings on a project by project basis. This was made up of a set of tables prepared for each project based on the key components of the logic map described in Chapter 3:

- **Context** - data taken from the Fact Sheets relating to project duration, value, scope of works.
- **Inputs** - the deployment of standard interventions and safety leadership interventions defined within the SLIT. These were broken down into the four areas within the SLIT: vision and goals, transformational leadership techniques, transactional leadership techniques, and monitoring and reviewing. Commentary was provided for each of these areas regarding the types and extent of safety interventions that were implemented. This was taken from the themes identified within the earlier material thematic analysis e.g. examples of safety leadership intervention deployed.
- **Outputs** – the four outputs identified in the logic map were i) belief in leadership commitment to safety, ii) role model safety leadership behaviour, iii) consistent response to incidents, and iv) feedback on safety performance. Commentary was detailed regarding the extent to which the relevant criteria had been achieved or not for each of the four.
- **Outcomes** – there were four outcomes expected to be achieved from implementing the SLIT. These were defined within the logic map as reduced accidents and incidents, increased visibility of safety leadership behaviours, Increased invoking of refusal to work and increased hazard and near miss reporting. Commentary was generated by the researcher detailing whether or not these outcomes had been achieved for each project.
- **Impacts** – this table identified whether or not there had been an increase in safety performance and an increased safety culture maturity scores for each project.
- **Relevant influencing factors** – an Influencing Factors Assessment was also undertaken for each project. This table identified a list of influencing factors, whether each factor was considered relevant for the particular project, and whether there was evidence of the factor having an impact on safety performance (either positive or negative).

In order to compare between the Intervention Group and Baseline Group projects, as well as a comparison across all six projects, each of the tables within the Overview Findings Sheet were collated into one table for the bullet points listed above e.g. inputs, outputs, outcomes, impacts, and relevant influencing factors. The subsequent tables showed each of the project's findings next to one another. These tables are provided within the next section.

7.4 Results

The results are reported in two ways: firstly, the results of each individual case study findings are provided as a narrative; and secondly, the results from across all case studies (Baseline and Intervention projects), are shown in a number of subsections each corresponding to the components of the logic map (Inputs, Influencing Factors, Outputs, Outcomes, Impacts). A narrative for each of these aspects supports the tables. The data is presented in this manner so that as well as individual case studies, the data can be used to compare between groups and across the whole sample.

7.4.1 Individual Case Studies

7.4.1.1 Intervention Group Project A

Context. Intervention Project A was a rail infrastructure enhancement project lasting for 35 weeks. The total project value was £6 million. The project had an average of 36 people working, peaking at 52 people for key project milestones. Between 26-50% of the work was subcontracted, the rest was delivered by directly employed labour and plant operating teams. There were two main subcontractors delivering works on the project more several months duration: mechanical and electrical contractor and a piling contractor. These two subcontractors were supported by smaller specialist contractors undertaking occasion one-off works for limited short durations.

Inputs. On this project overall there were limited safety leadership interventions deployed. This project undertook three safety leadership interventions from the SLIT; leaders exhibit role model behaviours, process for reporting safety concerns, and process for addressing culpability for safety related events.

At the beginning of the project three more interventions were included within the Project Intervention Plan but they were not implemented at all during the

project; these were commitment to individual's welfare (safety and wellbeing), creating behavioural norms and workforce involvement in goal setting. The decision not to apply these interventions was reported by the Project Manager as being due to the challenges on the programme, as well as a lack of understanding of the benefit of the interventions amongst the Project Management Team. Due to this the Project Manager was the only individual driving the interventions and therefore gave up due to lack of support.

Two additional interventions were started but were not implemented through the whole project timeline; these were visual performance metrics and, providing and receiving performance feedback and information on lessons learned. The reason these two interventions were started but not carried on was due to the activity being planned to carry out at a newly designed and installed briefing station where visual performance data and the relevant briefings were to take place. On this project challenges over location of the briefing station from the Client representative on site were unresolved and therefore the briefing station did not get implemented as the original Project Intervention Plan had envisaged.

The project also undertook eight safety interventions (not specifically relating to leadership) which were not identified within the SLIT; one of these was relating to competence, six relating to engagement and one relating to accident investigations.

Outputs. The outputs from these interventions identified a reduced belief in leadership commitment to safety from both the workforce and project management team, particularly towards the end of the project, where delivery was perceived to be more important. By contrast, management rate themselves as achieving reasonable levels of safety leadership behaviours. Whilst tools were in place in response to incidents, management were reported to turn a blind eye when safety requirements constrained delivery. Feedback on safety performance within the project was limited.

Outcomes and Impacts. As the inputs were limited, the outputs were largely reactive and indicated a lack of visible safety leadership, the expected outcomes and impacts were not achieved. There was no clear reduction in accidents/incidents on the project, and a lack of evidence of refusal to work processes being invoked. Near misses were reported (100 number) until the last 8 weeks of the project when zero reports were submitted. However, the project recorded an overall increase in self-reported safety culture maturity scores against the Hudson Model.

Influencing Factors. A number of influencing factors were identified to have a negative impact on project safety performance: Client requirements/expectations and changes to project scope of works, which contributed to design management and design delays, changes to project baseline construction programme (work activities compressed to deliver by the same end date), increased project resources which was more difficult to manage. There were also unforeseen challenges e.g. contamination, obstructions, which hadn't been identified in the planning process which impacted on the changes listed here. These factors were reported to have focused the project management team on delivering the work to meet the programme where new interventions were viewed, although desirable, as not directly contributing to the safe delivery of the works.

7.4.1.2 Intervention Group Project B

Context. Intervention Project B was a civils project involving drainage and utility diversions and new installations. The total project value was £1.1 million. The project construction programme was over 16 weeks with an average of 32-36 people working. Between 76-100% of the work was subcontracted. There was one main subcontractor engaged throughout the project lifecycle to deliver groundworks. Due to changes to the programme an additional contractor was procured mid-way through the project to undertake similar works, in order to achieve a revised project programme.

Inputs. There were limited safety leadership interventions deployed; only four from the SLIT; delivering of stand down sessions, individuals actively challenge working methods, processes, communications and behaviours where they are not in accordance with project safety goals, processes in place for delivering feedback on performance to the workforce, and the provision of visual safety performance data. This was reported by the Project Management Team to be attributable to a complete lack of engagement from the Subcontract Supervisor on site who instructed the workforce to disregard any safety initiatives. Initially the Project Management Team tried to implement the agreed interventions but gave up after weeks of trying. Additional programme pressures were also a factor in distracting the Project Management Team from the SLIT to project delivery requirements.

At the beginning of the project three more interventions were included within the Project Intervention Plan but they were not implemented at all during the project; these were visibility amongst workforce and, providing and receiving performance feedback and information on lessons learned. The Project

Intervention Plan was not included within the handover following the change of Project Manager and therefore these items were not undertaken.

Two additional interventions were started but were not implemented through the whole project timeline; these were visual performance metrics and, providing and receiving performance feedback and information on lessons learned. A similar level of workforce disengagement was stated by the Project Manager as the reason these interventions were not continued on the project. On several occasions the visual performance data was removed and ripped up by the workforce.

The project also undertook four interventions that were outside of the SLIT; two on engagement and two on materials to support safety communications.

Outputs. The outputs from these interventions identified a limited evidence of a belief in safety leadership on the project, particularly poor from the subcontractor management representative. Safety is a tick box exercise to appease the Client resident on site. Reporting of near misses was poor throughout the duration of the project. Safety being led by the Health and Safety Manager. Response to incidents was overseen by the Client on site, and there was a strong line taken with repeat offenders being removed from the project. Attempts by PC Site Management to use standard feedback techniques e.g. you said we did boards, posters, noticeboards, were defaced or removed by subcontract workforce. Feedback on safety performance had to be directed to the subcontract supervisor only. This had limited positive impact on overall safety outcomes.

Outcomes and Impacts. With limited inputs, the outputs were indicative of a reactive safety culture, where safety was implemented under duress from the Client and not lead through the project management hierarchy. A particularly disengaged manager from the subcontractor had a significant negative impact on the attitude towards safety from the workforce, evident in very limited self-reporting of safety concerns. Off-site Senior Management had intervened on the project due to specific concerns regarding safety performance. The overall project safety culture maturity had not improved.

Influencing Factors. A number of influencing factors were identified to have a negative impact on project safety performance: Client representative behaviours, and subcontractor safety expectations below industry standard. Two further factors were identified as having a notable significant negative impact; change in Project Management from the Principal Contractor early in the project, and again part way through led to a lack of commitment to the overall project deliverables from the new appointee(s). Secondly a delay to the

programme from unforeseen challenges which impacted on the design. This led to a doubling of the original resource forecasted for the project, combined with a pressure to meet a tight project handover programme. However, there were actions taken due to the poor safety performance; increase in dedicated health and safety resource and interventions from off-site Senior Management which made a positive impact on the project safety performance.

7.4.1.3 Intervention Group Project C

Context. Intervention Project C was a rail infrastructure enhancement project lasting for 56 weeks. The total project value was £2.8 million. The project had an average of less than 20 people working at any given time. Between 0-25% of the work was subcontracted, the rest was delivered by directly employed labour and plant operating teams. The subcontracted works were undertaken by a specialist piling organisation.

Inputs. This project delivered the highest number of interventions from the SLIT; behavioural safety leadership training, role model safety leadership behaviours, process for recognising and rewarding those who have made a positive contribution to safety, arrangements for positive intervention when at-risk behaviours are observed, communication of learning from incidents shared amongst all levels, process for reporting safety hazards from workforce to the management.

All of the interventions identified within the Project Intervention Plan had started to be implemented on the project. Five additional interventions were started but were not implemented through the whole project timeline; these were delivering of stand down sessions, participation in safety committees, appraisals and personal performance reviews, visual performance metrics and, providing and receiving performance feedback and information on lessons learned. The Project Management Team reported the influence of the Client representatives on site to have delayed these interventions being implemented as the Principal Contractor was instructed to follow specific safety initiatives instigated by the Client.

This project also implemented two additional interventions not included within the SLIT; safety expectations detailed within the subcontractor contracts, and daily task briefings for all works.

Outputs. The outputs from these interventions identify that there is some evidence that leaders are committed to safety and this is being recognised by the workforce, with an increased confidence in the reporting of safety related

events from the workforce with. Managers were found to actively challenge working methods, processes, communications and behaviours where they are not in accordance with the project safety and behavioural standards. The project response to incident investigations was taking a Fair Culture approach and using fair culture assessment tools which focus on the level of event and the contribution of human behaviour (error or violation), with appropriate actions taken.

Outcomes and Impacts. The outcomes were notably an increased visibility of leaders particularly at supervisory level, following a weekly engagement session with the workforce. There was also some evidence of self-reporting of hazards, near misses, although low in number (24 reports made). There was no change in the accident incident rate, but there was an overall increase in self-reported culture maturity scores from the project management team.

Influencing Factors. The Client was found to have the biggest impact on safety performance, both positive and negative. Where there were inappropriate or adversarial behaviours from individuals this was found to have a negative impact and undermine confidence for openness and reporting. However, the Client initiated several safety interventions (e.g. daily task briefings) which made a positive improvement to the safety arrangements on the project. Delays to programme, and the need for further design work resulted in an increased pressure to deliver to meet the project timescales, which was achieved through increasing the resources working on the project. This had a negative impact on safety performance as there was a greater need for deconstriction of work sites and more people to supervise.

7.4.1.4 Baseline Group Project A

Context. Baseline Project A involved construction activities for a new station and associated rail infrastructure remodelling works (piling, civils, earthworks and track works). The project value was £21 million, and the project was scheduled to take 12 months to complete. The average number of people working on the project was 33, however this number rose substantially for blockade works (where the operational railway is closed) to 113 people. Between 51-75% of the work was delivered by 12 different subcontractor organisations, the remainder undertaken by the Principal Contractors directly employed workforce.

Inputs. There were limited safety leadership interventions deployed by the project as part of their normal safety management arrangements; defined

project safety goals, behavioural safety leadership training, role model behaviours, process which identifies levels of culpability (error, violation) which is applied to incidents. This project also undertook defined technical safety training to minimum company standards, held contractor engagement meetings and delivered regular tool box talk awareness briefings. Whilst these are interventions which can have a positive impact on safety, they are not specific safety leadership interventions. The project did not undertake any additional interventions that could be identified as safety leadership activities.

Outputs. The outputs from the safety-related interventions implemented by the project were that there was a lack of belief that managers really mean what they say, hence a lack of workforce reporting (hazards, near misses). Safety leadership was found to be inconsistent between individuals in the site management team, particularly covering out of hours working. There was evidence that some subcontractors demonstrated higher levels of visibility and engagement for safety. Safety was regularly included within project meetings but feedback to the workforce was reactive in response to safety events or issues.

Outcomes and Impacts. The positive outcomes on safety performance were limited. There was an increase in near miss reports (total 72 reports) from the workforce up to the blockade where there was a condensed programme to meet the overall schedule of works. This was a key milestone. During and after the blockade there was a reduction in number of such reports, accompanied with a spike (increase) in accidents/incidents as hours of work increased. There was limited evidence of increased safety leadership behaviours from the project management team, but some evidence of greater engagement and visibility at subcontractor level.

Influencing Factors. There were both positive and negative influencing factors identified as having an impact on safety performance. The subcontractors increased visibility and engagement was supported by increased attendance from the subcontractor's health and safety team. This was reported as a positive impact, especially as this level of support continued during night, as well as daytime works. The adversarial nature of some Client representatives was reported to have a negative impact on safety. The project demanded a substantial amount of work to be undertaken during night shifts with peak resource deployed for a very short period of time (a weekend). Due to the short timescales affiliation to the project safety culture, this factor was reported as having a negative impact on safety.

7.4.1.5 Baseline Group Project B

Context. Baseline Project B involved the construction of a new station project including associated drainage, piling, civils, demolition, tunnelling and track works. The project value was £13 million, and the project was scheduled to last 11 months. The average number of people working on the project was 63, however this number rose substantially for weekend and night works to 104 people. Between 26-50% of the work was delivered by six subcontractor organisations, the remainder undertaken by the Principal Contractors directly employed workforce.

Inputs. This project undertook a high number of safety leadership interventions. These included a range of activities; schedule of stand down sessions, schedule for safety leadership tours, safety committee meetings with the workforce, process for reporting of safety concerns, process which identifies levels of culpability (error, violation) which is applied to incidents, process for recognising and rewarding those who have made a positive contribution to safety, and the communication of learning from incidents shared amongst all levels, process for reporting safety hazards from workforce to the management. This project also held contractor engagement meetings and provided behavioural safety posters on the site.

Outputs. The outputs from these interventions was an increased confidence in the reporting of safety related events and non-compliances from all levels of the project team with a total of 708 reports made during the project. Feedback was starting to happen via formal engagement sessions and stand downs. There was a belief that leaders have credible commitment to safety, through visible safety leadership from project management level; although this could be more consistent. Leadership behaviour was strongest at supervisory levels. Dedicated safety champions are a communication route for feedback to the workforce. A just culture approach had been undertaken in response to incidents with a reported positive impact.

Outcomes and Impacts. Positive outcomes were found relating to high quality reports of safety concerns from the workforce. There were higher levels of leader visibility relating to safety matters, particularly amongst supervisors, but less so amongst senior project management. However, there was an increase in accidents/incidents as hours of work increased on the project.

Influencing Factors. There were a few influencing factors identified as having a negative impact on project safety performance. The adversarial nature of the client was found to have a negative impact, as well as addressing and overcoming unforeseen circumstances during the works. Specific targets were

in place regarding project safety performance which was found to have a positive impact i.e. targeted inspections from subcontractor health and safety team.

7.4.1.6 Baseline Group Project C

Context. Baseline Project C involved utility diversion works for the construction of a new station project including associated track works. The project value was £3.5 million, and the project was scheduled to last 12 months. The average number of people working on the project was 15, however this number rose to a peak of 30 people. Between 0-25% of the work was delivered by two subcontractor organisations, with the majority of the works undertaken by the Principal Contractors directly employed workforce.

Inputs. This project also undertook a high number of safety leadership interventions. These included; defined project safety goals, schedule of stand down sessions, schedule for safety leadership tours, safety leadership training, role model behaviours, inductions clearly defined personal responsibility for safety, process for recognising and rewarding those who have made a positive contribution to safety, and a process for reporting safety hazards from workforce to the management. This project also undertook defined technical safety training to minimum company standards, held daily task briefings and regular random drugs and alcohol screening.

Outputs. The positive outputs reported from these interventions is that managers actively challenge working methods, processes, communications and behaviours where they are not in accordance with the project safety and behavioural standards. However, safety leadership was found to be inconsistent between individuals in the site management team and the client. There is limited evidence available that there are robust feedback processes in place, with feedback only in response to safety events or issues

Outcomes and Impacts. As the outputs were largely reactive and indicated a lack of visible safety leadership, the expected outcomes and impacts were not achieved. There was no clear reduction in accidents/incidents on the project, with only one incident reported. There was some evidence of near miss reporting but this was low in number (66 reports made).

Influencing Factors. A number of influencing factors have been identified as having a negative impact on the project. The breakdown in relationship between the Client and site management team was perceived to have an impact at workforce level with a reluctance to report close calls. There were

delays to the design from unforeseen circumstances, that led to delay in work starting on site, yet the handover deadline remained the same. Therefore, the increase in pressure to deliver the project on time was further complicated with an increase in workforce to deliver the works. The focus of Project Management was on delivering the work.

7.4.2 Inputs

7.4.2.1 Project Intervention Plans

Each Intervention project developed in Intervention Plan at the beginning of the project which defined the safety leadership interventions that would be applied from the SLIT. These were developed at the initial project briefing stage. Table 7.3 identifies the planned interventions undertaken for each of the Intervention Group projects against the SLIT content for the four areas identified within the SLIT: vision and goals, transformational leadership techniques, transactional leadership techniques and monitoring and reviewing safety performance. Table 7.3 also includes a description of the intervention activity identified within each of these four areas.

There were common intervention activities identified across the three Intervention Group projects for implementing across the four areas within the SLIT as follows:

Vision and Goals – There were five activities within the SLIT. Project A committed to undertake all five activities, whereas project B and C committed to undertake four out of the five activities. The activity that was excluded for both projects was ‘leaders clearly communicate their commitment to safety to all persons on the project’. The Project Managers developing the Intervention Plan stated that it was not required for them as everyone knew of their commitment through the induction and safety tour processes.

Transformational Leadership – There were seven activities within the SLIT. Intervention Projects A and C committed to undertake five out of seven activities, and Intervention Project B committed to four. All three projects declined to undertake the same two activities relating to a) the definition of personal safety behaviours and b) including these behaviours within project inductions. The researcher found that following explanation, the Project Manager from Intervention Projects A and C did not value this activity as an intervention to improve safety. Intervention Project B also declined to undertake health and safety committee meetings. In the project briefing the

Project Manager felt this was not necessary with such a small workforce on his particular project as informal dialogue would be achieved daily.

Transactional Leadership – There were three activities within the SLIT. Intervention Project A committed to undertake all three activities, and Intervention Projects B and C each committed to two. The activity that was excluded from the plan related to a formal process for managing errors and violations of safety rules. For Intervention projects B and C, the Principal Contractor parent company did not have processes in place to undertake this within their business.

Monitor and Review – There were six activities within the SLIT. Intervention Project C committed to five out of the six activities, and Intervention Projects A and B committed to four activities each. One of the areas that was declined identified the need for behaviours to be included within individual appraisals. All Project Managers stated that the scope of the individual appraisal was defined by the Principal Contractor parent company without opportunity to change this process. The second activity that was declined by Intervention Project A and B was a process for reporting safety hazards from the workforce to Project Management. The Project Managers reported that they were required to report lots of safety information already and did not want to take on more work.

7.4.2.2 Implementation of Project Intervention Plans

Table 7.3 identifies the actual interventions deployed by each of the Intervention Group projects. These are listed as a 'Yes' within Table 7.3.

Results show that the implementation of safety leadership interventions was generally poor across the three Intervention Group projects. The total number of interventions that were deployed were low in number; Intervention Project A – 3, Intervention Project B – 4 and Intervention Project C – 3. There was no consistency across the three projects in terms of the interventions that they did deploy.

From each of the intervention plans the Intervention Group projects only deployed up to 33% of their planned safety leadership interventions. A number of influencing factors were identified by the Project Managers as having a negative effect on the time and resource available to implement the full Intervention Plan. In addition, the level of attention and priority given by Project Managers to the safety leadership interventions was also affected.

From the different interviews that were completed across the Intervention Group projects, five themes were identified including reasons interventions were not deployed: Safety integrated with delivery, Communication and engagement, Compliance focused, Resources and Training. These themes are identified with a brief description within Table 7.4, as well as example statements taken from the interviews.

A lack of integration of safety within the project delivery was identified as a theme. Planning of how and when to introduce, communicate and then implement the interventions was a factor in whether the intervention was deployed or not. When there was poor planning there was a lack of forethought on how to implement the intervention, position, resources, frequency, within the wider construction delivery activities, the intervention was less well implemented.

Poor communication of the specific safety intervention from Project Managers was also identified as a theme affecting whether or not the intervention was deployed, and if it was this adopted across the project team. A lack of ownership within the team was reported as something that would result in the intervention not being implemented. Communications that were email rather than face to face resulted in interventions not being effectively deployed.

The focus of safety was reported to be more on compliance with statutory requirements than on implementing safety initiatives. Non-essential safety-related activities that were perceived to not add value were not implemented by the Project Management teams. This is linked to availability of resource.

A lack of people resources was also reported as an issue at critical milestones on the project programme, or towards the end of the project when individuals were moved off to other projects but there was still the need to undertake the interventions. Without enough people to do these activities the remaining team members prioritised the timely delivery of the project over those activities perceived as non-essential.

Training needs were also identified as a reason why some of the interventions were not implemented. Project Managers and frontline supervisors were specifically identified from the interviews as not having enough safety leadership skills to apply the SLIT interventions effectively. Individuals lacking the necessary awareness, understanding and skills to implement the safety leadership interventions was reported as a barrier to implementation.

During the evaluation of intervention activities, each project identified a number of different safety related interventions that were not leadership-

related or contained within the SLIT itself. Even though the number of interventions deployed from the SLIT was low, the projects did implement a number of other non-safety leadership interventions. These were based around competence/ training, workforce communication, resources/materials and incident response. Table shows the safety interventions that were not contained within the SLIT, but which were still deployed by each of the Intervention Group projects. These are marked as a 'Yes' within Table 7.5.

7.4.2.3 Comparison between Intervention and Baseline Group Projects

The projects are listed against whether they were in the Intervention Group or Baseline Group. Although the Baseline Group projects did not deploy the SLIT directly, these projects did implement identical activities which meet the criteria of the SLIT. These are shown a 'Yes' within Table 7.3 under the heading Baseline Group Projects.

A comparison of the three Intervention Group projects identified that as a group they deployed only 12 of 27 available interventions (44%). Of the 12 interventions only one was deployed by two projects. A comparison of the three Baseline Group projects identified that as a group they deployed 14 of 27 available interventions (52%).

In providing explanation for these results, the context outlined in Table 7.1 is an importance reference. The Intervention Group projects had a lower gross project value than the Baseline Group projects. The Intervention Group projects ranged from £1.1 million to £6 million, where as the Baseline Group project values ranged from £3.1 million to £21 million. The Intervention Group projects were also of a shorter duration and employed fewer people deployed (on average) than the Baseline Group projects. In addition, the Baseline Group also had more individuals appointed within the Principal Contractor Site Management team based on site (project leaders). This supports the importance of resources which was identified in section 7.4.2.2. All of these characteristics outline the scale of the project which is reflected in the availability of resources to implement safety-related interventions. The relevance of project size and associated resource availability is explained more in section 7.5.

Across the case studies, neither the baseline or intervention projects undertook 100% of the interventions outlined within the SLIT. Baseline projects were not provided with the SLIT, but when the interventions they had deployed were mapped to the SLIT contents, the baseline group had applied more

interventions than the Intervention Group. Across the four categories of interventions within the SLIT, the most common activity was within the transactional area. Table 7.3 also highlights this, as well as showing the number of times individual SLIT interventions were deployed across all projects. There was little overlap across the projects. Table 7.3 shows that several of the interventions were deployed by two projects, with transactional activities being implemented the most. In addition, the Baseline Group projects also undertook additional interventions relating to competence/training, engagement, resources/materials and monitoring activities, as listed in Table 7.5.

KEY – Shaded grey box identifies the interventions not included within the Project Intervention Plans (Intervention Group only) Yes – indicates intervention deployed				Intervention Group Projects			Baseline Group Projects		
	Description of Intervention Activity	A	B	C	A	B	C		
Vision and Goals	Leaders are defined within the project.								
	Safety goals are established within wider project objectives.				Yes		Yes		
	Leaders clearly communicate their commitment to safety to all persons on the project.								
	Each project will have a means for developing, communicating and monitoring compliance with behavioural standards.								
	Every project will have a stand down (time when work stops) scheduled as part of the development of their safety objectives and action plan.		Yes			Yes	Yes		
	Number of vision and goals interventions planned to be implemented	5	4	4					
	Number of vision and goals interventions actually implemented	0	1	0	1	1	2		
Transformational leadership	Employers will provide an explanation of personal safety behaviours as appropriate for the role, including personal contribution to achieving safety vision and values.								
	Health and Safety Committee Meetings will include Behavioural Safety standards. Senior management will attend all meetings.					Yes			
	Every project will have a schedule which defines the frequency of safety tours for Project Management, Site Management, Supervisors and the Supply Chain.								
	On-site project leaders to complete behavioural safety leadership training and exhibit role model behaviours.	Yes		Yes	Yes		Yes		
	Project inductions will provide an explanation of personal safety behaviours as appropriate for the role, including personal contribution to achieving safety vision and values.						Yes		
	Individuals actively challenge working methods, processes, communications and behaviours where they are not in accordance with the project safety goals.		Yes						
	Each project will have a process for the reporting of safety concerns from all employees and members of the supply chain.	Yes				Yes			
	Number of transformational leadership interventions planned for implementing	5	4	5					
	Number of transformational leadership interventions actually implemented	2	1	1	1	2	2		

		Intervention Group Projects			Baseline Group Projects		
	Description of Intervention Activity	A	B	C	A	B	C
Transactional leadership	Each project will have a process which identifies between different levels of culpability (error or violation / individual or group), and apply this process consistently when managing safety related events.	Yes					
	Each project will have a process for recognising and rewarding individuals and teams who have made a significant contribution to safety.					Yes	Yes
	Individuals will be informed of the project approach for positive intervention, and actively intervene when 'at risk' behaviour is observed.			Yes			
	Number of transactional leadership interventions planned to be implemented	3	2	2			
	Number of transactional leadership interventions actually implemented	1	0	1	0	1	1
Monitor and Review	As part of the formal management review, on a quarterly basis, projects will review safety data to identify performance trends. An action plan to address these issues will be developed.						
	The Personal Development Review Process will include a review of against the behavioural standards.						
	Each Project will have a mechanism for the reporting of safety hazards from the workforce to Project Management.			Yes		Yes	Yes
	Each project will have a process to provide feedback on performance for employees/members of the supply chain.		Yes			Yes	
	Each project will provide visual safety performance data for employees/members of the supply chain.		Yes				
	Each project will have a process for the sharing of outcomes from accident, incidents and significant near miss investigations amongst all employees and members of the supply chain.						
	Number of monitor and review interventions planned for implementing	4	4	5			
	Number of monitor and review interventions actually implemented	0	2	1	0	2	1
Total Number of interventions planned for implementing		17	14	16			
Total Number of interventions actually implemented		3	4	3	2	6	6

Table 7.3 Safety Leadership Interventions deployed per project

Theme	Commentary	Example statements taken from interviews
Safety integrated with delivery	Leaders need to integrate safety across the PDO so that safety is not perceived as an extra thing to do, but just part of what has to be done to complete the project. This should be achieved right from the start of the project, even before the construction works commence.	<i>Set our stall out at the beginning – make the time to do this better. Spend more time doing the things we thought we wanted to do from the start. There won't be any person who hasn't thought of good ideas for safety but there are many reasons why they haven't happened!</i> <i>The project management team undertake fantastic intervention's, but we are head down and arse up, so we don't give safety behaviours as much time as would like. We are constantly distracted by emails versus engagement on site and the investment associated with this.</i>
Communication and Engagement	Communication from the project leaders through to frontline supervisors, as well as their ongoing engagement in safety interventions is essential. Otherwise there is a lack of commitment from frontline supervisors whose behaviour may undermine the potential positive impact of the leadership intervention.	<i>We introduced the briefing station just as we had the OK to commence works following the delays, so the supervisors were more focused on delivery than the briefing station. I'm not sure they brought in really. It is difficult to challenge thinking and mind sets when they do not see value or benefit.</i> <i>As Project Manager I have rare interaction with the guys, I do engage at safety forums every month or two. I could spend more time on this.</i>
Compliance focused	Project level leadership is heavily focused on achieving compliance with statutory safety requirements.	<i>We are still heavily focused on compliance. It is a high-profile project and we are in the spotlight from everyone.</i> <i>We are too busy trying to keep the ship afloat and doing the basics.</i> <i>We need more focus on value adding and impact on safety – not just ticking the box.</i>
Resources	The number of available people to undertake the interventions and their capacity to do this alongside other duties defined within their job role.	<i>Now work is starting elsewhere, and this project is closing down, management are on other sites which means we are stretched.</i> <i>The pressures on the project and just personal priorities have meant that safety initiatives have not been given as much focus by everyone in the team as they could have. This makes it difficult.</i>
Training	Project Managers identified a need for more training in leadership skills.	<i>On this project we did not do any behavioural safety training.</i> <i>I know how we are doing by how much the supervisor screams at me!</i>

Table 7.4 Themes identified from the implementation of the SLIT including reasons interventions were not deployed

Theme	Non-SLIT Intervention Activity	Intervention Group Projects			Baseline Group Projects		
		A	B	C	A	B	C
Competence (individual/organisational)	Delivery of safety training for individuals to achieve minimum industry competence standards	Yes			Yes		Yes
	Weekly safety inspections undertaken by Client representatives	Yes	Yes				
	Checks undertaken during the subcontractor selection include safety to prove organisational competence			Yes		Yes	
Workforce Communication	Contractor engagement meetings to discuss safety performance and progress on construction works	Yes			Yes		
	Daily task briefings to communicate task for the day ahead	Yes		Yes			Yes
	Supervisors involved in developing and planning the safe system of work for specific tasks	Yes					
	Centralised briefing stations positioned on site as a communication hub and access to posters and key information	Yes					
	Tool Box Talks – weekly briefings to raise levels of safety awareness	Yes	Yes		Yes		
Resources/Materials	Behavioural Based Safety themed posters		Yes			Yes	
	Safety moments – safety is first on every agenda where a key topic is discussed prior to the meeting proceeding		Yes				
Process for Incident Response	Drugs and alcohol screening following any incident						Yes
	Health and Safety team lead investigations	Yes					
Total number of additional non-SLIT activities undertaken		8	4	2	3	2	3

Table 7.5 Deployment of Non-SLIT activities per project

7.4.3 Outputs

Table 7.6 shows an explanation of the findings for each of the six case studies, against the four areas identified as predicted outputs within the logic map. The outputs were activities directly resulting from the interventions, outputs expected to be produced by the intervention. These were:

- Belief in leadership commitment to safety
- Role model safety leadership behaviour
- Consistent response to incidents
- Feedback on safety performance

The evaluation of the outputs includes the level of participation and response to the interventions measured.

The outputs from the interventions were similar for each of the Intervention Group projects. There was a lack of leadership visibility with individual behaviours inconsistently demonstrating role model behaviours. Behaviours were largely focused at satisfying Client requirements. Intervention Project A demonstrated a lack of belief that managers really meant what they say; Intervention Project B had limited evidence that there was a belief in safety leadership on the project, whilst Intervention Project C did show some evidence that leaders are committed to safety.

The Intervention Group project also demonstrated an inconsistent leadership response to incidents with management reportedly turning a blind eye to specific rule breaches. There was some attempt at taking a fair/just culture approach, but this was not deployed by all Intervention Group projects. Feedback on safety performance was reactive, ad hoc and informal.

Therefore, the expected outputs defined within the logic map were at best only partially achieved across the Intervention Group. This could be attributed to the low level of implementation of safety leadership interventions on these projects.

For Baseline Group projects the reported outputs were mixed with areas such as fair/just culture not being widely adopted. Feedback to the workforce on safety performance was largely reactive and undertaken in response to incidents. There was evidence that leadership commitment and belief in safety were credible, with some role model behaviours displayed. These were not consistent, with supervisors showing greatest levels of role model safety-related behaviours, challenging unacceptable workforce behaviours. However, there was a gap between workforce and Project Management in terms of trust and engagement.

The identified outputs for the Baseline Group projects were slightly more established than the Intervention Group projects. This may be attributable to the Baseline Group deploying more safety leadership interventions than the Intervention Group.

Logic Map Outputs	Intervention Group Projects			Baseline Group Projects		
	A	B	C	A	B	C
Belief in leadership commitment to safety	The employees report a notable reduction in positive responses across all questions. Therefore, is a lack of belief that managers really mean what they say; and pressure to deliver the construction work is evident. The number of close calls reported increased steadily over the project duration, except the last 8 weeks of the project where they reduced significantly. The leader focus at this point was reported to be delivering construction work above safety. The interventions were undertaken less frequently if at all, during this period.	There is limited evidence that there is a belief in safety leadership on the project, from Client, PC or subcontractor. The subcontractor Site Manager is not particularly engaged in safety matters. There were some informal reports, but this was poor throughout the project duration.	There is some evidence that leaders are committed to safety and this is being recognised by the workforce. There are signs of an increased confidence in the reporting of safety related events from the workforce and subcontractors.	Safety leadership is inconsistent between individuals in the site management team particularly covering out of hours working. There is a lack of belief that managers really mean what they say. There is a gap between management and workforce at project level with the workforce unsupported and therefore so not report close calls.	There is a belief that leaders have credible commitment to safety. There is an increased confidence in the reporting of safety related events and non-compliances from all levels of the project team including the workforce and subcontractors.	Safety leadership is inconsistent between individuals in the site management team and the client. The breakdown in relationship between the Client and site management team was perceived to have an impact at workforce level with a reluctance to report close calls.

Logic Map Outputs	Intervention Group Projects			Baseline Group Projects		
	A	B	C	A	B	C
Role model safety leadership behaviour	There is limited evidence of visible safety leadership from project management. Management are perceived to be committed to saving/ making money above safety. Engagement in safety related decision making could be improved. The role of Health and Safety advisor is perceived to be poor i.e. compliance focused. However, management rate themselves as having reasonable levels of visible safety leadership.	There appears to be a lack of safety leadership from project management level; safety is a tick box exercise, to appease the Client. The Client was in attendance on site full time and ethos was very negative towards the PC/ workforce. Safety being led by the H&S Manager.	Managers actively challenge working methods, processes, communications and behaviours where they are not in accordance with the project safety and behavioural standards. This was kept at site level and informal. Client site management were reported to have a negative impact on safety.	There appears to be a lack of safety leadership from project management level; safety is a tick box exercise in progress meetings, and a lack of visibility on site of Site Management. There is evidence that some subcontractors demonstrate greater safety leadership where their management visit the project and talk to the supervisors and workforce, and give feedback.	There is evidence of visible safety leadership from project management level; although this could be more consistent. Leadership behaviour is strongest at supervisory levels. There is some evidence that Individuals actively challenge working methods and report hazards where they are not in accordance with the project safety standards.	Managers actively challenge working methods, processes, communications and behaviours where they are not in accordance with the project safety and behavioural standards. This was kept at site level and informal.

Logic Map Outputs	Intervention Group Projects			Baseline Group Projects		
	A	B	C	A	B	C
Consistent response to incidents	Several management representatives had been trained in use of the Just Culture Model and Consequences chart which was used in response to an incident. However, it was reported that management will 'turn a blind eye' to rule breaking behaviours where it is needed to progress works.	Response to incidents was overseen by the Client on site. Whilst the company had a fair culture model this was not used on this project. There was a strong line taken with repeat offenders removed from the project.	Several management representatives had been trained in use of the Fair Culture flow chart which was used in response to an incident.	Several management representatives had been trained in use of the Just Culture Model and Consequences chart which was used in response to an incident.	Several management representatives had been trained in use of the Just Culture Model and Consequences chart which was used in response to incidents with reported positive impact.	No management representatives had been trained in use of the Fair Culture Model and this has not been used (not introduced until Q4 of project)
Feedback on safety performance	Feedback is a reactive process only in response to safety events. Safety performance is included in progress meetings. Limited evidence available that there is robust feedback processes in place.	Attempts by PC Site Management to use standard feedback techniques e.g. you said we did boards, posters, noticeboards etc were defaced or removed by subcontract workforce. Feedback on safety performance had to be directed to the subcontract supervisor only. This had limited positive impact on overall safety outcomes.	Informal ad hoc feedback between workforce and supervisors takes place. There is some cascade of this to management, but negative impact of client means that information is kept 'off the record'. The teams are briefed regularly on their safety performance.	Feedback is a reactive process only in response to safety events or issues (from on or off the project). Safety performance is included in progress meetings. Limited evidence available that there is robust feedback processes in place.	Feedback is a starting to happen via formal engagement sessions and stand downs. Safety performance is included in progress meetings. Dedicated safety champions are a communication route for feedback to the workforce.	Feedback is a reactive and informal process, only in response to safety events or issues (from on or off the project). Safety performance is included in progress meetings. Limited evidence available that there is robust feedback processes in place.

Table 7.6 Outputs from safety interventions per project

7.4.4 Outcomes

The three Intervention Group projects provided limited evidence in support of improvements to safety outcomes. There were no occurrences of refusal to work processes being involved from any project which is not characteristic of a mature safety culture. For each project the number of accidents/incidents were mapped into a chart to identify whether there was a change in accident rate once SLIT interventions were implemented. This found that was no clear relationship between safety leadership interventions and a reduction in accident or incident rates. The numbers of such events reported were too low in number to analyse effectively. Two of the three Intervention projects (A and B) showed an increase in near miss reports, but these were negatively affected by critical programme milestones. Table 7.1 details the number of accidents for each of the project case studies participating in the study.

For all of the Baseline Group projects there was only limited evidence to support the effect on safety outcomes. Table 7.7 shows an explanation of the findings for each of the six case studies, against the four areas identified as predicted outcomes within the logic map.

The numbers of accidents or incidents reported were too low in number to analyse effectively. Table 7.1 lists the number of accidents/incidents that occurred on each project.

Analysis of Interviews and Employee Surveys showed that visibility of safety leadership behaviours was found amongst supervisors but not consistently across all nominated project safety leaders. The interventions being deployed were cascaded to supervisor level from the Project Management team, which resulted in the supervisors being more visible and engaging more with the workforce on safety matters.

Principal Contractor and Subcontractor Interviews, Employee Surveys and Project Records provided was no evidence that the refusal to work policy had been invoked.

Analysis of Employee Surveys, Interviews and Project Records identified that there was evidence of near misses being reported, although this was inconsistent and relatively low in number. The Intervention Group Project A reported 100 near misses up to the last eight weeks of the project when zero were reported. The interviews explained this as the focus was on delivering the project to handover at the agreed programme milestone, and the focus was not on safety interventions as much as it had been earlier in the project. The number of reported from Intervention Project B was negatively impacted by

the reports being generated by the Client Management on site who used the near miss reports as a method of identifying poor performance. It was due to this that, following an initial flurry of reports, the reports from the workforce ceased completely. Three projects reported some near miss reports but generally too low in numbers to complete any statistical analysis or correlation – Intervention Project C, Baseline Projects A and C. The only project that reported a good number of quality near miss reports was Baseline Project B. This project was measured on the number of near miss reports produced by their Client as part of the project safety performance measures. The interviews reported that whilst this generated a high quantity of reports, the quality of the reports was poor with housekeeping, site tidiness (8%) and welfare (9%) accounting for a high proportion of reports. The project Management Team stated that these were easy for the workforce to report and did not provide indication of a truly open reporting culture, as the reports were on unsafe conditions managed by the Principal Contractor. There were very few reports regarding unsafe behaviours, and specifically few regarding high risk operations such as lifting and moving plant activities.

Logic Map Outcomes	Intervention Group Projects			Baseline Group Projects		
	A	B	C	A	B	C
Reduced accidents and incidents	There was no clear reduction in the number of accidents or incidents.	There was no clear reduction in the number of accidents or incidents.	Low number – no clear evidence available.	Insufficient evidence available. There was an increase in accidents/incidents as hours of work increased.	insufficient evidence available. There was an increase in accidents/incidents as hours of work increased.	Insufficient evidence available. There was only 1 incident reported.
Increased visibility of safety leadership behaviours	There was limited visibility at project manager level although there was some.	No evidence to support this.	There was increased visibility of leaders at supervisory level. There was limited visibility at project manager level although there was some.	No evidence to support this amongst the site management team. Some engagement shown at subcontractor level.	There was increased visibility of leaders at supervisory level. There was limited visibility at project manager level although there was some.	No evidence to support this amongst the site management team.
Increased invoking of refusal to work	Insufficient evidence available.	No evidence to support this.	Insufficient evidence available.	Insufficient evidence available.	Insufficient evidence available.	No evidence available.
Increased hazard and near miss reporting	Increasing number of near miss reports throughout the project until the last 8 weeks where this significantly reduced. 100 number reported, then 0.	Low number of self-generated reports (30 number); greater number raised by the client (142 number).	Some reports (24 number) available but low in number.	Some reports (72 number) available but low in number.	708 number of quality reports available.	Some reports (66 number) available but low in number.

Table 7.7 Outcomes from safety interventions per project

7.4.5 Impacts

Increased safety performance was defined within the logic map as a reduction in lagging indicators (accident and incident data), and an increase in leading indicators (near miss and hazard reports). Overall there were low numbers of accidents/incidents reported from all of the projects. This made it difficult to rely on lagging indicators as the only measure. The defined leading indicators measure was the near miss reporting rate. For five out of six of the projects, this was found to show an increase in number of near misses raised throughout to project until the project neared completion or there was a key project milestone. Whereby the number of near misses reporting reduced noticeably. Intervention Group project B was the only exception to this where there were very low number of near miss reports raised throughout this project.

Two Intervention projects (A and C) self-reported a positive improvement in safety culture maturity scores at the end of the project i.e. the project management believed they had improved safety culture during delivery of their project. As identified in Chapter 2, increasingly safety culture maturity is demonstrated through attitudes and behaviours towards safety: feeling that it is safe, yet continuously looking for weaknesses and opportunities to improve safety performance.

Table 7.8 shows an explanation of the findings for each of the six case studies, against the predicted impacts within the logic map for increased safety performance and increased safety culture maturity scores.

Logic Map Impacts	Intervention Group Projects			Baseline Group Projects		
	A	B	C	A	B	C
Increased safety performance	Increase in near misses prior to end of contract works (8 weeks out). Then reduced. No change in accident incident rate. Low in number.	There was no reduction in reactive indicators nor an increase in positive indicators. Overall safety performance was poor with PC Off site senior management concerned.	No change in accident incident rate. Low in number. Numbers of near misses reports fluctuates.	Increase in near miss reports prior to the main blockade works, followed by a reduction in numbers of reports.	Increase in near miss reports during the project (highest across the PC company)	Increase in near miss reports, followed by a reduction in numbers of reports.
Increased safety culture maturity scores	Overall increase in self-reported culture maturity scores from the project management team.	Reduction in safety culture maturity scores.	Overall increase in self-reported culture maturity scores from the project management team.			

Table 7.8 Impacts from safety interventions per project

7.4.6 Influencing factors for each project

Of the 22 potential influencing factors that were identified within Chapter 2 Literature review that were expected to be affecting safety within a Project Delivery Organisation, nine of these were not identified across any of the six case study projects. The most prevalent factors were Client expectations and requirements and situational constraints e.g. unforeseen challenges, changes to volume of resources, project programme and scope of works. Each of these were found to have a negative impact on safety on the project.

The only influencing factor relevant across all projects was Client requirements and expectations. Client requirements was found to have a negative impact on project safety culture on five out of six of the projects. Specifically, Client behaviour was reported as having an impact on safety, largely through their adversarial nature and taking a position of authority and power towards those working for the Principal Contractor and Supply Chain. One project reported a positive impact from the Client due to the level of importance and prioritisation given to safety by the Client team. This was reported to have helped improve a more consistent approach to higher safety standards on site.

Situational constraints were reported as a negative factor across all projects. Delays to design and project programme, unforeseen challenges, changing scope of work and increase of workforce numbers on the project were all commonly reported as having a negative impact on safety. This was due to the capacity of the Project Management Team being overloaded with more construction work to be undertaken in a reduced period of time i.e. the work becomes concentrated so there is more pressure on everyone on the project. When such situational constraints were in play the team's focus on safety was limited to compliance only; initiatives and engagement which take more time to implement were not deployed.

Only one project reported a change to individual project appointments. This was found to have had a negative impact on the safety for that project. This was attributed to the poor-quality handover between Project Managers relating to the project scope, progress, as well as a lack of commitment from those individuals to the overall outcome of the project as they knew they were only there for a short time and would be moving to another project. The newly appointed individuals knew that they were only on the project short-term.

There were three factors that were found to have both a positive impact on safety on one project and negative impact on safety on another project. These were:

- Subcontractor Parent Company requirements/expectations
- Access to competent health and safety advice
- Existing safety performance

The attitude to safety from each subcontractor was found to affect the overall safety culture on the project. Where the attitude to safety was poor, the subcontractor management and workforce were less engaged in safety interventions delivered by the Principal Contractor. Their attitude eroded the overall safety culture on the project as subcultures became established. Responding and managing this behaviour took up more time from the Project Management Team, leaving less time for further safety interventions. This was particularly evident on Intervention Project B where the subcontractor workforce defaced the safety materials displayed in the welfare facilities on site. However, Baseline Project A identified the positive impact of subcontractors who have a proactive and engaging attitude towards safety. Where the Subcontractors off-site management added the project and undertook safety leadership tours, engaging their workforce and the Principal Contractors Project Management team there was a positive impact on safety culture on the project.

The role undertaken by the dedicated health and safety resource for each project was also found to be variable. Where the individuals undertook a compliance-focused role policing the health and safety standards, this made a negative contribution to the safety culture on the project. This was attributed to a lack of engagement between the Project Management team and the Health and Safety Advisor/Manager, where the Project Management team would ignore or make platitudes to the Health and Safety Advisor/Manager. This had a bigger impact as the Project Management team were more disengaged from safety as a whole, even when they had defined responsibilities for safety processes i.e. safety became something that was undertaken under duress. These are not characteristics associated with a positive safety culture. However, there was one project (Baseline Project A) where the Health and Safety Advisor/Manager was very engaging in their approach and spent time with the Project Management team supporting the implementation of safety interventions. This was reported to have had a positive impact on the safety culture of the project.

Safety performance measures were found to have a positive impact on safety performance which was attributed to the level of importance placed on safety measures on that particular project by both the Client and the Principal Contractor.

Table 7.9 identifies the factors that were not identified as relevant on the project– shown as ‘blank’ across the relevant row for all projects. These were the sector of industry company works in, annual turnover of Parent Company, number of people directly employed, role on a construction project, proportion of directly employed/subcontractors, tiers of subcontractors, safety management system accreditation, previous safety performance and changes to subcontractor appointments.

KEY	Blank – factor identified as not relevant on this project	Data not available	√- – factor relevant on this project with evidence of a negative impact on safety			
√ - factor relevant on this project but no evidence of impact on safety			√+ - factor relevant on this project with evidence of a positive impact on safety			
Influencing Factors Brief Detail	Intervention Group Projects			Baseline Group Projects		
	A	B	C	A	B	C
Client requirements/expectations	√ -	√ -	√	√ -	√ -	√ -
Unforeseen challenges e.g. contamination, obstructions etc	√ -	√ -	√ -		√ -	√ -
Changes to number of project resources	√ -	√ -	√ -	√ -		√ -
Changes to project baseline construction programme	√ -	√ -	√ -			√ -
Design management and design delays	√ -	√ -	√ -			√ -
Subcontractor Parent Company requirements/expectations	√	√ -		√ +		√ -
Access to competent health and safety advice	√	√		√ +	√ -	√
Change of project scope of works	√ -	√ -				√ -
Existing safety performance		√ +				√ -
Principal Contractor Parent Company requirements/ expectations	√		√			
Changes to individual project appointments		√ -				√ -
Changes to legislation and/or industry standards	√					
Safety performance measures					√ +	
Sector of industry company works in						
Annual turnover						
Number of people directly employed						
Role on a construction project						
Proportion of directly employed/subcontractors						
Tiers of subcontractors						
Safety management system accreditation						
Previous safety performance						
Changes to subcontractor appointments						

Table 7.9 Influencing factors and associated impact identified from analysis for each project

7.5 Review of Main Findings

Study 4 sought to address three research questions relating to the effectiveness of safety leadership interventions for improving safety culture maturity and performance with a Project Delivery Organisation, the relevance of influencing factors and any specific considerations for the successful implementation of safety improvement programmes within this sector.

The study identified that safety related interventions were deployed across all six projects. Only some of these interventions were from the SLIT and related to safety leadership activities. Across the case studies, neither the baseline nor intervention projects undertook 100% of the interventions outlined within the SLIT. There were some Intervention Group projects who initiated safety interventions from the SLIT but did not continue to apply these throughout the project timeline. Intervention Project B deployed the fewest SLIT activities of the three projects. This project was particularly challenging, and in addition to the other influencing factors (delays to programme, increase in resources), this project also had two changes of leadership and a wholly disengaged subcontractor both of which have been identified as having a significant effect on safety outcomes.

This study identified five themes for reasons interventions were not deployed:

- safety integrated with delivery – when leaders fail to integrate safety across the Project Delivery Organisation so that safety is not perceived as an extra thing to do, but just part of what has to be done to complete the project.
- communication and engagement – a lack of communication from the project leaders through to frontline supervisors and poor engagement in safety interventions.
- compliance focused - project level leadership focuses their attention on achieving compliance with statutory safety requirements rather than achieving a mature safety culture.
- resources - availability and capacity of people to undertake the interventions alongside other duties defined within their job role.
- Training – a lack of leadership skills training for Project Managers.

These five themes could be transferable across all Project Delivery Organisations for consideration when implementing safety leadership interventions.

The Baseline Group Project applied more interventions from the SLIT than the Intervention Group projects. Possible explanation for these results can be related the size of each project with 'smaller' projects deploying less safety

interventions than larger projects. The contextual factors for each project help to determine project size including project value, duration and number of people working on the project – workforce and Project Management team. The context for each project is detailed in Table 7.1. This study has found that the size of the project affects the availability of resources on the project to implement safety interventions. The projects who had more leaders implemented more safety interventions, whether they were included within the SLIT or not. The interviews have indicated that there is a perception amongst Project Management that more leaders were needed to implement the SLIT. Therefore, resource availability was identified as a potential barrier to intervention.

Whilst the focus on what was being deployed from the SLIT was valid, the study also found that successful safety outcomes were less about ‘what’ was being implemented and more reliant on ‘how’ this activity was introduced and supported by the Project Management Team. Where the interventions were not perceived to be value adding by the Project Management Team (going above statutory compliance), less effort was made to introduce and continue with the interventions. These interventions were inconsistently applied and therefore it was difficult to conclude whether the interventions contributed to improved safety outcomes. On the other hand, where the Project Management Team were committed to making the intervention work on their project, the necessary effort and focus was given, resulting in more favourable safety outcomes. This supports other studies by Krause (1997) and Petersen (1999) who identified a number of critical leadership-orientated success factors, including that when leaders are committed to safety and to the change being undertaken, leader visibility and proactive engagement and involvement of others in safety decision making increases. These studies state that without the right leadership in place any change programmes are likely to fail. The findings from Study 4 would support the importance of a leaders demonstrating the correct level of commitment and behaviour to safety.

The Intervention Group projects provided limited evidence in support of improvements to safety outcomes. The expected safety outcomes defined in the logic map were for a reduction in accidents/incidents, increased visibility of safety leadership behaviours, increased invoking of the refusal to work policy and increased hazard/near miss reporting. There was no clear relationship between the implementation of safety leadership interventions and a reduction in accident or incident rates. The numbers of such events reported were too low in number to analyse effectively. Two of the three projects showed an increase in near miss reports, but these were negatively affected by

critical programme milestones. The same two projects self-reported a positive improvement in safety culture maturity scores at the end of the project i.e. the project management believed that had improved safety culture during delivery of their project. Whilst this could be indication of positive outcomes from the safety leadership interventions, this may also be due to social-desirability bias (Cooper 2000) where individuals report the results that they believe will make them more acceptable to the wider group.

There was only limited evidence to support the effect on safety outcomes within Baseline Group projects. Visibility of safety leadership behaviours was found amongst supervisors but not consistently across all nominated project safety leaders (i.e. Project Management team, subcontractor management and project supervisors).

There was evidence that near misses were being reported, although this was inconsistent and relatively low in number. There was no evidence that the refusal to work policy had been invoked.

Overall all projects reported very similar outputs, outcomes and impacts; some increase in near miss reports, improved supervisor visibility, but overall a lack of consistency of safety leadership behaviours across the Project Management Team. Any reported improvements were affected by an increase in pressure to deliver the project works e.g. handover of project, achieving a key project milestone. The researcher also concludes that there is a lack of understanding of safety leadership amongst Project Management Teams, and a focus on achieving safety compliance more so than improving safety behaviours, which is taken from the study results.

As already stated, the numbers of accidents or incidents reported were too low in number to analyse effectively and there was no evidence to support a reduction of accidents/incidents during a project. It is challenging to undertake statistical trending for any reduction of accidents/incidents during the project lifecycle with such low numbers. A greater reliance is therefore placed upon other measures of safety performance. However, as there were no reports of invoking of the refusal to work policy from any project and this would not provide a meaningful alternative measure of safety performance.

The findings identified from Study 4 are made following a thorough method of evaluation based on the use of a logic map. In addition, the normal logic map components (inputs, outputs, outcomes, impacts) is was necessary to include 'Influencing Factors' within the map itself. The methodological approach was to identify and evaluate the relevance of these influencing factors throughout the logic map to determine not only what happened/did not happen but also

the factors that may have contributed to these findings. This approach was important in have a consistent evaluation framework allowing comparison across all six case study projects.

The influencing factors that were reported to have had an effect on the project's safety performance were similar across all projects;

- Client requirements/expectations
- Change of project scope of works
- Design management and design delays
- Unforeseen challenges e.g. contamination, obstructions etc
- Changes to project baseline construction programme
- Changes to number of project resources

There were a number of influencing factors that were not identified as relevant on any of the six projects. These were mainly factors managed away from the project such as annual turnover of Parent Company, safety management system accreditation, previous safety performance and changes to subcontractor appointments. Table 7.9 lists the relevance of the 22 influencing factors in more detail. Whilst this study has not found these factors to have an impact, further research is needed to explore the relevance of these on the relationships between the Principal Contractor Parent Company and the Project Management Team for each individual project.

Following the literature review it was anticipated that contractorisation would be found to have had a significant impact on safety performance. Across the six case studies the Supply Chain were only found to have had a negative impact on safety outcomes in one instance (Intervention Project B). For several other examples the Supply Chain engagement in safety was reported to make a positive contribution to safety on the project. Subcontractor safety interventions and support from health and safety teams were reported as positively influencing factors. Where these arrangements were deployed effectively, they had a positive impact on openness, reporting, engagement and safety performance as a whole. Study 4 found that contractorisation has some impact on safety within a Project Delivery Organisation, but this was less prevalent than other factors relating to client behaviour and situational constraints.

Whilst each individual member organisation within the Project Delivery Organisation did have some influence on project safety performance, the overriding factor that really influences positive outcomes was down to the individual Project Managers prioritising of safety amongst other requirements to deliver the project. Where individuals deployed safety leadership

interventions more consistently and effectively, this was found to improve near miss reporting and increase visibility of safety leadership behaviours.

The wider implications of these results and how these meet the thesis objectives are discussed further in Chapter 8.

7.5.1 Potential Study Limitations

Six number case studies participated in the study from only two different medium sized Principal Contractors. Whilst this was part of the study design in order to minimise additional variables that needed to be included within the evaluation, it is unlikely that these two Principal Contractors are wholly representative of all Principal Contractors working within the Infrastructure Engineering Sector. Therefore, the findings may not be truly representative of the whole industry.

The two different groups of projects (Intervention and Baseline) participating in Study 4 was also considered a potential limitation. The study design was to create a control (the Baseline Group) for comparison with the Intervention Group projects. During the analysis it was apparent that the Baseline Group deployed as many safety leadership interventions as the Intervention Group, even though they were not given the SLIT resources. Therefore, it was difficult to treat the Baseline Group as a control group within the analysis. This may have been due to the different size of projects (measured via project duration, value and appointed resources) involved in both the Intervention and Baseline Groups.

For both of these limitations, it is recommended that specific consideration should be given to project size when selecting participants in future studies.

The complex nature of the study design was developed to address the different aspects of validity and reliability for comparison across the six case study projects. However, the study design was still subject to social desirability bias, particularly relevant in the context of safety.

Within this study there were times when data was from a single source within each project, which could be a potential limitation especially if the data is based on perceptions of an individual. The study design minimised any inadequacies from single data sources through data triangulation during the evaluation process.

Whilst some of the studies collected both leading and lagging data the numbers of events/occurrences were so low that there was insufficient information to

include as a measure of outputs and outcomes e.g. low numbers of accidents, low number of close call reports, low number of occurrences refusal to work being invoked. This meant that robust findings in relation to the predictions made through the logic map from inputs to impacts on safety performance were limited. Further consideration could be given to other leading indicators as measures of safety.

7.6 Chapter Summary

This chapter details findings from the implementation of a Safety Leadership Intervention Tool (SLIT) across six Project Delivery Organisations. The contents of the SLIT was applied in a partial manner across the Intervention Group projects. Overall the interventions were not exhaustively deployed, however other non-safety leadership interventions were deployed. The study has provided an insight into the current safety culture maturity of the projects and is consistent with findings from earlier studies (refer to Chapter 4 Understanding Safety within Construction Projects). From this study it can be concluded that Project Delivery Organisations are reluctant to implement new safety interventions. This is particularly evident when there is a greater focus on delivering the project to a specified timescale/deadline. Further research would be needed to establish whether this reluctance is for all types of safety interventions or specifically safety leadership interventions.

Within a Project Delivery Organisation influencing factors have been found to affect safety performance. Individuals whose roles enable them to exert influence on the day to day running of the project e.g. Client representative, Project manager, can have a positive or negative impact on the safety culture maturity, depending on whether they demonstrate good role model behaviours or not. Proactive and consistent supervisor leadership and engagement can make a positive contribution to the safety culture maturity of the project. Conversely where the project experiences any change to the plan which impacts on the programme of works and associated resource levels, this has been found to have a negative impact on project safety outcomes. This can include changes to design, unforeseen obstructions, delays to programme, and additional scope of works.

The discussion chapter which follows will explore the findings of this chapter in more detail and relate these to the wider work contained within the PhD.

8. Discussion

8.1 Introduction to Chapter

The research presented in this thesis draws on a number of different areas identified within the literature relating to safety culture, safety performance and leadership. This research takes a novel approach to obtain a greater understanding of the influencing factors that have potential to impact on safety within a project environment and with this knowledge determine how safety leadership interventions can contribute to improved safety culture and performance.

Within the industry the majority of the work is delivered through a small number of Principal Contractors, with the Supply Chain procured as second and third tier contracting organisations to deliver specialist works. The organisation and interfaces between these parties affects the safety culture on the project, as they work together for a defined period of time under the direction of the Principal Contractor, forming a Project Delivery Organisation. There is limited research to date into the influencing factors affecting the adoption of safety leadership interventions. The thesis explores the influencing factors that have the potential to impact on the safety culture maturity of a Project Delivery Organisation.

The many studies (Wu et al 2008, O'Dea and Flin 2001, Clarke and Flitcroft 2013, Hopkins 2006, Fleming and Lardner 2001, Walters et al 2006) involving safety culture have identified the importance of safety leadership in an organisation with a mature safety culture and high levels of safety performance. However, there is a lack of research to understand safety leadership interventions and outcomes within a Project Delivery Organisation.

The thesis had an aim to investigate safety leadership within construction projects, specifically to understand the current industry position regarding perceptions of safety culture, safety leadership, and associated intervention programmes (Studies 1, 2 and 3), and to evaluate the effectiveness of safety leadership interventions within a Project Delivery Organisation and make recommendations for industry (Study 4).

Aligned to the thesis objectives, the rest of this chapter will discuss the findings in relation to the following three areas:

- Safety culture maturity within a Project Delivery Organisation
- The role of safety leadership

- Understanding the influencing factors affecting safety within construction projects

8.2 Safety Culture Maturity within a Project Delivery Organisation

Measuring safety performance can be a challenge recognised by many (HSE 2011b, Hale 2009, Grabowski et al 2007, Lindsay 1992) as successful safety performance results in the absence of an outcome rather than a presence (i.e. no accidents). Cognisant of this, safety performance is often determined by the safety management arrangements established to manage risk within an organisation (Smith and Wadsworth 2009).

Lagging indicators are statistical measures of injuries, incidents, events with the potential to cause injury or loss (near misses), and other losses such as damage to property (DTI 2010, HSE 2011b, Shannon et al 1997). The lagging indicators that were captured throughout the research provided very limited information as most projects had few, if any, incidents to include in their safety statistics. Therefore, looking across each of the separate studies, this research has relied more on leading indicators as a measure of safety.

The leading indicators applied to this research were based around measurements associated with adoption of safety interventions (Hopkins 2009, Øien et al 2011, Dyrebourg 2009, Erikson 2009) and the assessment of organisational safety culture (Grubb and Swanson 1999). This approach supports a study by Hale et al (2010) which considered the more successful organisations had safety performance measures that more focused on measures of the safety interventions (e.g. safety reports, inspections, records of unsafe behaviour) than accident data.

The remainder of this section focuses on safety culture maturity - a typical leading indicator. Safety leadership interventions are discussed in section 8.3.

8.2.1 Perceptions of Safety Culture Maturity

There are several studies that use perception surveys as a measure of safety climate (Mearns and Flin 1999, Guldenmund 2000, Zohar 1980, 2000, 2005). Perception surveys were used within this thesis within Study 1 and 4. In Study 1 ratings of safety culture maturity were provided by the Principal Contractors and Supply Chain; both for themselves and the other group. Principal Contractors were reported to be more mature than the Supply Chain by both themselves and the Supply Chain. In Study 4 the Project Management team

rated their own project's safety culture maturity on the Project Maturity Assessment record.

The research has identified that how the Project Management Team rate their projects safety culture maturity is higher than the reality. Study 1 found that Principal Contractor maturity was around level 3 Calculative on the Hudson Model. At level 3 organisations will have:

- relatively low accident rates
- the majority of people accept personal responsibility for their own safety
- Managers recognise that often causes of accidents originate from management decisions
- safety performance is actively monitored, and the data is used effectively

If projects were truly a level 3 calculative in safety culture maturity leaders would be sharing lots of information with the workforce and holding frequent safety-related initiatives. However, Study 4 found that leaders were not demonstrating such visible role model behaviours. Whilst Project Managers rated themselves to be around level 3 calculative safety culture maturity, in practice there was limited evidence of management commitment and behaviours that would be visible if an organisation had a level 3 calculative safety culture maturity. This study found that leader's behaviours were more aligned to a safety culture maturity level 2 reactive where despite an initial communication push, management commitment wains over time as things get 'back to normal'. This research has found that Project Delivery Organisations are not as mature as they consider themselves to be.

This research has found that within a Project Delivery Organisation there is evidence of both self-enhancement (Hoorens 1993) and social-desirability bias (Cooper 2000). Self-enhancement is particularly relevant in the context of safety values as it makes people feel good about themselves (Hoorens 1993). Literature has shown that when individuals rate themselves, or in this case the project they are responsible for, they have a tendency to rate themselves higher than reality. In addition, the Project Management team show possible social-desirability bias by answering questions (survey and interview) in a manner that will be viewed favourably by others.

These findings are important for undertaking similar research relating to safety culture maturity within a Project Delivery Organisation and the potential impacts of bias. It is considered that sole-reliance on perceptions of safety culture maturity would not necessarily provide a true assessment of safety culture maturity within a project. A case study approach has been found to give

a more thorough evaluation of actual safety culture maturity as evidenced from the working practices and visible behaviours displayed on the project.

8.2.2 Readiness to Change

Differences in perception of safety culture maturity between members of a Project Delivery Organisation may affect the successful implementation of a Safety Improvement Programme. Both Lewin (1951) and Kotter (1996) recognise the importance of 'creating the climate for change', whilst Dunphy and Stace (1993), Herscovitch and Meyer (2002) and Hartley (2002) state that understanding the contextual factors facing an organisation is an important part of any change-related approach for taken by a contemporary organisation (such as a Project Delivery Organisation).

This research has identified contextual information relating to Project Delivery Organisations; the external and internal pressures, constraints and opportunities facing the organisation, leadership, and availability of resources. The specific contribution of influencing factors is discussed further in section 8.4.

There are added difficulties for initiating any change programme specifically associated with a Project Delivery Organisation: the perceptions of safety culture of all project members for themselves, other project members and for the project as a whole. Dunphy and Stace (1993) state that the need to change is based on perceptions of leaders, managers, supervisors and workforce. The PhD research has identified that there is a difference in perception of safety culture maturity amongst members of a Project Delivery Organisation, which may affect the successful implementation of a Safety Improvement Programme. Study 1 found that the perceived safety culture maturity of Principal Contractors was found to be higher than that of the Supply Chain. This is supportive of a study by Walters and James (2009) where larger organisations were found to have a more mature safety culture. This may have an impact on change-efficacy as the Project Management Team are likely to find it difficult to obtain the necessary commitment to generate changes to improve safety performance when members of the project believe their safety performance is better than it really is.

There was greater consistency for maturity ratings given by the Principal Contractors for themselves, than those received from the Supply Chain. It could be concluded that whilst Principal Contractors tend have a similar view regarding their perceived safety culture maturity. By contrast, the Supply Chain

perceptions are less consistent. There are two possible explanations for this. Firstly, it can be concluded that self-enhancement is not always evident within a Project Delivery Organisation when they are asked to rate other member organisations. This may be attributable to the adversarial nature of relationships between Principal Contractors and their Supply Chain (Akintoye et al 2000; Cox and Ireland 2002; Briscoe et al 2001; Hinze and Gambatese 2003, Briscoe and Dainty 2005).

The second possible explanation lies within the method undertaken in Study 1. For each Principal Contractor, the number of data points (safety culture maturity ratings) was provided by a number of different people representing the Principal Contractor organisation. In contrast, the data points provided by the Supply Chain are from one individual per supplier/subcontractor organisation. Therefore, this means that the results for the Supply Chain are based on one individual's perception and may not be truly representative of the whole supply chain organisation. However, as the ratings are for a much larger number of organisations, this may represent the variability that could be expected within this diverse group. If Study 1 was to be repeated it is recommended to extend the sample size to include more participants from each of the Supply Chain organisations.

This research has found that a combination of methods should be used to obtain a true assessment of safety culture maturity within a Project Delivery Organisation, not purely relying on perceptions but taking a more interference case study approach. Where projects are looking to improve safety performance, it is recommended to include measures of prevailing safety attitudes from each member organisation on the project, as part of the preparations and readiness to change. Where such measures provide indication of likely resistance to change or a lack of commitment, necessary actions should be included within the Safety Improvement Programme to address these prior to introducing a new intervention.

8.3 Role of Safety Leadership

8.3.1 What are Safety Leadership Interventions?

This research has found that there was some level of understanding of safety leadership interventions within a Project Delivery Organisation, and that Senior Management of Principal Contractors demonstrate a greater depth of understanding than both the Client and Supply Chain groups. Within Study 3,

Principal Contractors provided more examples of interventions than the Clients and Supply Chain representatives, giving an indication that as a group they are more aware and have more experience of implementing safety leadership interventions than the other groups. This may be expected as it is the statutory duty of the Principal Contractors to manage safety on a construction project.

Study 4 involved the implementation of a Safety Leadership Intervention Tool (SLIT) consisting of four areas: vision and goals, transformational leadership, transactional leadership, and monitor and review, with a number of specific intervention activities defined for each of the areas. In Study 4 the adoption of the SLIT by projects was limited, however some of the projects did implement other safety related interventions that were not specific to leadership. This research has found that there was awareness of types of interventions that are 'safety leadership' but in reality, projects tended to implement non-safety leadership interventions focused on workforce behaviours rather than improving Project Management role model behaviour. This may be an indication that the importance of safety leadership for improving safety performance is not well recognised amongst leaders contributing to an issue with change efficacy, with leaders focus on improving the behaviour of the workforce rather than themselves. This is worthy of further exploration in further studies.

The need to improve safety leadership skills within the sector has been identified for over a decade (CIOB 2008), and this research has found that there is still some work to be done to improve safety leadership within the sector.

8.3.1.1 Common safety leadership interventions

There are a number of safety leadership interventions being deployed across the industry. Study 3 identified a total of 26 different examples of safety leadership interventions which mostly aligned to nine good safety leadership areas identified within the literature (Clarke and Flitcroft 2013, Conchie and Moon 2010, Farrington-Darby et al 2005, Flin and Yule 2004, Floyd and Wooldridge 1997, Gadd and Collins 2002, Lekka and Healey 2012, O'Dea and Flin 2001, Simard and Marchand 1995, Vredenburg 2000, Zohar 2002a, Zohar 2002b);

- Safety as a top priority
- Demonstrable commitment to safety
- Increasing visibility around safety
- Enable safety reporting

- Workforce involvement
- Create an open and learning culture
- Provide recognition for good safety performance
- Ensure effective communications
- Effective safety management arrangements

Half of the intervention examples provided within Study 3 were based around communications, in particular opportunities for leader engagement and the sharing of information. Study 4 also found that communications relating to the introduction and ongoing implementation of a safety leadership intervention determined whether an intervention was effectively deployed or not. Communication is particularly relevant for a Project Delivery Organisation intending to implement safety leadership interventions. Vredenburg (2000) and Gadd and Collins (2002) identify the importance of leaders creating an open and learning culture. If Principal Contractors could develop such a culture within a Project Delivery Organisation there would be an environment that enabled the sharing of lessons between all parties through open two-way communication channels for both good and bad safety related news (e.g. shared leadership training, workshops and safety inspections).

Whilst communication is recognised as being important for effective safety leadership interventions, Study 4 found that communications from Project Management within the Project Delivery Organisation was poor. This is explored further in section 8.3.2.2.

8.3.1.2 Role Type: Senior Management, Project Management and Supervisors

The thesis identified how safety leadership was adopted on projects as part of a Safety Improvement Programme. Study 2 established that Behavioural Safety Programmes (a recognised industry term of reference for improvement initiatives that focus on safety culture) were focused on improving safety culture. However, only 10% of respondents included safety leadership within their Behavioural Safety Programme, although the programmes were delivered by Directors. This is an interesting contradiction: projects recognise that safety culture needs to be improved, and this needs to be led from Senior Management commitment, yet the development of leadership skills is not included in the Safety Improvement Programmes. This research found that Programme's contents are more focused on frontline supervisory leadership and transactional activities, than strategic leadership and direction. In future studies may be worthwhile considering whether the mindset of Project Management is that safety is really implemented by others. Further studies

could also be undertaken to better understand what could be done to support and develop the skills of individuals in leadership positions or those who are likely to become leaders in the future.

There were similar results from two further studies – 3 and 4. Study 3 involved interviews across Client, Principal Contractor and Supply Chain representatives. Part of the study involved a review of examples of safety leadership interventions from the construction industry with identified safety leadership practices from within literature. This study also found that leadership interventions relating to i) safety as a top priority and ii) demonstrable commitment to safety were not reported from interviewees. In Study 4, where interventions related to ‘Vision and Goals’ (the strategic direction from Senior Management) these were less well adopted than interventions targeted at transactional leadership.

This is similar to findings in earlier studies by Thompson et al (1998), Marsh et al (1998), and Wu et al (2008) which may be an indication that there is a greater awareness and prevalence of safety leadership interventions that can be applied at a supervisory level, more so than at a Senior Management level. In order to align with literature, there is an opportunity to extend the existing safety leadership interventions from supervisors to higher levels of management.

The research highlights the importance of understanding safety leadership at all levels within a Project Delivery Organisation, supporting research by Donovan et al (2016) that emphasised the importance of vertical integration, understanding safety leadership across multiple levels of an organisation. More recently there has been a greater emphasis on middle management influences on safety performance (Callari et al 2019). This is of particular importance for Project Delivery Organisations that have complex organisational interfaces.

8.3.2 Safety Leadership Interventions in Practice

This research has confirmed that studying safety interventions is complicated. The experience and role of the researcher as a Chartered Health and Safety Practitioner was valuable for the study in two aspects. Firstly, in facilitating access for organisation and individuals to participate in the relevant studies within the PhD which meant that there was extensive access to a range of participants across a Project Delivery Organisation (Client, Principal Contractor and Supply Chain). The second aspect is in relation to the researcher’s experience to understand the language and terminology identified within the

data collection and analysis stages of each of the studies. This includes the tutorial of safety culture maturity for a project context in Study 1, analysis of questionnaire responses in Study 2, the exploration of topics during the semi-structure interviews in Study 3 and the evaluation of data in Study 4.

A particular learning point is regarding the SLIT tool itself. The research focused initially on ensuring that the content and resources provided within the SLIT were robust and reflected literature on safety leadership as well as findings from earlier studies 1, 2 and 3. However one of the findings from the research was that successful safety outcomes were less about 'what' was being implemented and more reliant on 'how' this activity was introduced and supported by the Project Management Team. Therefore, it is recommended that the design of a future SLIT should include a focus on how the interventions are being deployed as well as the contents of the interventions themselves.

Project size was determined by gross value, duration and the resources within the Project Management Team. Each of these aspects was found to be important particularly within Study 4. The longer the project duration and the higher the project value, the more people were appointed within the Project Management Team. The more people resource available to a project the more safety-related interventions that were deployed. The relevance of resource availability as well as other barriers to intervention are explained more in section 8.4.3.

A number of barriers to implementation have been identified as well as several enabling factors which would be relevant for other Project Delivery Organisations to consider as part of implementing any Safety Improvement Programme. These are detailed in the remainder of this section.

8.3.2.1 Context of the Project Delivery Organisation

Studies 3 and 4 identified that understanding the context in which the leadership intervention was to be implemented was considered as important for managing organisational change (Hartley 2002). Schein (2010) also states that it is important for an organisation to understand their position in the wider industry. This research supports other research findings where due consideration should be given to both industry and organisational factors that could impact on safety interventions, as follows;

- other priorities and initiatives that are being implemented at the same time and the role of leaders in delivering these (safety or non-safety related), including time and resource limitations (Hofmann and Stetzer 1996)

- the trigger for implementing any improvement programme, combined with the desire and intent to improve leadership interventions (Fleming and Lardner 2001)
- externally-led influencing factors lead to an unstable motivation and conflicting demands, more challenging for any organisation/individual to balance the desire to change with day to day operations and project delivery (Peters and O'Connor 1980)

8.3.2.2 Prioritisation of Safety

How well a project integrates safety within project delivery activities was identified as important. Where there is a perception that safety and delivery cause conflict and subsequently that there has to be a choice between working safely or getting the work done, this had been found to have a negative impact on implementing safety leadership interventions. However, if safety is integrated as an essential part of getting work done there is a greater level of adoption of the intervention. Studies by Zohar (1980), Fleming (2001), Berends (1995), HSE (1999) each recognise the importance of prioritising safety in the workplace where the need for production is properly balanced against safety risk so that safety is not ignored. The thesis has also found that prioritisation of safety within a Project Delivery Organisation is an important aspect that can impact on the effectiveness of safety interventions.

Another theme that has been identified and related to prioritisation is the acceptance that good safety performance is achieved when a project meets statutory requirements i.e. compliance with the law. Studies by Hudson (1991), Parker et al (2006) and Fleming (2001) state that when an organisation seeks to improve its safety culture there is a minimum foundation level of maturity assumed within the majority of safety culture maturity models which assumes the organisational arrangements are compliant with health and safety legislation with an adequate Safety Management System in place. However, Study 4 found that projects were largely focused on achieving statutory compliance with safety legislation. This raises a question about the project's acceptance of implementing safety leadership interventions to improve project safety culture maturity. Challenges regarding measuring safety performance are discussed further in section 8.3.1.

8.3.2.3 Preparation for Intervention

Preparations for interventions should include the allocation of sufficient resource (time, money, people) to deliver leadership interventions effectively. For example, there needs to be enough of the right people with the capacity to do a monthly Safety Leadership Tour. Individuals need training prior to conducting the Safety Tour, and there is need for sufficient budget to pay for this training.

Availability of resource to implement the safety interventions was also identified as a theme that could inhibit how well safety interventions are deployed. This includes the capacity of individuals to implement the safety leadership interventions and highlights the role of leaders in delivering these activities. The number of people, their available time, other supplementary resources e.g. materials, were reported to affect the implementation of the SLIT. In addition, the capability of leaders, and individual levels of training in leadership skills was also identified as a theme – an area reported as restricting the effective implementation of the SLIT as there was a lack of such training within the Study 4 sample.

Studies by Fleming and Lardner (2001), and Vredenburg (2002) clearly identify visible safety leadership skills where senior management show their commitment to safety, which can be achieved through provision of awareness training of psychological principles that describe how and why people behave in particular ways. This would also include the role of leaders in creating a positive work environment for individuals to succeed and work safely. Both the area of resource capacity and leader capability were identified as themes affecting the successful implementation of safety leadership interventions within projects. It is recommended that these aspects are considered by Principal Contractors implementing Safety Improvement Programmes.

8.3.2.4 Leadership Commitment and Behaviour

This research found that leadership style and behaviour was important and was heavily reliant on individual desire and ability to perform well. Success is dependent on how the workforce perceive the commitment to safety and whether it is believable from leader to leader (i.e. do they walk the talk, challenging at risk behaviours in a prompt and positive manner, each and every time such behaviour is observed). Donovan et al (2016), Hopkins (2006), Fleming and Lardner (2001), Krause (1997) and Petersen (1999) also found that leadership style and perceived level of commitment was important in the context of safety. Being seen to engage in 'action' is relevant for effective

leadership. When leaders deliver on their commitments and promises, providing feedback to the wider teams to help manage their expectations, this helps to support credibility and develop trust. There is recognition that leadership is not a quick fix and will take some time to have a positive impact.

This research found that where the interventions were not perceived to be value adding by the Project Management Team (going above statutory compliance), less effort was made to introduce and continue with the interventions. These interventions were inconsistently applied and therefore it was difficult to conclude whether the interventions contributed to improved safety outcomes. On the other hand, where the Project Management Team were committed to making the intervention work on their project, the necessary effort and focus was given, resulting in more favourable safety outputs.

This supports other studies by Krause (1997) and Petersen (1999) who identified a number of critical leadership-orientated success factors, including that when leaders are committed to safety and to the change being undertaken, leader visibility and proactive engagement and involvement of others in safety decision making increases. These earlier studies state that without the right leadership in place any change programmes are likely to fail. The findings from this research would support the importance of a leaders demonstrating the correct level of commitment and behaviour to safety.

8.3.2.5 Communication

Another theme was relating to how the interventions were communicated and the effectiveness of any engagement and specific involvement of individuals in the planning and introduction of the intervention from across the project. Where there was a lack of communication from the project leaders through to frontline supervisors the intervention was less well adopted. This is likely to be attributed to a lack of understanding of what was involved in the interventions, the reasons and benefits expected from implementing such an activity and the role of everyone in adopting this across the project. Characteristics of a positive safety culture include good communications on safety matters, communications that are regular, relevant and delivered in an engaging manner (Mearns et al 2003, HSE 1999, Geller 1994). However, a number of studies (Briscoe et al 2001, Briscoe and Dainty 2005, Winkler and Irwin 2003) have identified communication and co-ordination as a particular challenge when working in a project environment. Cohen (1977), Pate-Cornell (1990) state that communication is a key element of an effective Safety Improvement

Programme. It can be concluded that communication regarding the intervention (what it is, the equipment/materials/people required, when it will be undertaken) is an area of importance for Project Delivery Organisations looking to implement a Safety Improvement Programme.

8.4 Understanding the Influencing Factors affecting Safety within Construction Projects

This research found that there were three key areas identified for achieving successful safety outcomes: the role of the Client, situational constraints, and resource availability and role demands. Each of these are discussed in more detail.

8.4.1 Client Behaviour

This research has established the importance safety leadership at all levels within a Project Delivery Organisation, supporting research by Donovan et al (2016) and Callari et al (2019) that emphasised the importance of vertical integration and understanding safety leadership across multiple levels of an organisation. This is of particular importance within Project Delivery Organisations that have complex organisational interfaces.

Study 4 found that Client safety-related behaviours had a significant impact on the overall project safety culture. Where the Client displayed aggressive, derogatory or inflammatory behaviours, the Project Management team were less motivated on safety matters, and the reporting of hazards and near misses from the workforce was suppressed. A study by Bresnen and Marshall (2000a) reported conflicting objectives and uncollaborative behaviours between the Client and the Principal Contractor Parent Company and Project Management Teams having an impact on behaviours, but this was less evident at site level as the Client generally did not have a visible presence on site. However, this research has found that these uncollaborative behaviours did have a negative impact at project level, particularly where the Client was resident on or a frequent visitor to site. Five of the case study projects identified a negative impact from poor client behaviours. For example, one statement taken from Table 7.5 (Chapter 7) from the Principal Contractor interviews highlights an uncollaborative attitude '*Client visits did not focus on safety for the right reasons. Individuals liked their position to express how others should be subservient!*' which had a negative impact as individuals on the project became defensive and disengaged from safety as a result of these behaviours. Only one

project reported a positive impact from the Client, and this was due to the level of importance and prioritisation given to safety by the Client team.

A number of studies (Cox and Ireland 2002, Briscoe et al 2001, Hinze and Gambatese 2003, Briscoe and Dainty 2005) have reported that the contractual relationships between organisations working on a construction project have an important influence on who holds the power within the relationship. Whilst these previous studies have been focused on the Principal Contractor having the power over the Supply Chain, the findings of studies within this thesis have indicated another power-relationship between the Client and Project Delivery Organisation as a whole. Study 4 found that Client expectations and requirements was a factor that affected safety on each of the six case study projects.

This research has identified the role of Client as an area worthy of further research to understand the impact of a Client on safety performance within a Project Delivery Organisation.

8.4.2 Situational Constraints

This research has identified that the safety culture on projects is affected by situational constraints; changes to the original project scope, programme, resource forecast and personnel, delays to programme and changes in work scope, detailed design, resources, sequencing of works each had a negative impact on safety performance.

Study 4 found that some projects implemented safety-related interventions and a positive safety culture was developing as a result. Yet when there was an acceleration of works to meet a programme deadline, or a key project delivery milestone was approaching, the safety-related interventions that were perceived as 'non-essential' stopped being implemented or were implemented sporadically. This undermines any trust-based relationship between management and workforce, and creates a perception that leaders are more committed to delivering work than working safely (Krause 1997, Petersen 1999). It is considered that without the right leadership in place any change programmes are likely to fail, a conclusion supported by the thesis findings. These reasons were attributed to a lack of time and resource to do everything that was expected and therefore the Project Management team prioritised what safety-activities were continued during this period. Peters and O'Connor (1980) identified these as situational constraints where the characteristics of a

workplace which are beyond an individual's control, but directly affect their safety performance.

8.4.3 Resource Availability and Role Demands

The most significant influencing factors were related to change impacting on role demands. Any occurrence which involved a change to the original programme of works, delay in access to site, delay in design, increase in resource demands to meet forecasted project output, 24-hour working, were found to have significant negative impact on the deployment of safety interventions and therefore safety outcomes. This is supported by Hofmann and Stetzer (1996) who state conflict from excessive work demands will reduce safe outcomes. In Study 4 projects that reported issues with resource availability also has a reduction in the reporting of hazards and near misses. Increased role demands and limited resource availability are frequent events for Project Delivery Organisations to manage, yet there was a widespread acceptance of such factors and their potential to impact on safety performance, being reported by Project Management Teams as influencing factors across all six case study projects. There was a general acceptance that this was the norm (the accepted safety culture) within construction projects, for the project team to be under pressure and have to compromise on safety standards. It is recommended that the industry develops strategies to improve the management of resource and role demands to mitigate any negative impact on safety.

Changes to key personnel were also found to have a significant negative impact on safety. A change to a Project Manager or other similar member of the project team introduces a lack of commitment to implement interventions perceived as 'additional' (even if only for a short period of time), as well as a lack of consistency between the two individual approaches. One of the case studies was particularly affected by this, where an interim appointment was made, this was found to be detrimental due to the lack of commitment from the interim Project Manager to the successful project delivery (*"I'm only here for a few weeks I'll not rock the boat!"*). Where the Project Manager, the Project leader for safety, changes it can be anticipated that leadership for safety is affected. A change of personnel could be for the better, but this example was not identified within the examples in Study 4. Studies by Hopkins (2006), Fleming and Lardner (2001) and Wu et al (2008) found that visible commitment of leaders towards safety was essential in achieving a positive safety culture. This research supports their conclusions and identifies the significance of

changes to leadership personnel; when there is a change in personnel who show a lack of commitment to the overall project, including safety, then safety performance is negatively affected.

8.4.4 Contractorisation

This research found that the Supply Chain was not the most significant factor in achieving successful safety outcomes. It is the safety leadership activities undertaken by the Principal Contractor has greatest impact on safety outcomes for a Project Delivery Organisation. This is providing that the Supply Chain organisations are committed to improving safety performance. Where there is a wholesale lack of commitment from the Supply Chain it is very difficult for the Principal Contractor to implement effective interventions due to the mixed messages received by the workforce regarding priorities. Due to the transient nature of the industry workers are more aligned to the priorities of their employer rather than the project they are working on. This is a challenge for the industry to limit the negative impact of the transient and dynamic nature of the workforce. Improvements in safety performance are more likely to be successful where member organisations value safety as a priority as well as delivering the work.

8.4.5 Other Factors for Consideration

Other potential influencing factors that were not identified within Study 4 as making a significant contribution were; safety management systems, investment in project as a proportion of turnover, access to health and safety resource, and existing/previous safety performance. These potential influencing factors are mostly managed by the parent company off the project/site. This may be attributed to the methodological approach taken where the focus was on measuring safety interventions at a project level, and not at the actions of the parent company (Principal Contractor or Subcontractor) at organisational level.

8.5 Reflections on Methodological Approach

The difficulties in measuring safety performance are widely recognised with research recommending use of a combination of lagging and leading indicators. Lagging indicators include injuries, incidents, events with the potential to cause injury or loss (near misses), and other losses such as damage to property (DTI

2010, HSE 2011b, Shannon et al 1997). Leading indicators measure the effectiveness of safety risk management (Smith and Wadsworth 2009) or safety interventions (Hopkins 2009, Øien et al 2011, Dyrebourg 2009, Erikson 2009). Whilst some of the studies collected both leading and lagging data it was determined that this would not provide sufficient information and more in-depth evaluation techniques were necessary.

The approach was also based on many well-established techniques for data collection (surveys, interviews, workshops etc) and data evaluation (non-parametric statistical tests, thematic and comparative analysis). The research approach was also informed by safety interventions studies that recognise the complexity of safety within organisations (Pederson et al 2012, Pawson et al 2000). These studies report taking a 'realist' approach to evaluation where the context and relationships between many different factors influencing the application of the intervention remain the focus (Ryan et al 2018). A similar 'realist' approach was taken within the thesis with the logic map as the framework for achieving this.

The use of a logic map for both intervention design and evaluation was adopted. The logic map included details on the context from each project, defined interventions within the SLIT based in literature, detailed of expected outputs and outcomes from the intervention, the relationships between the inputs (interventions), influencing factors and the impact on safety performance. The use of a logic map provided a method to articulate underlying assumptions regarding expected impacts from the interventions established from existing research and findings from Studies 1, 2 and 3. The logic map also provides the framework for evaluation including the identification of influencing factors which have potential to impact on safety performance. Logic mapping as a method of evaluation of interventions is a more emerging approach.

This research has taken a multi-methods approach to the research based on a combination of approaches from studies of safety culture, performance and leadership, as well as diagnostic tools relating to change management and intervention programmes. The researcher's experience also informed the approach taken, cognisant of the complex nature of projects within the Construction Industry.

The research methodology also had to take account of the many complex factors that affect safety within a project environment. It was considered important to establish a thorough level of understanding of the domain as part of the research, as directed by many literature sources – context of

interventions for safety is of paramount importance. Specific studies (1 to 3) were undertaken to achieve the following research objectives;

- Determining the current perceived level of safety culture maturity within a Project Delivery Organisation
- Existence and the perceived effectiveness of safety improvement programmes within a Project Delivery Organisation
- Determining the current level of understanding and application of safety leadership within a project environment

These conclusions from these studies informed subsequent studies undertaken within the thesis.

8.5.1 Understanding safety interventions within construction projects (Studies 1, 2 and 3)

Study 1 provided a good assessment of the perceived level of safety culture maturity across Project Delivery Organisations. The collation of safety culture perception ratings across many different Principal Contractors and their Supply Chain was a simple method of collecting these data in a format that was easily analysed using statistical tests. Other studies that evaluated perceptions of safety culture also adopted a similar analytic approach determining the mean ratings between different participant groups (Clarke 1999, Mearns et al 2003, Clarke 2000, Glendon and Litherland 2001, Zohar and Gill 2005).

It was important to be clear on the level of culture maturity prior to developing the SLIT as this would inform the contents and resources. A well-tried method of evaluating safety culture using a safety culture maturity model was found to be insufficient. Evaluating differences in perception amongst key organisations within the Project Delivery Organisation poses a challenge, as the current safety culture maturity models lack sufficient scope to assess the safety culture maturity of member organisations within a project with the additional complex relationships this involves. Specific topics that are missing relate to the contractual interfaces between project members, the nature of relationships between companies working together on the project, clarity over specific roles and responsibilities, engagement, communication and co-ordination between all parties, minimum standards of training including leadership and non - technical skills. It would be appropriate to review and update the descriptions contained within traditional safety culture maturity models to specifically include the inter-organisational relationships between different project members. By developing the available materials further, it would be possible to

identify the specific areas of safety arrangements that could be improved for Project Delivery Organisations as a quasi-organisation.

Study 2 was a simple study to collect information via a survey questionnaire providing information relating to any existing Safety Improvement Programmes. Chapter 4 provides details on the method undertaken which is recommended for other similar studies, with an update to the questionnaire so that the questions are targeted on examples of safety leadership interventions being adopted across the industry.

To assess the level of understanding of safety leadership as a topic, Study 3 was undertaken based on a method of interviews. The semi-structured interviews focused on how well the study participants could explain the concept of safety leadership, and whether they could provide any examples of real-world application within a Project Delivery Organisation. The interviews were analysed using a thematic approach. The interviews themselves worked well but it would be worthwhile developing more structured interview questions based on the outputs of Study 3 to explore further their mindset towards safety and whether they feel safety is a function undertaken by others on the project. A questionnaire could be included within the interview to establish the level of awareness of the many different safety leadership intervention types. The questionnaire could include more information on ranking of the interventions in terms of effectiveness at improving safety outcomes. It would also be valuable to duplicate the interviews and questionnaire amongst the workforce on a project to gain compare whether the leader's perceptions of safety interventions is the same or different to the workforce as the usual recipients of the interventions.

Studies 1, 2 and 3 provided an understanding of the industry approach to safety leadership, and associated intervention programmes, as well as the prevailing perceptions of safety culture maturity within a Project Delivery Organisation. It was identified very early that perceptions alone would not provide sufficient information to understand the interfaces and relationships within a project. However, perceptions were found to be important in relation to effective deployment of interventions and desirable safety outcomes. Data sources were triangulated to avoid over-reliance on the perceptions of safety performance reported from project teams. These early studies also highlighted the challenge of measuring safety performance within a Project Delivery Organisation which informed the approach taken for the next stage of research, specifically Study 4 adopting a logic mapping approach.

8.5.2 Evaluating the influencing factors and related success for safety leadership interventions (Study 4)

Within Study 4 bespoke data collection and evaluation tools were used to obtain relevant information from Project Delivery Organisations. The approach taken used multiple methods to gather data at different times and in different places and using evidence from different types of data sources. The methods used to collect the data were found to be appropriate and effective at capturing information via survey, interview and specific project records. The pilot was found to be valuable in the development of materials and methodology.

The approach of Study 4 was based on a logic mapping approach to predict and evaluate the impact of intervention activities. The use of a logic map was found to be essential in achieving the study objectives as a framework to evaluate the safety leadership interventions. The logic map also helped to identify the different categories of information that were needed and where these needed to be sourced from e.g. project records, interviews, perception surveys, performance data. The use of a logic map is recommended for studies concerned with the evaluation of interventions. Safety-related studies often focus on accident and incident rates to measure safety performance, the impacts of an intervention with well-known limitations of bias and under-reporting. However, taking a logic mapping approach identifies a range of measures that can be obtained (outputs and outcomes) earlier in the logic pathway. This is particularly valuable for measuring safety in a project environment where there is limited time for the Project Delivery Organisation to be in existence, and the full impacts on safety may not have time to be realised.

For studies of Project Delivery Organisations, it is recommended to also include an assessment of influencing factors at outputs, outcomes and impact stages of the logic map. This is essential to evaluate the external and influencing factors that may be contributing to the effectiveness of interventions and the impact on safety performance.

Data triangulation was also adopted (Denzin 1978, Patton 1999). Data source triangulation was used to examine the consistency of different data sources using the same method e.g. at different points in time, at different places. This was achieved through repeating the interviews, surveys and audits throughout the project duration (a longitudinal study). Methodological triangulation was also achieved through using a combination of methods to gather data including interviews, surveys and audits. This approach minimised any inadequacies from single data sources within Study 4 as a key aspect informing the evaluation

process. These were important aspects of the study to maintain levels of reliability when comparing across the six case study projects.

8.6 Limitations of Research

Six case study projects participated in the study as this was the maximum one researcher could manage within the PhD timescales. This was largely due to the extensive quantities of data generated from each project and the level of evaluation undertaken for each project individually as well as the comparison across all six projects. With the limited number of case studies, the projects were taken from only two different medium sized Principal Contractors in order to minimise additional variables that needed to be included within the evaluation. It is unlikely that these two Principal Contractors are wholly representative of all Principal Contractors working within the Infrastructure Engineering Sector, some organisations are larger and smaller in size. Size is a factor that affects safety performance (Walters and James 2009). Therefore, the findings may not be truly representative of the whole industry. Future research could apply the same methodological approach described in Study 4 to other construction projects managed by other Principal Contractors.

The two different groups of projects (Intervention and Baseline) participating in Study 4 was also considered a potential limitation. The study design was to create a control (the Baseline Group) for comparison with the Intervention Group projects. During the analysis it was apparent that the Baseline Group deployed as many safety leadership interventions as the Intervention Group, even though they were not given the SLIT resources. Therefore, it was difficult to treat the Baseline Group as a control group within the analysis. This may have been due to the different size of projects (measured via project duration, value and appointed resources) involved in both the Intervention and Baseline Groups. In future studies it is recommended that specific consideration should be given to project size when determining the allocation of projects to either of these groups.

A third limitation was the use of perceptions to establish views towards safety, safety culture and safety leadership. There are several studies that use perception surveys as a measure of safety climate (Mearns and Flin 1999, Guldenmund 2000, Zohar 1980, 2000, 2005). Perception surveys often collate and analyse data against likert or similar rating scales (Cooper and Phillips 2004). This research focused on the relationship between Principal Contractor and the Supply Chain. The lack of Client perceptions within Studies 1 and 4 is a

limitation. In future studies it would be prudent to include the Client attitudes towards safety.

8.7 Chapter Summary

The aim of the thesis was to better understand the Infrastructure Engineering Sector of the Construction Industry's perceptions of safety culture, safety leadership, and associated intervention programmes in order to evaluate the effectiveness of safety leadership interventions within a Project Delivery Organisation. In order to meet the thesis aim, a number of research objectives were identified:

- Understanding the effectiveness of safety leadership interventions on safety culture maturity and performance
- Identifying the relevance of influencing factors on safety and leadership within Project Delivery Organisations
- Establishing specific considerations for the successful implementation of Safety Improvement Programmes within this sector
- Determining the current perceived level of safety culture maturity within a Project Delivery Organisation
- Existence and the perceived effectiveness of safety improvement programmes within a Project Delivery Organisation
- Determining the current level of understanding and application of safety leadership within a project environment

This chapter presents the main research findings and identifies how this aim and objectives were met across four separate studies. The main findings relate to:

- Safety culture maturity within a Project Delivery Organisation
- The role of safety leadership
- Understanding the influencing factors affecting safety within construction projects

The methodological approach and limitations of the research were also discussed. The next chapter outlines the research conclusions, identifies the contribution to the research fields of safety leadership, safety intervention and safety culture, and provides guidance for future research in this domain.

9. Concluding Statement and Recommendations

9.1 Introduction to Chapter

The research presented in this thesis has investigated safety leadership within the Infrastructure Engineering Sector of the Construction Industry, specifically evaluating safety, safety culture and safety leadership within a Project Delivery Organisation. This concluding chapter states the contributions made by the research and provides guidelines for industry seeking to implement safety leadership interventions.

The Infrastructure Engineering Sector of the Construction Industry is one of the high-risk sectors of work in the UK (HSE 2009), where engineering and construction activities that either enhance or maintain the rail and public highway infrastructure are undertaken in a hazardous environment. The industry recognises that safety performance has reached a plateau and the focus on improvement has shifted to achieve a next step change in safety behaviours and culture.

The thesis builds upon existing research relating to safety performance (Mearns et al 2003, DeJoy et al 2004, Grabowski et al 2007, Hale et al 2010, Walters and James 2009, Winkler and Irwin 2003), safety culture (Fleming 2001, Fleming and Lardner 2008, Cooper 2001, Parker et al 2006, Zohar 1980, 2002) and safety leadership (Hopkins 2006, Fleming and Lardner 2001, Hofmann et al 1995, Shannon et al 1997). The findings are applied to construction projects. Construction projects are a dynamic transient environment where organisations are contracted to work together for a defined and limited period of time – a quasi-organisation. The characteristics, inter-organisational relationships and challenges associated with a 'quasi-organisation' (a Project Delivery Organisation) have been explored throughout the thesis to ascertain whether influencing factors impact on project safety culture and performance. The thesis has investigated the role of leadership in improving safety, through the testing of a set of safety leadership interventions.

The specific conclusions and contributions that have been identified from the thesis are outlined within this chapter.

The thesis adopted many well-established techniques for data collection and evaluation taking a multi-methods approach. This research has also found that the application of existing safety culture maturity models to measure safety culture do not take sufficient account of the complex relationships and influencing factors within a Project Delivery Organisation. The thesis has made

a specific methodological contribution for future studies seeking to evaluate interventions through the use of a logic map for both intervention design and evaluation. A logic mapping approach can be taken to inform the data collection, collation and analysis of relationships across a wide range of data sources.

A multi-methods approach has been taken in order to develop guidance for Project Delivery Organisations to effectively implement safety leadership interventions, making recommendations for the Construction Industry based on the analysis and results within this thesis.

9.2 Research Aim and Objectives

The aim of the thesis was to better understand the Infrastructure Engineering Sector of the Construction Industry's perceptions of safety culture, safety leadership, and associated intervention programmes in order to evaluate the effectiveness of safety leadership interventions within a Project Delivery Organisation. In order to meet the thesis aim, a number of research objectives were identified:

- Understanding the effectiveness of safety leadership interventions on safety culture maturity and performance
- Identifying the relevance of influencing factors on safety and leadership within Project Delivery Organisations
- Establishing specific considerations for the successful implementation of Safety Improvement Programmes within this sector
- Determining the current perceived level of safety culture maturity within a Project Delivery Organisation
- Existence and the perceived effectiveness of safety improvement programmes within a Project Delivery Organisation
- Determining the current level of understanding and application of safety leadership within a project environment

Progress against each objective is outlined in the remainder of this section.

The first objective was to establish the current perceived level of safety culture maturity within a Project Delivery Organisation. The results identified a significant difference in the perceived safety culture maturity of the Principal Contractor and Supply Chain, with Principal Contractors perceived by all parties as more mature than the Supply Chain. This suggests that the power structure

across a project has more of an effect on perceptions than self-enhancement by any organizational type (Hoorens 1993). The divergent power relationship between Principal Contractor and their Supply Chain may influence the reported levels of safety culture maturity for the project as a whole, and has a bearing on how safety culture interventions should be delivered to effect change.

The second objective was to establish the existence of Safety Improvement Programmes within Project Delivery Organisations and to identify the typical contents of these. Study 2 involved surveys of the Supply Chain for two different Principal Contractors. This study found that whilst Principal Contractors were implementing Safety Improvement Programmes their effectiveness within each Project Delivery Organisation may be diluted by the Supply Chain with their non-application of such programmes. This study identified that while only a small proportion of the Supply Chain were adopting a Safety Improvement Programme, they rated highly the positive impact of awareness, engagement and a reduction of accidents/incidents where these were implemented by Principal Contractors. Those programmes that were in place within the Supply Chain are aligned to literature to a greater or lesser extent. The setting of objectives for improving safety culture, nomination of champions to lead behavioural safety in the workplace, and the delivery of behavioural safety awareness training were all aspects included within their programmes.

The third objective was to establish the current level of understanding of safety leadership amongst duty holders (Clients, Principal Contractors and the Supply Chain) and to identify examples of safety leadership interventions already deployed in the sector. In-depth interviews were undertaken with representatives from Client, Principal Contractor and Supply Chain, to identify attitudes to safety leadership and consider how this may impact on safety performance. The level of understanding of safety leadership as a topic was evaluated against how well the study participants could explain the concept, and whether they could provide any examples of real-world application. A total of 26 different examples of safety leadership interventions from the sector were identified from this study. Half of the intervention examples provided were based around communications, in particular opportunities for leader engagement or the sharing of information. This study identified that there are numerous safety leadership interventions being deployed within the sector, with the likely success of these leadership interventions being influenced by five themes; context, preparation, communication, leadership behaviour and style, and action.

These study findings informed the development of a Safety Leadership Intervention Tool (SLIT) for the next phase of PhD research, detailed in Chapter 6. The contents of the SLIT was aligned to the prevailing safety culture maturity of the Project Delivery Organisation (as identified in Study 1) building on any existing safety leadership practices identified within Studies 2 and 3, as well as being founded on the findings from the literature review.

The fourth research objective was to establish how effective are safety leadership interventions on safety culture maturity and performance within a Project Delivery Organisation. Study 4 involved extensive evaluation of six case study projects, three of which were provided with the SLIT as the Intervention Group. The remaining three projects were the Baseline Group and not provided with the SLIT. Study 4 found that neither the baseline nor intervention projects undertook 100% of the interventions outlined within the SLIT. There were some Intervention Group projects who initiated safety interventions from the SLIT but did not continue to apply these throughout the project timeline. This study identified five themes for reasons interventions were not deployed: lack of safety integration with delivery, lack of communication and engagement, Project Managers too compliance focused, lack of resources and training. With limited adoption of safety leadership interventions across all projects, this study could not establish a clear relationship between leadership intervention and changes to project safety culture and performance. Overall all six projects reported very similar outputs, outcomes and impacts; some increase in near miss reports, improved supervisor visibility, but overall a lack of consistency of safety leadership behaviours across the Project Management Team. Any reported improvements were affected by an increase in pressure to deliver the project works e.g. handover of project, achieving a key project milestone.

The fifth objective evaluated the impact of influencing factors on leadership interventions and safety culture and performance within a Project Delivery Organisation, which was also included within the scope of Study 4. The influencing factors that were reported to have had an effect on a project's safety performance were Client requirements/expectations and situational constraints. Contractorisation was not found to have a significant impact on safety performance for the sample. Study 4 also found that the size of each project was also important, with 'smaller' projects deploying less safety interventions than larger projects due to the availability of resources on the project to implement safety interventions.

The overriding factor that was found to influence positive outcomes was down to the individual Project Managers prioritisation of safety as equally if not more

important that other project deliverables. Where individuals deployed safety leadership interventions more consistently and effectively, this was found to improve near miss reporting and increase visibility of safety leadership behaviours.

Perceptions of safety culture maturity were found to have an impact on change-efficacy as it becomes more difficult to obtain the necessary commitment to generate changes to improve safety performance when members of the project believe their safety performance is better than it really is.

The sixth and final objective was to develop guidance for the Construction Industry for those seeking to adopt safety leadership interventions to improve safety culture and safety performance. Section 9.4 contains this guidance.

9.3 Contributions

The thesis makes a number of academic contributions from the research that has been undertaken with are explained in this section, which include:

- The understanding of a structure of multiple organisations working temporarily as one entity, and how this influences safety culture (section 9.3.1)
- The importance of change efficacy - how safety leadership interventions are adopted is equally as important as the content of the intervention (section 9.3.2)
- The identification of five enablers and five barriers to successful implementation of safety leadership interventions (section 9.3.2)
- The main influencing factors affecting safety culture on construction projects are Client behaviour, situational constraints and resource demands (section 9.3.3)
- The appropriateness of existing safety culture maturity models for quasi-organisations, when existing safety culture maturity models focus on perceptions of safety within organisations rather than between organisations (9.3.4)
- Logic mapping as an approach for the planning and evaluation of safety interventions (section 9.3.5)

Also outlined are the contributions which are relevant for those implementing safety leadership interventions within the Construction Industry.

9.3.1 Project Delivery Organisations

Safety culture research tends to treat organisations as a single body (Schein 2010, Farrington-Darby et al 1997), with less focus on understanding how perceptions vary in a multi stakeholder environment. One such example of a multi-stakeholder environment is a construction project. Whilst there is considerable research on the characteristics of positive and negative safety cultures, research to date does not consider the interfaces and relationships between different organisations that are co-ordinated to work together for a determined period of time forming a quasi-organisation. Therefore, this thesis makes a contribution to existing knowledge by evaluating the significance of 'organisational' arrangements and structure upon safety culture. An output of the thesis is the development of a model (as shown in Figure 9.1), which outlines the key stakeholders within a Project Delivery Organisation, and established their contribution to safety culture on a construction project.

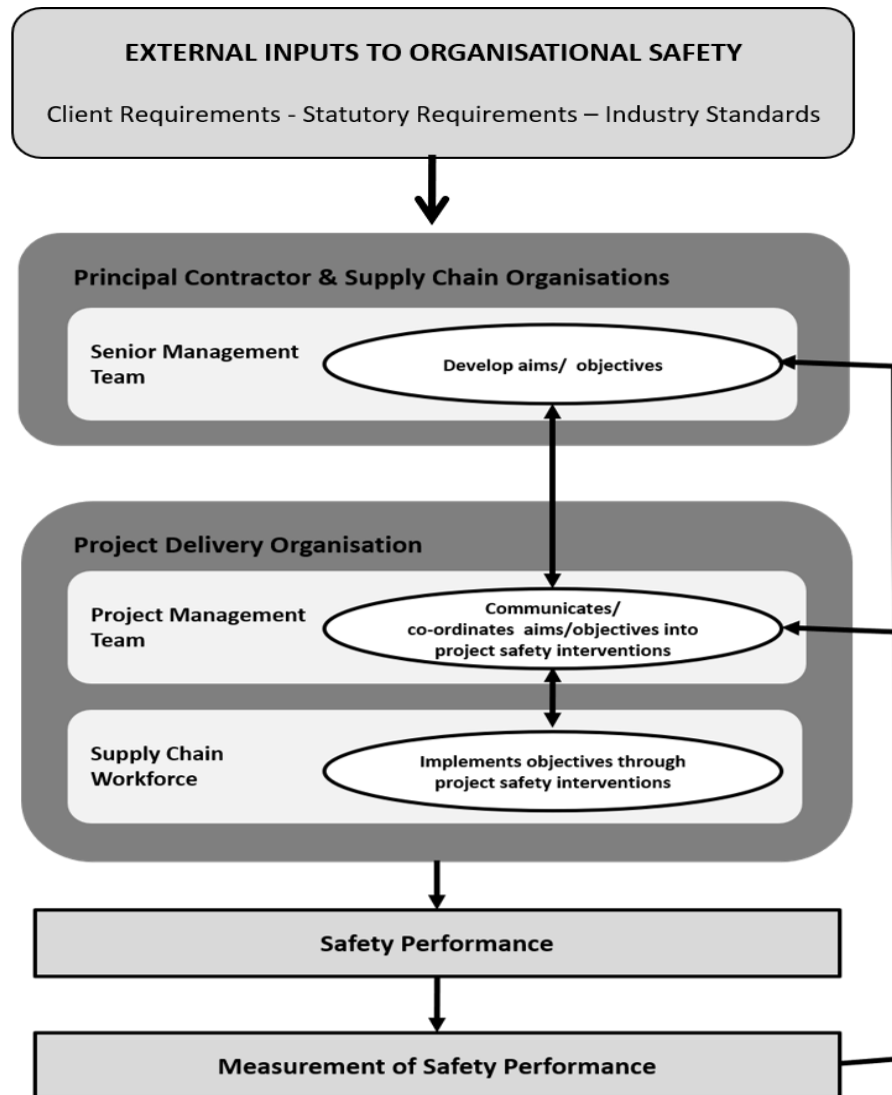


Figure 9.1 Model of a Project Delivery Organisation in relation to safety

Understanding this organisational structure is important for those seeking to introduce Safety Improvement Programmes on construction projects because there will be both within-group homogeneity and between-group variation in safety-related perceptions at different levels of an organisation (Budworth 1997, Cox and Cheyne 2000, Lee and Harrison 2000, Zohar 2000). Effective Safety Improvement Programmes can target interventions for the respective social groups and hierarchy within the project.

9.3.2 Safety Leadership Interventions

This research established that while safety leadership interventions have the potential to positively impact on safety performance, it is how the interventions are implemented that is equally as important as the intervention itself.

Change efficacy, the perceived need for a change and the commitment to the change, has been identified as critical factors affecting successful outcomes of safety leadership interventions. This is consistent with change theory studies (Burnes 2004, Weiner 2009, Bandura 1997) as well as other studies relating to safety and leadership (Hopkins 2006, Fleming and Lardner 2001). A leader's perceived value of the intervention can help or hinder commitment to the change. If the leader does not fully recognise the beneficial outputs and outcomes that are expected from an intervention there is less likely that a positive impact on safety culture and performance will be achieved. The perceptions of the wider team relating to the potential value they recognise from the intervention is also an important factor. For each project that deployed interventions, the perceptions reported from those working on the project was important. If the interventions were perceived to be valuable for improving safety from both the Project Management Team and the workforce there was an increase in positive safety outputs and outcomes. If there was an inconsistency in perceived value and benefit of the interventions between the Project Management Team and the workforce there were fewer positive safety outputs and outcomes. Where the Project Management Team did not perceive value in a particular intervention, this was found to be ineffectively deployed and therefore did not achieve any positive safety outputs or outcomes for the project.

Therefore the 'how' an intervention is introduced to a project as part of a Safety Improvement Programme should be an important consideration, as well as the contents of the programme. This research has identified five enablers for successful implementation of safety leadership interventions:

- Context - the environment and context in which the safety leadership interventions are being applied, including organisational and industry factors.
- Preparation - the focus on planning the safety leadership interventions; what needs to be considered before implementing the interventions.
- Communication - the importance of communication and engagement with the whole project team, to support the implementation of safety leadership interventions.
- Leadership style and behaviour- reliance on the individual leader's skills and commitment who will be introducing the safety leadership interventions.
- Action - continual delivery of commitments and promises by leaders.

This research has identified five barriers to the successful implementation of safety leadership interventions:

- safety integrated with delivery – when leaders fail to integrate safety across the PDO so that safety is not perceived as an extra thing to do, but just part of what has to be done to complete the project.
- communication and engagement – a lack of communication from the project leaders through to frontline supervisors and poor engagement in safety interventions.
- compliance focused - project level leadership focuses their attention on achieving compliance with statutory safety requirements rather than achieving a mature safety culture.
- resources - availability and capacity of people to undertake the interventions alongside other duties defined within their job role, largely determined by project size.
- training – a lack of leadership skills training for Project Managers.

This research has found that there is still some work to be done to improve safety leadership within the sector.

9.3.3 Influencing Factors

The research has identified two main influencing factors that can impact on the effectiveness of safety leadership interventions within a Project Delivery Organisation. These are the Client behaviour and situational constraints. This research reaffirms previous studies noting the importance of both these aspects for safety on construction projects as detailed below.

Client behaviours have been found to affect a project safety culture, with adversarial and uncollaborative behaviours impacting on the capacity of a

Project Management Team for the implementation of safety leadership interventions. The research findings support other studies by HSE (2016), Bednarz (2016), Bresnen and Marshall (2000a) and Winkler and Irwin (2003) who established that Clients' can have a direct impact on project safety performance.

This research has also found that situational constraints negatively affect safety culture within a Project Delivery Organisation due to resource availability and role demands. Delays to design and project programme, unforeseen challenges, changing scope of work and increase of workforce numbers on the project were all found to have a negative impact on safety. This was due to the capacity of the Project Management Team being overloaded with more construction work to be undertaken in a reduced period of time i.e. the work becomes concertinaed so there is more pressure on everyone on the project. When such situational constraints were in play the capacity of the project team was limited to statutory compliance only; safety interventions that are beyond compliance were not deployed.

Contractorisation was not found to have the greatest impact on safety culture which is contrary to other studies (HSE 2003, Walters and James 2009).

9.3.4 Safety Culture Maturity Models

This research has built upon the limited existing studies assessing organisational safety culture within the Construction Industry (Grubb and Swanson 1999). Research into safety culture maturity is largely reliant on maturity models as a method of evaluation. This research has specifically found that the current safety culture maturity models (Westrum 1988, 1991, Parker et al 2006, and Fleming 2001) lack sufficient scope to assess the safety culture maturity of member organisations within a project with the additional complex relationships this involves. The complex organisational interfaces within a Project Delivery Organisation poses specific challenges that are not addressed within existing safety culture maturity models which are focused on perceptions of safety *within* organisations rather than *between* organisations. This finding is a contribution to existing academic research and may be a factor in why there are limited studies assessing safety culture within the Construction Industry.

9.3.5 Methodological Approach

This research has taken a novel approach to obtain a greater understanding of the influencing factors that have potential to impact on safety within a project environment and with this knowledge determine how safety leadership interventions can contribute to improved safety performance. Recognising that safety performance data is particularly difficult to collect and subject to bias (Robson et al 2001, Hale 2009) a logic map was used to evaluate the interventions and impact on safety performance. The use of a logic map is an emerging approach for use in intervention studies, previously used by the government in planning public infrastructure interventions. This thesis transfers the existing academic practices to a new sector of industry and applies these to the context of safety.

The logic map was developed based on the work of Hills (2010), Connell and Kubisch (1998), and Wholey et al (2004), and expanded further to include the evaluation of influencing factors for the steps within the logic map (inputs, outputs, outcomes).

The logic map provided the framework to evaluate the safety leadership interventions based on a wide range of data sources. The logic map informed the approach taken for data collection as the level of detail needed during the preparation of the logic map determined the different categories of information that were needed and where these needed to be sourced from e.g. project records, interviews, perception surveys, performance data. This also identified where each data source was needed within the evaluation, providing a structure for the data to be collated in a useful way across inputs, outputs, outcomes and impacts for each project.

The logic map formed the framework to investigate relationships and establish the relevance of influencing factors on safety interventions. This was achieved through establishing causal logic between the different steps on the logic map for example, identifying the reason for a specific input leading to output and an outcome.

There was a need to evaluate the project safety culture at a number of intervals in the project timeline. The logic map provided a consistent method of evaluating the data at each interval.

As there was also a need for comparison across sample of projects there needed to be consistency in data collection, collation and analysis between the different projects as well. The thoroughness of the logic map enabled synthesis of data for comparison across the different projects in a consistent manner.

9.3.6 Helping Great Britain Work Well

This research has made a contribution in terms of the 'Helping Great Britain Work Well – A new health and safety system strategy' published by the HSE in 2016, providing findings for Project Delivery Organisations within the Infrastructure Engineering Sector. This research has identified the relevance of:

- the impact on safety culture within a Project Delivery Organisation where there is extensive reliance on subcontracting
- complex relationships between organisations and the impact on safety within a Project Delivery Organisation
- the influence of safety leadership amongst the Client Principal Contractor and Supply Chain behaviours on project safety culture
- the impact of situational constraints (changes to design, procurement and resources) on project safety culture

9.4 Guidance for Industry

Leaders work at different levels within a Project Delivery Organisation: Client, Principal Contractor and the Supply Chain. This research has identified that each of these groups of leaders needs to have an improved awareness of safety leadership in relation to the role that they carry out, as well as the development of leadership skills that support visible role model behaviours.

It can be concluded that for a Project Delivery Organisation to be effective at implementing a Safety Improvement Programme, it is recommended that understanding the project as a whole (all member organisations and influencing factors) is important as these will contribute or impede the effectiveness of the Safety Improvement Programme.

There are a number of guidelines developed from this research which are relevant for management within Principal Contractors.

Guidance for Senior Management from Principal Contractors

- Raise the awareness of Client representatives of the influence of their behaviours and the potential impact on project safety performance.
- Develop the change management skills of leaders within the Project Management team in order to improve preparation, communication and implementation of safety interventions.

Guidance for Project Management Teams

- Project Manager to focus on developing trust-based relationships enhancing collaboration and conflict resolution skills amongst all members of a Project Delivery Organisation.
- Raise awareness of the role of leaders in developing a positive safety culture amongst the Supply Chain.
- Due consideration should be given to planning and managing the change, as well as determining the content and appropriateness of the intervention itself.

Guidance for Introducing Safety Interventions

- Focus should be on management behaviours and not just the workforce. Interventions are more successful when leaders are perceived to be committed to safety therefore visible leadership and commitment to safety and the specific intervention is crucial.
- Change often viewed as imposition due to lack of engagement leading to resistance to the change. For ease of implementation and minimising resistance to change, it is important that the project is ready for the change in safety processes and standards. Preparatory work and good levels of engagement are recommended prior to introducing a new intervention.
- The perceived value of the intervention can help or hinder commitment to the change. Therefore, it is important that those working on the project understand the expected benefits brought by adopting the intervention.

9.5 Suggestions for Future Research

This research investigated safety leadership within Infrastructure Engineering Projects in the Construction Industry. Further studies could evaluate in more depth the factors influencing safety performance within a Project Delivery Organisation, for each of the following areas.

- Evaluate the impact of the Client priorities and behaviours on project safety performance, including the power relationship with Principal Contractors. This could be achieved through a condensed version of this thesis which focused specifically on Client behaviour. A future study would include an assessment of Clients' attitudes towards safety, and also identify any client-related interventions that would be expected from a literature review and from understanding current industry practices. The development of a logic map to evaluate client safety interventions and their anticipated impact on project safety culture and performance would also be recommended.

- Determine the role types for those who are identified as leaders for safety within a Project Delivery Organisation and establish the mindset towards safety leadership. A study should include whether these individuals have clear roles, responsibilities and are empowered to make a positive impact on safety performance. If so, how is this achieved. If specific role types are not identified as leaders, lack clear responsibility or are not empowered, a study should explore why this is the case. It would be important to establish whether there are any barriers to certain role types being supported as leaders of safety. This study would be valuable for industry leaders to better understand the role of leaders for safety and how improvements could be made.
- Develop and test a programme to support the effective management of change when introducing safety improvements. Such a study could build upon existing change frameworks from Hartley (2002) or Dunphy and Stace (1993) and establish a framework for construction projects deploying safety interventions. Once developed this Framework could be deployed and subsequently evaluate the effectiveness of this as a management tool.
- Development of existing safety culture maturity models that are more appropriate for Project Delivery Organisations. The study would establish the relevance of existing safety culture maturity models for a quasi-organisation and identify specific areas of content for development. The study output would be updated guidance on how to develop safety culture through Safety Improvement Programmes for Project Delivery Organisation.

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Appendices

Appendix 1 – Study 2 Survey Questionnaire

Appendix 2 – Logic Map

Appendix 3 - Study 4 Principal Contractor/Subcontractor/Project Fact Sheet

Appendix 4 – Study 4 Principal Contractor/Subcontractor/Project Initial Interview

Appendix 5 – Study 4 Project Management Assessment

Appendix 6 – Employee Survey

Appendix 7 - Study 4 Project Follow Up Interview

Appendix 1 – Study 2 Survey Questionnaire

Behavioural Safety within the Construction Industry Supply Chain Company Survey Questionnaire



This survey has been developed to obtain a greater understanding of behavioural safety amongst subcontractors, which forms part of a larger research project to understand the value of safety behaviour programmes across the construction industry supply chain.

All completed surveys will be collated and analysed, the results of which will be used in the study. If you do not wish to answer any of the questions included in the survey, you may skip them and move on to the next question. All information recorded is anonymous.

Please complete and return the questionnaire within the envelope provided by 1st June 2011. Your assistance is greatly appreciated.

For support in completing the survey, or for an electronic version, please contact Shelley Stiles on eaxsls@nottingham.ac.uk or 07791 633143.

Section A: Company Information

Q1 What sectors of the construction industry do you work in?

Please tick as many as are appropriate

Civil Engineering ☐	House Building ☐	Non-residential building ☐
Rail ☐	Power ☐	Utilities ☐
Other (please state) _____		

Q2 What is your company's main scope of work?

Please tick as many as are appropriate

Abseiling ☐	Asbestos Removal ☐	Bridges ☐
Building work ☐	Civil works ☐	Cladding ☐
Contingent Labour ☐	Concrete works ☐	Demolition ☐
Drainage works ☐	Earthworks ☐	Electrical works ☐
Fencing ☐	Glazing ☐	Highway works ☐
Joinery ☐	Lifting and Jacking ☐	Lifts and escalators ☐
Mechanical works ☐	Painting ☐	Piling ☐
Plant hire ☐	Roofing ☐	Scaffolding ☐
Signalling ☐	Site Investigation ☐	Telecoms ☐
Track ☐	Traffic Management ☐	Vegetation Clearance ☐
Other (please state) _____		

Q3 What is your average company annual turnover? *Please tick*

Less than £100,000 ☐	£100,00 to £500,000 ☐	£500,000 to £1 million ☐
£1 to £5 million ☐	£5 to £20 million ☐	More than £20 million ☐

Q4 How many people does your company employ directly? *Please tick*

0-5 ☐	6-25 ☐	26-50 ☐	51-100 ☐
101-200 ☐	201-250 ☐	251-400 ☐	>400 ☐

Behavioural Safety within the Construction Industry Supply Chain Company Survey Questionnaire



Q5 Do you use subcontractors? Please tick Yes ☐ No ☐

If yes, how much of your work is delivered by subcontractors? Please tick

0-25% ☐ 26-50% ☐ 51-75% ☐ 75-100% ☐

Q6 What access do you have to competent health and safety advice? Please tick

Internal person – full time role ☐ External consultant or similar ☐
Internal person – part time/shared role ☐ None ☐
Other (please state) _____

Q7 What involvement does your company have in construction projects?

Please tick as many as are appropriate

Client ☐ CDM Co-ordinator ☐ Subcontractor ☐
Designer ☐ Principal Contractor ☐ Supplier/manufacturer ☐
Other (please state) _____

Q8 Does your company have management systems that are accredited to a recognised standard?

Please tick as many as are appropriate

ISO 9001 ☐ ISO 14001 ☐ OSHAS 18001 ☐
CHAS ☐ Constructionline ☐ Link up ☐
Other (please state) _____

Q9 What was your company safety performance measured using AFR (accident frequency rate) for the last 2 years?

Please tick

Below 0.1 Above 0.1

2010	☐	☐
2009	☐	☐

AFR= $\frac{\text{Number of reportable accidents} \times 100,000}{\text{Total number of hours worked}}$

**Behavioural Safety within
the Construction Industry Supply Chain
Company Survey Questionnaire**



Section B: Behavioural Safety

Q10 What do you understand by the term behavioural safety programme?

Q11 Does your company have a behavioural safety programme in place? *Please tick*

If no please go to question 17

Yes ☐

No ☐

Q12 Who is included within your programme? *Please tick as many as are appropriate*

Direct employees ☐ Temporary contract employees ☐ Subcontractors ☐

Other (please state) _____

Q13 What are the specific objectives of your programme?

Q14 What is included in your programme?

**Behavioural Safety within
the Construction Industry Supply Chain
Company Survey Questionnaire**



Q15 Does your company have a nominated 'champion' for behavioural safety? *Please tick*

Yes ☐ No ☐

Q16 Have you delivered any training for behavioural safety in your company? *Please tick*

Yes ☐ No ☐

Q17 Have you been requested to follow another client's and/or principal contractor's behavioural safety programmes? *Please tick*

Yes ☐ No ☐

Q18 Have there been any key successes of your own/another organisation's behavioural safety programme? *Please tick*

If yes, please provide details below

Yes ☐ No ☐

If you have any other comments please add them here. *Please continue overleaf if necessary*

Thank you for taking time to complete the questionnaire

Appendix 2 – Logic Map

Context	Poor safety performance within the infrastructure engineering sector of the Construction Industry			
	Lack of safety leadership			
	No research for improving safety culture within quasi-organisations 'projects'			
	Specific characteristics of the infrastructure engineering sector of the Construction Industry and prevailing safety culture			
When?	Inputs (A)	Outputs (B)	Outcomes (C)	Impact (D)
	Planning and enabling phase prior to commencement of each project	During each project	At the end of each project	Across all projects
	A1. Safety vision and goals defined	B1. Belief in leadership commitment to safety	C1. Reduced accidents and incidents	D1. Increased safety performance
	A2. Transformational leadership skills applied	B2. Role model safety leadership behaviour	C2. Increased visibility of safety leadership behaviours	D2. Increased safety culture maturity scores
	A3. Transactional leadership skills applied	B3. Consistent response to incidents	C3. Increased invoking of refusal to work	
	A4. Safety performance monitoring and review	B4. Feedback on safety performance	C4. Increased hazard and near miss reporting	

Component from the logic map	Information Context	Source of Information	Leadership Aspects	Reliability Comments	Validity Comments	Assessment Method					Assessment Criteria	General Comments and Considerations	Links
						Fact Sheets	PC Interviews	SC Interviews	Project Records	Employee Survey			
A1. Safety vision and goals defined	Defined safety goals and objectives for the project, including behavioural standards, within project documentation	Project H&S Plan, Policy Statements, Site Induction, Site Rules	Sets the vision, defines expectations for safety behaviour. How do leaders translate goals into action?	Easy to collect (i.e. whether they exist or not).	How do other people understand the integration and priority of goals with other business objectives? How are they brought to life? More difficult to understand the impact in isolation.	X	X	X			How many as a proportion of wider business goals? What are they?	Could do analysis on what type of goals easily.	B1
	Personal safety behaviours are defined, including personal contribution to achieving safety vision and values.	Behavioural standards within site induction, and project roles and responsibilities	Defines behavioural standards for everyone - sets expectations.	Easy to collect (i.e. whether they exist or not).	What is the relationship with values, objectives and behaviour? Difficult to determine this.		X	X	X		What behaviours are defined? How are these communicated? Are these widely understood?	Current test does not include a test of identification or understanding of project safety goals within the employee survey.	B1
A2. Transformational leadership skills applied	There is a schedule which defines the frequency of safety tours for Senior Management.	Safety tour schedule, records of completed safety tours	Visible leadership in the workplace. Opportunity for engagement with the workforce. Walking the talk. Demonstrate role model behaviours.	Collection of number data is easy. Qualitative review of the tour records more difficult and subjective. Reliance upon others to record their tour.	Balance: paperwork reflects actual engagement. What is more important? Is the emphasis on doing the tour or demonstrating transformational leadership.		X	X	X		Who undertake tours at which level in the company? How many are scheduled and completed (% planned tours completed), Quality of tour records (engagement).	Does the employee survey adequately cover this?	B1 B2 B4
	Leaders to complete behavioural safety leadership training and understand role model behaviours.	Course attendance register	Awareness of good safety leadership and how to demonstrate role model behaviours.	Usual course feedback sheets completed. Reliance on actual consistency of the training across PDOs.	Training evaluation (not individual) is included within the study i.e. individuals learning not traced throughout the duration of the project.				X	X	% of leaders attended training	How does courageous leadership questionnaire contribute? Are the specific skills covered on the course reflected in the employee survey and other assessments? Show traceability of these.	B1 B2
	Senior management attendance at Health and Safety Committee Meetings.	Minutes of H&S Committee meetings	Visible leadership and engagement on workforce safety matters. Walk the talk. Make time and priority.	Attendance can be easily measured. Importance of who attends and their level?	Demonstrates actual occurrence and attendance, does not demonstrate contribution to the meeting	X	X	X	X		Content of minutes, frequency and attendance at meetings	How will meeting minutes be evaluated? Needs a qualitative approach.	B1 B2 B3 B4

A3. Transactional leadership skills applied	A defined process which identifies between different levels of culpability (error or violation / individual or group).	Fair play decision model (or equivalent), Examples of application	Leads response to incidents - is it blame focused, or learning about root cause and corrective/preventative actions? Ensures fairness for all and don't walk by. Leading the culture.	Having a fairplay model is straightforward- but how is this evaluated for quality? Can it be aligned to other similar academic models e.g. GEMS, HFACS etc?	Understanding the link between fear/blame culture and a total lack of accountability is difficult. Understanding how the leaders behaviours affect/or not this is important for the evaluation i.e. does the leader ignore at risk behaviour or is it dealt with fairly, consistently and appropriately? Also what is the resulting impact on safety culture?						Who applies the process? How widely it is understood?	The effective implementation of such a model is more subjective to evaluate.	B2 B3 C1 C2
	Arrangements for recognition and reward those who have made a significant contribution to safety.	Award scheme, Evidence of awards	Reinforcement and recognition of safe behaviours.	Existence of an award scheme is easy to understand and evaluate. However the nature of the award scheme is more difficult.							Frequency, recipients, what issued for? Award type. How are people identified and selected for an award? How often are awards given?	Need to understand what good looks like	B2 C2
	Defined process for positive intervention which is communicated to all project members, with examples of positive interventions being carried out.	Positive intervention process, site induction, records/number of interventions	Don't walk by, walk the talk. Role of the leader is to set expectations, provide resource, monitor results.	Process and reports are OK.	What do positive interventions indicate culturally? What if they are not being reported? How can it be understood why it is working/not reported? Barriers etc?						Normalise the data by number of persons, How is this managed?	How will the quality of the reports be evaluated? Normalisation of data is important to give this context.	B4 C1 C3 C4
	Sharing the outcomes of accident, incidents and significant near miss investigations amongst all levels of the project.	Bulletins/alerts, records of briefings	Role of the leader is to set expectations, provide resource, monitor results. Focus on learning.	Relies on the quality of the investigation process to identify transferable lessons which may not be relevant in every incident. Method/Process for communication is easy to determine, the effectiveness is more subjective.	What is the significance for culture? How does this impact/be influenced by leaders' trust, fear, blame etc						Verification of communications and the process compliance is necessary. This is not currently included in the assessment tools.	How will this be measured? 'All' persons?	B3 C1 C2 C3 C4
View													

A4. Safety performance monitoring and re

The Personal Development Review Process will include a review of against the behavioural standards.	PDRs/Appraisals	Demonstration of reinforcement and review of desired behaviours - link to performance management.	Reliance on quality of records kept and generated by individuals. Occurrence/records should be readily available.	Consider whether the project timeline is simultaneous with the company appraisal process - will these be undertaken for every project? Does this matter?	X	X	X	Link to leadership for leaders reinforcing desirable behaviours, Goals setting etc	B1 B2 B4 C2
As part of the formal management review, safety data is reviewed to identify performance trends. An action plan to address these issues will be developed	Minutes of management review, action plans	Leadership commitment at a strategic level.	Easy to collect (i.e. whether they exist or not).	Demonstrates actual occurrence and attendance, does not degree of commitment in relation to other business aspects i.e. priority given to safety.	X	X	X	What does good look like?	B1
Each project provides visual safety performance data for employees and members of the supply chain.	Posters / noticeboards etc	Leadership provision of resources to enable feedback to occur.	Easy to collect (i.e. whether they exist or not).	Process for provision, also needs to account for frequency. Does not test whether the target audience have seen or read or acted upon the data.			X	What? Where?, how often updated?	B4

Component from the logic map	Information Context	Source of Information	Leadership Aspects	Reliability Comments	Validity Comments	Assessment Method				Assessment Criteria	General Comments and Considerations	Links
						Fact Sheets	PC Interviews	SC Interviews	Project Records	Employee Survey		
B1. Belief in leadership commitment to safety	All persons working on the project believe that leaders have credible commitment to safety.	Perceptions of project members	Belief in leaders commitment - walking the talk	How is leadership commitment demonstrated?	What makes individuals perceive commitment in different ways? What impact does this have on their decision making process, commitment to safety?		X	X		X	Assessed by employee survey perceptions. Comparison with intent of leaders from PC and SC interviews.	C2 C3 C4 D2
	Increased confidence in reporting of safety related events and non-compliances	Perceptions of project members	Leaders setting a positive example for learning and not a blame culture	Highly subjective but easy to collect perceptions	Need to understand the relationship between leadership and reporting culture. If there is fear for reporting safety related events what does this		X	X	X	X	Covered in audit and interviews as well as employee survey. Can these be triangulated?	C1 C3 C4 D1 D2
		Data	Resource and process for the collection of data and the follow up response (action and feedback)	Data is easy to collect.	Indication of learning and reporting processes in place. Reliant on appropriate culture to maintain reporting. What other commitment is		X	X	X	X	Is the project of sufficient duration to trend data sufficiently in relation to leadership commitment?	C1 C3 C4 D1 D3
B2. Role model safety leadership behaviour	Individuals actively challenge working methods, processes, communications and behaviours where they are not in accordance with the project safety goals and behavioural	'Challenge' data e.g. near miss, hazard, safety concern, positive intervention reports and inspection action items	How leaders enable 'challenges' to happen. Resources, process, commitment, leading by example etc	Data is easy to collect.	How many of the reports are generated from leaders and which from the workforce? What does this indicate? How are they related to the behavioural standards		X	X	X	X	How is this managed? Who provides the reports - leaders, managers, supervisors, workforce, other?	C1 C2 C3 C4 D1 D2
B3. Consistent response to incidents	Culpability model is applied consistently when managing safety related events.	Examples of application	Leaders application of the process to develop a fair and just culture - not blame.	Records of following process is easy. However depends on occurrence. Does not indicate when this should have been applied but was not.	Following the process is OK, but the context and implication for leadership is what happens not only during the process but also afterwards. Understand the		X	X	X		How are non-compliances addressed? What actions are taken?	C2 C3 C4 D2

B4. Feedback on safety performance	Each Project has a mechanism for the reporting of safety hazards from the workforce to Project Management.	Number of hazard cards	Resource and process for the collection of data and the follow up response (action and feedback)	Data is easy to collect.	What actions leaders take in response to the reports is important.	X	X	X	X	Normalise the data by number of persons and by role. Also how feedback is given and monitored.	Is this inclusive or exclusive of all parties? How is this managed?	C1 C3 C4
	All employees and members of the supply chain report of safety concerns.	Number of safety concerns raised	Resource and process for the collection of data and the follow up response (action and feedback)	Data is easy to collect.	What actions leaders take in response to the reports is important.	X	X	X	X	Normalise the data by number of persons and by role. Also how feedback is given and monitored. Proportion of safety events where this is used – severity? Actual or potential?	How is this managed?	C4
	Each project has a process to provide feedback on safety performance for employees and members of the supply chain.	Process, Feedback (e.g. email, reports)	Resource for process to be in place	Process is easy. Understanding whether the feedback process is effective is more difficult. How many times should feedback	Consider the proportion of safety v delivery (other) measures. Also who was involved as recipients?	X	X	X	X	Normalise the data by number of persons. Method of communication.	How widely it is understood? What impact does this have on individual's commitment to safety, reporting etc? How is	C2 ?

Component from the logic map	Information Context	Source of Information	Leadership Aspects	Reliability Comments	Validity Comments	Assessment Method					Assessment Criteria	General Comments and Considerations	Links
						Fact Sheets	PC Interviews	SC Interviews	Project Records	Employee Survey			
C1. Reduced accidents and incidents	Reduction in lagging indicators (accident and incident data)	AFR, AIR, FWI, LTI	Achievement of safety goals.	Consistency of records and reporting a concern.	Reactive measure/lagging indicator of safety performance widely accepted across the	X			X		Comparison of data over line and between participants.	Comparison and normalisation of data to be consistent	D1
C2. Increased visibility of safety leadership behaviours	Identification and recognition of safety leadership behaviours by individuals on the project.	Perceptions of project members	Understanding of what good safety leadership behaviours are.; then demonstrating these.	Many variables due to reliance on individuals. Definition of what good looks like is important.	What impact does this have on their decision making process, commitment to safety, reporting of events		X	X		X	Increased occurrence so need to understand what normal occurrence is.	Reliance on perceptions. This should be captured within assessment tools.	D2
C3. Increased invoking of refusal to work	Increased confidence to stop work for safety concerns without fear of retribution.	Records of refusals	Process and resources, monitoring of reports; plus subsequent actions taken. Indication of leadership	Consistency of records and reporting a concern. How is leadership impact recorded/evidenced as	Corrective actions being taken? What impact does this have on their decision making process,	X	X	X	X	X	Types of refusals. Reasons for refusals e.g. poor planning etc. Understand leadership aspect	Reliance on perceptions. This should be captured within assessment tools.	D1 D2
C4. Increased hazard and near miss reporting	Increase in leading indicators (near miss and hazard reports	Near miss, hazard, safety concern reports	Process and resources, monitoring of reports; plus subsequent actions taken. Indication of leadership	Consistency of records and reporting a concern. How is leadership impact recorded/evidenced as	Corrective actions being taken? What impact does this have on their decision making process,	X	X	X	X	X	Types of reports. Reasons for reports e.g. poor planning etc. Corrective action being taken?	Reliance on perceptions. This should be captured within assessment tools.	D1

Component from the logic map	Information Context	Source of Information	Leadership Aspects	Reliability Comments	Validity Comments	Assessment Method					Assessment Criteria	General Comments and Considerations
						Fact Sheets	PC Interviews	SC Interviews	Project Records	Employee Survey		
D1. Increased safety performance	Reduction in lagging indicators (accident and incident data). Increase in leading indicators (near miss and hazard reports).	AFR, AIR, FWI, LTI, Near miss and hazard reports. Inspection and audit non-compliances.	Achievement of safety goals.	Consistency of records and reporting a concern.	Measures of safety performance widely accepted across the industry.	X			X		Comparison of data between control and participant groups as well as between Principal Contractor Projects	What happens if it is 0?
D2. Increased safety culture maturity scores	Feeling that it is safe, yet continuously looking for weaknesses and opportunities to improve.	Perceptions	Achievement of safety goals.	Reliance on perceptions.	Measures of safety performance widely accepted across the other sectors.		X	X		X	Comparison of data between control and participant groups as well as between Principal Contractor Projects	Will the duration of the project allow for this to happen? It takes years not months?

Appendix 3 - Study 4 Principal Contractor/Subcontractor/Project Fact Sheet

Understanding Safety on Construction Projects Project Fact Sheet



Section A: Contact Information

Project _____

Project _____

Address _____

Contact Name _____ Role/Position _____

Email address _____ Mobile Number _____

Section B: About the Project

Q1 What is the project's main scope of work?

Abseiling	☐	Asbestos Removal	☐	Bridges	☐
Building work	☐	Civil works	☐	Cladding	☐
Contingent Labour	☐	Concrete works	☐	Demolition	☐
Drainage works	☐	Earthworks	☐	Electrical works	☐
Fencing	☐	Glazing	☐	Highway works	☐
Joinery	☐	Lifting and Jacking	☐	Lifts and escalators	☐
Mechanical works	☐	Painting	☐	Piling	☐
Plant hire	☐	Roofing	☐	Scaffolding	☐
Signalling	☐	Site Investigation	☐	Telecoms	☐
Track	☐	Traffic Management	☐	Vegetation Clearance	☐
Other (please state)	_____				

Q2 What type of project is this?

Design & build ☐ Construct only ☐ Other ☐

Other (please state) _____

Q3 What is the project value?

Q4 What is the project duration?

Q5 Please identify key project stakeholders

Principal Contractor _____

Client _____

Designer _____

Other significant third parties _____

Understanding Safety on Construction Projects

Project Fact Sheet

Q6 Will you use subcontractors on the project? Yes ☐ No ☐

If yes, how much of your work is delivered by subcontractors?

0-25% ☐ 26-50% ☐ 51-75% ☐ 75-100% ☐

Q7 What will be the typical organisational structure of the project?

One tier of subcontractors ☐ Three tiers of subcontractors ☐
Two tiers of subcontractors ☐ More than three tiers of subcontractors ☐

Q8 What provisions have been made for access to competent health and safety advice?

Internal person – full time role ☐ External consultant or similar ☐
Internal person – part time/shared role ☐ None ☐
Other (please state) _____

Q9 Will your company behavioural safety/safety culture improvement programme be applied on this project?

Yes ☐ No ☐

Q10 What measures do you use to assess the project safety performance?

AFR (Accident frequency rate) ☐ Drugs and alcohol screening tests ☐
AIR (Accident incident rate) ☐ Audits undertaken ☐
Lost time injury rate ☐ Safety tours completed ☐
Number of near misses reported ☐ Culture survey/ safety maturity ☐
Number of training days delivered ☐ None ☐
Other (please state) _____

Q11 Who is responsible for carrying out the following activities on the project? Tick as many as appropriate.

		Principal Contractor	Subcontractor	Other
A	Management communicating safety issues with the workforce			
B	Workforce acting safety and care for colleagues			
C	Issuing rewards for good safety performance			
D	Finding out the causes of accidents			
E	Prioritising safety			
F	Management of subcontractors			
G	Undertaking training			
H	Provision of expert safety advice			
I	Work planning and issuing permits to work			
J	Method statements and Risk Assessments			
K	Safety management system and procedures			
L	Accident and incident reporting and investigation			
M	Reporting unsafe acts, near misses and close calls			
N	Implementing action taken after a safety incident			
O	Daily safety checks and inspections			
P	Carrying out safety meetings			
Q	Audits			
R	Benchmarking and use of statistics			

Understanding Safety on Construction Projects

Project Fact Sheet

Q12 Here is a list of statements for 11 different areas of safety management. Each area has a number of statements; please tick those that you think describes safety on your project. Tick as many as appropriate.

Commitment to Safety	
	Managers tell everyone to work safely to avoid causing problems.
	After accidents, topical safety messages are sent down from management. Management interest in these topics reduces over time.
	There are frequent safety initiatives.
	Management communicate a lot of safety information to the workforce.
	Management talk but do not really listen.
	Everyone is involved in two way safety communications.
	Management frequently ask about the views of the workforce.
	There are good levels of feedback to management on safety matters.
	There are appropriate and timely communications following an incident.
	Individuals look after themselves.
	Individuals take risks, but don't worry as they believe they won't get caught.
	Following an accident everyone declares their commitment of caring for colleagues.
	Individuals are aware of the costs of safety failures which is shared through the project.
	Individuals talk positively about safety, but do not always act safely 100% of the time.
	The workforce are proud of their safety performance.
	The workforce are committed to improving safety performance.
	Everyone cares for one another as the norm.
	If there is a safety incident, everyone is affected by it.
	Individuals have passion for safety and are driven to make improvements.
	Making money is the only priority.
	Safety is seen to cost money.
	Money is spent on safety to ensure compliance with the law.
	Continuing project delivery is a priority.
	It is not clear the balance between safety and productivity.
	Management spend the majority of time dealing with operational issues.
	Safety measures are not always implemented if they cost money.
	Safety is made a priority as the importance of good safety performance for good business is understood.
	The project will accept delays where production time is taken to address safety concerns.
	It is believed that safety makes money so there is no need to balance safety and productivity.
	There are plans to develop project safety performance through investment in subcontractors.
Management of Contractors	
	Subcontractors are expected to get the job done with minimum effort and expense.
	Safety problems are the responsibility of the subcontractor.
	The most important issue when selecting a subcontractor is price, but poor safety performance has consequences for choosing subcontractors.
	Subcontractors have to meet extensive pre-qualification requirements, based on questionnaires and statistics.
	Subcontractors have to get up to the required safety standard using their own resources.
	Subcontractor pre-qualification requires proof that there is a working safety management system.
	The principal contractor helps with subcontractor training.
	No compromises are made for subcontractor safety capability.

Understanding Safety on Construction Projects

Project Fact Sheet

	Solutions to safety problems are found together with subcontractors.
Training	
	Safety training is delivered only to satisfy legal requirements.
	Individual training programmes are delivered.
	After an incident extra safety training is delivered but the effort decreases over time.
	Minimum safety training standards are in place.
	Knowledge gained from training is tested at the end of the course.
	Some training is delivered on the job.
	Knowledge and skills gained from training are tested on the job through assessments.
	Some training needs are identified by the workforce and reported to management.
	Inter-Personal skills are as important as technical knowledge e.g. Good briefing skills, intervention skills etc.
	Competence is seen as more than a training course.
Safety Performance	
	There are no rewards for good safety performance.
	There are often punishments for safety failures.
	There are often punishments for poor safety performance.
	Bonuses are reduced when there are accidents.
	Rewarding good safety is not common.
	Safety is promoted through quizzes, competitions etc with prizes for the winners.
	Bonuses are calculated using safety figures e.g. AFR, AIR, FWI
	Good safety performance is promoted.
	Individual performance appraisals include safety behaviours and compliance, as well as safety figures.
	Recognition of safety performance is given a high priority by all managers and supervisors.
	Everyone is motivated by good safety performance to continue to improve this further.
Safety Resources	
	There is one/or few people in the safety team.
	The safety team is small and viewed as having limited power and influence.
	The safety team is available as and when needed but stay very much in the background.
	The safety team are seen as a police force.
	The safety team is large and viewed as having some power and influence.
	The safety team focus on analysing statistics and safety data.
	Advice given by the safety team is appreciated by the project team.
	Senior management have safety qualifications.
	The safety team report direct to the project manager.
	Safety responsibilities are distributed across the project.
	The safety team is small and viewed as having power and influence.
Safety Procedures	
	There are few safety procedures.
	Safety procedures are seen as providing protection from prosecution and not adding value.
	The purpose of procedures is seen as preventing accidents.
	Safety procedures are often created after an accident.
	There are many safety procedures which are seen to hinder project delivery.
	Some safety procedures are replaced with reliance on individual training and competence.
	Safety procedures are seen as best practise.

Understanding Safety on Construction Projects

Project Fact Sheet

	Safety procedures are occasionally seen as inconvenient to project delivery.
	Management try to remove procedures that do not add value.
	Everyone is empowered to challenge safety procedures that do not add value.
	Non-compliance with safety procedures is reported to project management promptly.
	Safety procedures are continuously improved.
Safety Meetings	
	Safety meetings are seen as a waste of time.
	There are few safety meetings held on the project.
	Safety meetings are chaired by management.
	Safety meetings become a 'tick box' exercise to finish as quickly as possible.
	Safety meetings are poorly attended.
	Safety meetings are seen as a waste of time.
	Safety meetings are dominated by non-safety issues.
	Safety meetings are held regularly, but only amongst management.
	Safety meetings follow a strict agenda.
	Safety meetings feel like a genuine forum for interaction at all levels on the project.
	Safety is included on the agenda at every project meeting.
	The workforce hold their own safety meeting with management attending by invitation.
	Safety meetings are chaired by any individual working on the project.
	Safety meetings are short and focused on key priorities.
Safe Systems of Work	
	There are no or little risk assessments undertaken.
	Routine works are undertaken without risk assessments in place.
	Risk assessments are produced after there has been an accident.
	Risk assessments are completed for all work activities.
	The workforce accept risk assessments as standard practice.
	Managers, supervisors and workforce are involved in developing risk assessments for their work activities.
	There are frequent reviews and updates of risk assessments.
	There is no or little planning of safe system of work.
	There are some routine works undertaken without method statements in place.
	There is informal planning of safe systems of work, focused on getting the job done.
	There is a lot of emphasis on risk assessment.
	There is a lot of emphasis on permits to work.
	It is believed that the planning system works well and there is no need to improve.
	Safety and work planning are integrated within method statements and risk assessments.
	Supervisors and managers monitor compliance with the planned safe systems of work.
	Learning from previous incidents is built into the planning of safe systems of work.
	There is less focus on paperwork but more emphasis on thinking about safety.
Dealing with unsafe events	
	There are no near miss/close call reports.
	Reporting of hazards/near misses/close calls is simple and factual.
	Focus is on who or what causes this event to happen.
	There is no tracking of how near misses/close calls are closed out.
	Reported near misses/close calls are categorised for trend analysis.

Understanding Safety on Construction Projects

Project Fact Sheet

	The focus is on generating enough near miss/close call reports.
	There are KPI targets for near misses/close call reports on the project and/or per subcontractor.
	Management focus is on understanding why the near miss/close call happened.
	There is a swift reporting of near misses/close calls to project management.
	Management monitor the close out of actions following near miss/close call reports.
	There is good visibility of those near misses/close calls that have been reported across the project.
	Trends identified from near miss/close call reports are used to improve safety performance on the project.
	Safety incidents are not always reported.
	Investigations take place after there has been a serious incident.
	The focus of the investigation is to protect the principal contractor from prosecution.
	Investigations do not identify issues with human factors.
	There is adhoc and informal reporting of safety incidents.
	Investigations identify immediate causes of incidents.
	Investigations are recorded.
	There is little follow up on monitoring actions identified from investigations.
	There are extensive incident investigations which generate action plans for improvement.
	Remedial actions concentrate on training and updating safety systems of work, risk assessments etc.
	Those conducting investigations have received formal training.
	Monitoring of remedial actions is undertaken to ensure close out has taken place.
	Lessons learned from incidents are distributed across the project.
	There is little communication between the project and parent organisations to share lessons learned.
	There is trend analysis across multiple incidents and root causes to understand why safety incidents are happening.
	There are planned audits to check that remedial actions have made a positive impact on safety performance.
	Individuals are blamed for accidents.
	It is believed that all accidents are not preventable.
	Individuals involved in accidents are removed from the project.
	It is believed that accidents happen and are bad luck.
	The workforce are believed to cause accidents.
	Causes of accidents are understood to be a combination of machinery equipment failures, as well as people.
	The safety management system and procedures are viewed as the cause of accidents.
	The safety management system, the people and equipment are reviewed to understand the causes of accidents.
	Management take some responsibility for the accident.
	Management focus on trying to understand the root cause of an accident.
	A holistic view of the project safety arrangements is determine the influences of both people and processes.
	After an accident the focus is on the individuals involved.
	The priority is to recommence work activities as soon as possible.
	Project management are annoyed by stupid accidents.
	Incident reports are not all communicated through the project organisation to the project manager.
	Warning letters are issued by project management for poor safety performance.
	Management reaction to incidents is focused on the impact to the project safety statistics.
	Management are disappointed but concern over the wellbeing of the individuals is expressed.
	Investigation focuses on root causes.
	Investigation findings are communicated to supervisors on the project.
	Project management lead the incident response and talk directly to those involved.

Understanding Safety on Construction Projects

Project Fact Sheet

	Individuals take incidents involving others personally when working on the project.
Safety Monitoring	
	There is no formal requirement for checking safety on a daily basis.
	There is a reliance on the safety team to spot problems.
	Supervisors and managers complete safety inspections but on an ad hoc basis.
	There is no system for co-ordinating safety inspections.
	There is no system for monitoring close out of safety inspections.
	There are regular safety inspections undertaken by a number of roles across the project.
	Inspections focus on compliance with safety requirements and procedures.
	Supervisors encourage work teams to check safety for themselves.
	Management undertaking inspections are viewed as sincere and genuinely committed to safety.
	There are inter-discipline/subcontractor/role joint inspections undertaken.
	There is a process for everyone to check and report safety hazards on a daily basis.
	There are few management inspections undertaken.
	Safety audits are rarely undertaken.
	Safety audits only occur after an incident.
	Safety audits are undertaken based on a pre-determined schedule.
	Management are focused on the project position in 'league tables'.
	Audits focus on the immediate causes of accidents.
	There are regular safety audits undertaken focused on significant project risks.
	Receiving an audit is not welcomed by managers/supervisors.
	Audits are structured on the safety procedures and project management system requirements.
	There is an extensive safety audit programme.
	Auditors are welcomed by managers/supervisors as it is recognised that outside help is an advantage.
	Audits are seen as positive, even though they are painful.
	Safety audits are routinely monitored for close out of non-conformities.
	Audits focus on behaviours as well as equipment and safety procedures/systems.
	Statutory reporting is complied with.
	There are no additional safety KPI.
	Management are focused on the project position in 'league tables'.
	KPIs focus on the immediate causes of accidents.
	Lagging safety indicators are used on the project.
	The project safety data is compared with other industry benchmarking information.
	Management display lots of performance data on the project.
	KPIs inform progress on addressing current safety problems.
	Management strive to have the best safety in the industry.
	Leading safety indicators are used on the project.
	Trend analysis is undertaken to inform safety improvement strategies.
	Benchmarking is undertaken outside of the industry.
	Everyone is involved in identifying action points for improvement across the project.

Q13 Are there any further details regarding project safety arrangements that are relevant?

Appendix 4 – Study 4 Principal Contractor/Subcontractor/Project Initial Interview

Understanding Safety on Construction Projects Project Initial Interview



Section A: Contact Information

Project _____
Contact Name _____ Role/Position _____
Email address _____ Mobile Number _____

Section B: Project Safety Arrangements

In this section we ask you about the project safety arrangements for 10 areas: B1 to B10.

Section B1: Commitment to Safety

- Q1 Please describe how you communicate to employees about safety and involve them in safety.
Q2 What information is communicated?
Q3 How often does this communication take place?
Q4 Are managers expected to visit worksites to discuss safety?
Q5 Please describe how workforce are expected to demonstrate their commitment to safety.
Q6 How would you describe typical safety behaviours on this project? E.g. adhere to rules, short cuts, attitude
Q7 What are the objectives on this project?
Q8 What are the safety objectives on this project?

Section B2: Safety Performance

- Q9 Does the project provide punishment for poor safety performance?
Q10 Does the project provide reward for good safety performance?

Section B3: Management of Contractors

- Q11 What is your process for selecting contractors to work?
Q12 Please describe your safety expectations for contractors working on your behalf.
Q13 How do you monitor and manager that contractors are meeting your safety expectations?

Section B4: Training

- Q14 What safety training do you provide for managers?
Q15 What safety training do you provide for supervisors?
Q16 What safety training do you provide for the workforce?
Q17 What is the attitude to training?

Section B5: Project Safety Resources

- Q18 What arrangements are made for access to competent safety advice?
Q19 What are the line management and reporting arrangements for the safety representative(s)?
Q20 What is the role of the safety representative(s)?

Understanding Safety on Construction Projects

Project Initial Interview

Section B6: Safety Procedures

Q21 How does the project value the safety management system; procedures and rules?

Section B7: Safety Meetings

Q22 What are the arrangements for safety meetings?

Q23 Who attends the safety meetings?

Q24 What topics are discussed at safety meetings?

Section B8: Safe Systems of Work

Q25 Who undertakes risk assessments and safe systems of work planning?

Q26 What arrangements does the project have for planning safety in work activities?

Q27 How would you describe the workforces approach to safe systems of work?

Q28 How would you describe workforce involvement in safe system of work?

Section B9: Dealing with unsafe events, including accidents and incidents

Q29 How would you describe the project approach to managing unsafe events?

Q30 What safety related events are employees encouraged to report?

Q31 Please describe the process for reporting accidents and incidents and other safety events.

Q32 Please describe the process for reporting and investigating accidents and incidents.

Q33 What is the general response to accidents/incidents etc?

Section B10: Safety Monitoring

Q34 Please describe the arrangements for monitoring safety.

Q35 How often are these checks carried out?

Q36 Who is responsible for carrying out the monitoring?

Section C: Successes and Challenges

Q37 What are the safety successes within on this project?

Q38 What are the greatest safety challenges within on this project?

Q39 How do you know that you are keeping the workforce safe?

Q40 What are the focus areas/objectives for the project to improve health and safety?

Appendix 5 – Study 4 Project Management Assessment

Understanding Safety on Construction Projects

Project Management Assessment

Section A: Contact Information

Project _____

Project _____

Address _____

Contact Name _____ Role/Position _____

Email address _____ Mobile Number _____

Section B: About the Project

Q1 Here is a list of statements for 11 different areas of safety management. Each area has a number of statements; please tick those that you think describes safety on your project. Tick as many as appropriate.

Commitment to Safety	
	Managers tell everyone to work safely to avoid causing problems.
	After accidents, topical safety messages are sent down from management. Management interest in these topics reduces over time.
	There are frequent safety initiatives.
	Management communicate a lot of safety information to the workforce.
	Management talk but do not really listen.
	Everyone is involved in two way safety communications.
	Management frequently ask about the views of the workforce.
	There are good levels of feedback to management on safety matters.
	There are appropriate and timely communications following an incident.
	Individuals look after themselves.
	Individuals take risks, but don't worry as they believe they won't get caught.
	Following an accident everyone declares their commitment of caring for colleagues.
	Individuals are aware of the costs of safety failures which is shared through the project.
	Individuals talk positively about safety, but do not always act safely 100% of the time.
	The workforce are proud of their safety performance.
	The workforce are committed to improving safety performance.
	Everyone cares for one another as the norm.
	If there is a safety incident, everyone is affected by it.
	Individuals have passion for safety and are driven to make improvements.
	Making money is the only priority.
	Safety is seen to cost money.
	Money is spent on safety to ensure compliance with the law.
	Continuing project delivery is a priority.
	It is not clear the balance between safety and productivity.
	Management spend the majority of time dealing with operational issues.
	Safety measures are not always implemented if they cost money.

Understanding Safety on Construction Projects

Project Management Assessment

	Safety is made a priority as the importance of good safety performance for good business is understood.
	The project will accept delays where production time is taken to address safety concerns.
	It is believed that safety makes money so there is no need to balance safety and productivity.
	There are plans to develop project safety performance through investment in subcontractors.
Management of Contractors	
	Subcontractors are expected to get the job done with minimum effort and expense.
	Safety problems are the responsibility of the subcontractor.
	The most important issue when selecting a subcontractor is price, but poor safety performance has consequences for choosing subcontractors.
	Subcontractors have to meet extensive pre-qualification requirements, based on questionnaires and statistics.
	Subcontractors have to get up to the required safety standard using their own resources.
	Subcontractor pre-qualification requires proof that there is a working safety management system.
	The principal contractor helps with subcontractor training.
	No compromises are made for subcontractor safety capability.
	Solutions to safety problems are found together with subcontractors.
Training	
	Safety training is delivered only to satisfy legal requirements.
	Individual training programmes are delivered.
	After an incident extra safety training is delivered but the effort decreases over time.
	Minimum safety training standards are in place.
	Knowledge gained from training is tested at the end of the course.
	Some training is delivered on the job.
	Knowledge and skills gained from training are tested on the job through assessments.
	Some training needs are identified by the workforce and reported to management.
	Inter-Personal skills are as important as technical knowledge e.g. Good briefing skills, intervention skills etc.
	Competence is seen as more than a training course.
Safety Performance	
	There are no rewards for good safety performance.
	There are often punishments for safety failures.
	There are often punishments for poor safety performance.
	Bonuses are reduced when there are accidents.
	Rewarding good safety is not common.
	Safety is promoted through quizzes, competitions etc with prizes for the winners.
	Bonuses are calculated using safety figures e.g. AFR, AIR, FWI
	Good safety performance is promoted.
	Individual performance appraisals include safety behaviours and compliance, as well as safety figures.
	Recognition of safety performance is given a high priority by all managers and supervisors.
	Everyone is motivated by good safety performance to continue to improve this further.
Safety Resources	
	There is one/or few people in the safety team.
	The safety team is small and viewed as having limited power and influence.
	The safety team is available as and when needed but stay very much in the background.
	The safety team are seen as a police force.
	The safety team is large and viewed as having some power and influence.
	The safety team focus on analysing statistics and safety data.

Understanding Safety on Construction Projects

Project Management Assessment

	Advice given by the safety team is appreciated by the project team.
	Senior management have safety qualifications.
	The safety team report direct to the project manager.
	Safety responsibilities are distributed across the project.
	The safety team is small and viewed as having power and influence.
Safety Procedures	
	There are few safety procedures.
	Safety procedures are seen as providing protection from prosecution and not adding value.
	The purpose of procedures is seen as preventing accidents.
	Safety procedures are often created after an accident.
	There are many safety procedures which are seen to hinder project delivery.
	Some safety procedures are replaced with reliance on individual training and competence.
	Safety procedures are seen as best practise.
	Safety procedures are occasionally seen as inconvenient to project delivery.
	Management try to remove procedures that do not add value.
	Everyone is empowered to challenge safety procedures that do not add value.
	Non-compliance with safety procedures is reported to project management promptly.
	Safety procedures are continuously improved.
Safety Meetings	
	Safety meetings are seen as a waste of time.
	There are few safety meetings held on the project.
	Safety meetings are chaired by management.
	Safety meetings become a 'tick box' exercise to finish as quickly as possible.
	Safety meetings are poorly attended.
	Safety meetings are seen as a waste of time.
	Safety meetings are dominated by non-safety issues.
	Safety meetings are held regularly, but only amongst management.
	Safety meetings follow a strict agenda.
	Safety meetings feel like a genuine forum for interaction at all levels on the project.
	Safety is included on the agenda at every project meeting.
	The workforce hold their own safety meeting with management attending by invitation.
	Safety meetings are chaired by any individual working on the project.
	Safety meetings are short and focused on key priorities.
Safe Systems of Work	
	There are no or little risk assessments undertaken.
	Routine works are undertaken without risk assessments in place.
	Risk assessments are produced after there has been an accident.
	Risk assessments are completed for all work activities.
	The workforce accept risk assessments as standard practice.
	Managers, supervisors and workforce are involved in developing risk assessments for their work activities.
	There are frequent reviews and updates of risk assessments.
	There is no or little planning of safe system of work.
	There are some routine works undertaken without method statements in place.
	There is informal planning of safe systems of work, focused on getting the job done.

Appendix 6 – Employee Survey

Understanding Safety on Construction Projects

Employee Survey Questionnaire



You are invited to take part in a research study. Before you decide whether to take part it is important for you to understand why the research is being done and what it will involve. Please read the following information carefully, discuss it with others if you wish and take time to decide whether or not you wish to take part.

If you would like more information or have any questions please contact Shelley Stiles at the University of Nottingham. Email: eaxsls@nottingham.ac.uk Tel: 07791 633143

This survey forms part of a wider research project seeking to gain a better understanding of safety on construction projects, to improve safety performance. This project is participating in the research and therefore we request that you complete this questionnaire.

The research will be evaluated and findings may be published in academic journals and industry publications; which will not name you as a participant or contain any information that will enable you to be identified as a participant. A summary report for this project will be provided to the project management team. Participants will not be identified in any report or publication.

All questionnaires are anonymous, your name is not being included on the forms. All completed questionnaires provided directly to the researcher in a sealed envelope maintaining 100% confidentiality. The researcher will collate and analyse the data as part of the research.

All information which is collected about you during the course of the research will be kept strictly confidential. Our procedures for handling, processing, storage and destruction of your data are compliant with the Data Protection Act 1998. All data from the trial will be kept by us for five years, in line with the University of Nottingham's data storage policy, after this time it will be destroyed.

To complete the questionnaire, please read the questions and tick the most appropriate answer(s). If you do not wish to answer any of the questions included in the survey, you may skip them and move on to the next question.

Please tick as appropriate

I have been invited to participate in research for understanding safety on construction projects. I have read the foregoing information and had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I agree for this questionnaire to be included in the research. ☐

Information about you

Q1. Who do you work for?

Principal Contractor ☐ Contractor ☐ Other ☐

If other please state

Q2. What is your job role?

Project/Site Management ☐ Site Supervisor ☐ Operative ☐ Support Function ☐ Other ☐

Q3. How long have you been on this project?

Less than 1 week ☐ Less than a month ☐ 1-6 months ☐ 6-12 months ☐ More than 12 months ☐

Q4. How long have you worked in the construction industry?

Less than 1 year ☐ 1-5 years ☐ 5 – 10 years ☐ 10-20 years ☐ More than 20 years ☐

Understanding Safety on Construction Projects

Employee Survey Questionnaire

Questions about safety on this project

We would like to know what you think about safety on this project.

Q5. How would you describe the project's safety performance?

Above average ☐ Average ☐ Below average ☐ Other ☐

Q6. Answer the following statements for this project

- A** Safety is more important than getting the job done
- B** Safety is more important than making money
- C** Senior Managers are committed to health and safety
- D** Safety issues are always brought to my attention
- E** Managers would never expect me to break safety rules to get the job done
- F** Supervisors would never expect me to break safety rules to get the job done
- G** I would be supported for stopping work for safety concerns
- H** Site Management act quickly to respond to safety concerns
- I** I'm always stopped by someone if I am not working safely
- J** I would stop work that I thought was unsafe
- K** I am regularly involved in safety decisions relating to my work activity

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Don't Know

Q7. If you could change one thing to improve safety on this project, what would it be?

Understanding Safety on Construction Projects

Employee Survey Questionnaire

Questions about safety in your company

We would like to know what you think about safety in your company.

Q8. How would you describe your safety in your company?

Above average ☐ Average ☐ Below average ☐ Other ☐

Q9. Answer the following statements for your company

- A** Safety is more important than getting the job done
- B** Safety is more important than making money
- C** Senior Managers are committed to health and safety
- D** Safety issues are always brought to my attention
- E** Managers would never expect me to break safety rules to get the job done
- F** Supervisors would never expect me to break safety rules to get the job done
- G** I would be supported for stopping work for safety concerns
- H** The company acts quickly to respond to safety concerns
- I** I'm always stopped by someone if I am not working safely
- J** I would stop work that I thought was unsafe
- K** I am regularly involved in safety decisions relating to my work activity

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Don't Know

Q10. If you could change one thing to improve safety in your company, what would it be?

Understanding Safety on Construction Projects

Employee Survey Questionnaire

Questions comparing safety for your company and this project

We would like to you to compare your company's approach to safety on this project.

Q11. How would you compare safety on this project with that of your company?

My company's safety is better ☐ Both about the same ☐ This project's safety is better ☐ Other ☐

Please explain your answer (if your company is better -why? if the project is better – why?)

Q12. What are the biggest problems affecting safety on this project? Tick as many as appropriate.

- | | |
|--------------------------|---|
| ☐ | Managers are only committed to getting the job done |
| ☐ | Managers are only committed to saving/making money |
| ☐ | Safety is not important to the site supervisors |
| ☐ | Managers do not listen when I raise safety concerns |
| ☐ | I am never involved in developing the safe system of work for my activity |
| ☐ | I am rarely stopped if I am found working unsafely |
| ☐ | There is poor planning for safety here |
| ☐ | The safety advisor/manager is poor |
| ☐ | Other (please list below) |

Thank you for taking time to complete this questionnaire.

Appendix 7 - Study 4 Project Follow Up Interview

Understanding Safety on Construction Projects

Project Follow Up Interview



Section A: Contact Information

Project _____

Project _____

Address _____

Contact Name _____ Role/Position _____

Email address _____ Mobile Number _____

Section B: Follow Up Questions

Questions	Yes	No	N/A
Q1 Have there been changes to your projects main scope of work?			
Q2 Have there been changes to the project duration and/or programme?			
Q3 Have there been changes to how many people are working on the project?			
Q4 Have there been changes to your use of subcontractors?			
Q5 Have there been changes to your access to competent health and safety advice?			
Q6 Have there been changes to your safety management systems accreditations to a recognised standard?			
Q7 Have there been changes to your approach to improving behavioural and cultural safety?			
Q8 Have there been any other changes which may have impacted on the project safety culture? <i>(please state)</i>			

Q9 What is your project safety performance measured using AFR (accident frequency rate)? *Please tick*

Below 0.1 Above 0.1

AFR= $\frac{\text{Number of reportable accidents} \times 100,000}{\text{Total number of hours worked}}$

Understanding Safety on Construction Projects

Project Follow Up Interview

Section C: Project Safety Arrangements

In this section we would like to know if there have been any changes regarding the Project Safety Arrangements.

Q10 Who is responsible for carrying out the following activities on the project? Tick as many as appropriate.

		Principal Contractor	Subcontractor	Other
A	Management communicating safety issues with the workforce			
B	Workforce acting safety and care for colleagues			
C	Issuing rewards for good safety performance			
D	Finding out the causes of accidents			
E	Prioritising safety			
F	Management of subcontractors			
G	Undertaking training			
H	Provision of expert safety advice			
I	Work planning and issuing permits to work			
J	Method statements and Risk Assessments			
K	Safety management system and procedures			
L	Accident and incident reporting and investigation			
M	Reporting unsafe acts, near misses and close calls			
N	Implementing action taken after a safety incident			
O	Daily safety checks and inspections			
P	Carrying out safety meetings			
Q	Audits			
R	Benchmarking and use of statistics			

Q11 What are the lessons you have learned from applying the interventions?

Q12 Please describe the project arrangements for safety leadership.

Q13 How would you rate the effectiveness of the safety leadership on this project?

N/A ☐ Don't know ☐ Poor ☐ Fair ☐ Good ☐ Excellent ☐

Understanding Safety on Construction Projects
Project Follow Up Interview

Q14 Please describe the project arrangements for workforce engagement.

Q15 How would you rate the effectiveness of the workforce engagement on this project?

N/A ☐ Don't know ☐ Poor ☐ Fair ☐ Good ☐ Excellent ☐

Section D: Project Safety Successes and Challenges

Q16 How would you describe subcontractor's safety performance?

Above average ☐ Average ☐ Below average ☐ Other ☐

Q17 How would you describe the Principal Contractor's safety performance?

Above average ☐ Average ☐ Below average ☐ Other ☐

Q18 How would you describe the safety on this project?

Above average ☐ Average ☐ Below average ☐ Other ☐

Q19 What continuous improvement actions were undertaken that added most value on the project to improve health and safety?

Q20 What continuous improvement actions were undertaken that added least value on the project to improve health and safety?
