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Using Stakeholder Theory to Explain the Development and Operation of Safety Culture and Systems to Improve Safety Performance in the Construction Industry in Saudi Arabia

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Abstract

Project management in the Saudi Arabian construction industry is an activity complicated by the current widespread lack of a mature organisational safety culture, which results in a high incidence of serious and fatal accidents, making it difficult to deliver project objectives. The thesis addresses this major problem. In Saudi Arabia, the General Organization for Social Insurance (GOSI) released a report on the number of work-related fatalities, injuries, and disabilities for 2009-2010. There were 85,624 serious workers' compensation claims and 587 fatalities compensated for (GOSI 2009-2010).

The construction industry has the highest number of accidents in Saudi Arabia, with 50.2% of all compensation cases related to construction. Such a high accident rate is not acceptable. Human resources are too valuable to waste through avoidable incidents. It is imperative, therefore, to identify factors and establish policy frameworks that can reduce the number of accidents.

The main causes of these accidents have been linked directly to pressures from management. Inconsistencies in policies, standards, quality control, training and knowledge dissemination all impact workforces negatively, as do financial restrictions, lack of interaction between workers, the workplace environment, equipment and materials (Charles *et al.* 2007; Gibb *et al.* 2006). Accidents have also been indirectly linked to human behaviour, social pressure, attitudes to risk taking, trade customs, financial pressure and industry traditions (Charles *et al.* 2007).

For many years, researchers around the globe have investigated the causes of the high level of accidents in the construction industry. In Saudi Arabia, they have grappled with the problem of understanding the 'safety' or 'accident' phenomenon, and have failed to identify the causes of the high number of accidents, or to determine the barriers that prevent individual workers, companies, and the government from improving safety.

Despite the growing body of literature on safety culture in the construction industry, it is still widely recognised that the empirical validation of stakeholder involvement in safety culture at the level of senior management is limited. Senior management contribution to safety performance has rarely been studied, and the connections between top management's actions and their objectives in relation to safety performance appear to have been neglected.

This research is therefore an attempt to verify the causal relationships and interactions between stakeholder involvement, safety culture, and safety performance in the construction industry, thus providing a better understanding of their interaction which, in turn, may improve safety. To achieve this objective, a conceptual model was developed to enable empirical research via responses to a questionnaire distributed to the three different types of project – small, medium, and large – that comprise the Saudi construction industry. A total of 384 valid responses was received.

The results were analysed by means of various statistical methods, including inferential statistics. The proposed model was validated using reliability analysis, construct validity, confirmatory factor analysis, and structural equation modelling.

The qualitative findings confirmed the significance of stakeholder involvement in enforcing and influencing a positive safety culture, and revealed certain safety issues specific to Saudi Arabian construction projects. Furthermore, the results show that in the context of the Saudi construction industry, a stakeholder's involvement is positively associated with an organisation's safety attitudes, management safety practices, the effectiveness of the safety management system, and safety performance.

The model provided in this study is a systematic approach to assess the safety culture of construction organisations and to guide them in self-assessments. The research contributes to the literature pertaining to assessments of stakeholder involvement and safety culture. Furthermore, it offers a valuable tool to government bodies and regulatory agencies for assessing their efforts in improving safety culture.

Using Stakeholder Theory to Explain the Development and Operation of Safety Culture and Systems to Improve Safety Performance in the Construction Industry in Saudi Arabia

Introduction

1.1 Focus of the thesis

This study explores the extent to which stakeholders endorse a positive safety culture on Saudi Arabian construction projects. In recent years, *stakeholder theory* has become a commonly accepted management theory for framing an organisation's strategies, yet little is known about how primary and secondary stakeholders may influence the safety culture of a construction project. Even so, the stakeholders are expected to contribute to (Newcombe 2003; Smith, J & Love 2004), and influence, the development of that project (Chinyio & Olomolaiye 2009). Despite this expectation, there is still a large gap in the general conceptualisation of a safety culture in a construction project, due to both a lack of agreement on what 'safety' means and a lack of integration into accepted models of business operation.

The interaction between stakeholder theory and safety culture in balancing responsibilities and preventing injury or loss of life are obvious and significant. However, the types of interaction between the stakeholders, theories of relationships and safety culture that could provide a positive safety outcome are not very well developed in Saudi Arabian construction projects. No conceptual model has been produced to explain the relationships between stakeholder involvement and safety culture. This study addresses this shortcoming.

This research was an attempt to verify the causal relationships between stakeholder involvement, safety culture, and safety performance in the construction industry, thus providing a greater understanding of their interaction which, in turn, will facilitate safety improvement. To achieve this outcome, a conceptual model was hypothesised and empirically tested using information gathered via a questionnaire survey covering the main attributes of construction safety culture.

Stakeholders can be defined as 'any group or individual who can affect, or is affected by, the achievement of the organisation's objectives' (Freeman 1984, 2010). Chinyio and Olomolaiye (2009) argue that stakeholders can influence an organisation's goals, activities, improvement, and functions.

Safety culture in the construction industry can be defined as

> *the product of individual and group behaviours, attitudes, norms and values, perceptions, and thoughts that determine the commitment to, and style and proficiency of, an organization's system and how its personnel act and react in terms of the company's on-going safety performance in construction site environments. (Choudhry, R et al. 2007b, p. 211)*

According to Freeman *et al.* (2010), stakeholder involvement is growing and inevitable in decisions relating to issues of health and safety, and the reasons may be attributable to growing expectations for accountability and transparency, a greater desire for participation by stakeholders, or a decline in public trust.

1.2 Background to the research

The construction industry contributes significantly to a nation's economic growth, which can be in part measured by development projects, such as roads, bridges, and buildings. The success of these projects is therefore a concern to stakeholders and governments (Wibowo 2009). The construction industry differs from other industries due to its fragmented structure, diffused responsibility, prototypical nature, the influences of interest groups, a transient and itinerant labour force, and a lack of research and development (Jaafari 1996). Construction projects frequently involve different phases of activities, various processes, and different parties. Thus, the level of success in carrying out a construction project will depend greatly on the quality of the organisation's resources, management, and finance.

People become involved in construction projects in order to manage and meet the requirements of a project, and to deliver its objectives. Sometimes that involvement leads to accidents, with the possible pain and suffering of a serious injury. In Saudi Arabia, for example, in 2009-2010, there were 85,624 serious workers' compensation claims for work-related injuries and 587 fatalities compensated for (GOSI 2009-2010).

These numbers reflect the fact that the construction industry has the highest number of accidents in Saudi Arabia. Table 1.1 shows that 50.2% of all compensation cases are related to construction. Such a high accident rate is simply not acceptable. Since human beings are the most valuable resources in construction, it is crucial not only for the construction industry, but for society as a whole, to identify factors and establish policy frameworks that can reduce the number of construction accidents.

Table 1.1 Serious claims: number and percentage of total by industry, 2009-2010 (Adapted from GOSI, 2011)

Industry	Local	Non-local	Total	%
Agriculture and Fishing	67	761	828	1.0%
Mines and Petroleum	465	902	1367	1.6%
Manufacturing	2180	13274	15454	17.9%
Electricity	496	1111	1607	1.9%
Construction	731	42577	43308	50.2%
Trade	1042	15897	16939	19.6%
Money and Property	104	1962	2066	2.4%
Social Services	301	2584	2885	3.3%
Post and Telecommunications	193	1564	1757	2.0%
Total			**86211**	100%
	2009-2010			
	1430H			

In Saudi Arabia, the impact of accidents in the construction industry has been well documented since 2003 by the General Organization for Social Insurance (GOSI) (GOSI 2009-2010). The general impact of accidents, safety, and health include the following:

- financial implications for the country, companies, and individuals
- loss of employee morale
- psychological consequences for individuals, families, and colleagues
- pain, suffering or death resulting in incalculable consequences to the country, the company, to the individual, families, and society at large.

The construction industry in Saudi Arabia has continued to suffer from a consistently high accident rate. Table 1.2 shows that there has been no significant improvement in the rate since the turn of the century.

Table 1.2 The number of workers and accidents in the construction industry in Saudi Arabia, 2006-2010 (Adapted from GOSI, 2011)

Construction industry	Number of workers	Number of accidents
2006-2007	1,055,496	37,427
2007-2008	1,248,774	38,929
2008-2009	1,410,517	44,430
2009-2010	1,599,903	43,308

Workplace incidents on project sites have a major impact on projects and organisations through loss of productivity, absenteeism, labour turnover, medical expenses, plant or equipment loss, fines and legal expenses, public image, and other losses (Tang *et al.* 2004).

Some of the main causes of those accidents have been linked directly to pressure from management, and involve such diverse areas as policies, standards, financial restrictions, lack of safety commitment, restricted training, knowledge and information, poor quality control, lack of interaction between workers within the workplace, and equipment and materials (Charles *et al.* 2007; Gibb *et al.* 2006). The accidents have also been linked indirectly to behaviours, social pressures, and attitudes to risk taking, to trade customs, financial pressure, and industry tradition (Charles *et al.* 2007).

Workplace safety accidents can be prevented through effective safety management, but the same type of accidents periodically recur in industry because industry fails to learn from previous incidents, and does little to prevent them from recurring (Lingard & Rowlinson 2005). Senior management also makes inappropriate decisions when there is a lack of reliable and complete assessment from the beginning of a project, which could eventually be a threat to the survival of an organisation (Badri *et al.* 2011).

Accidents occur within the construction industry due to a failure of one or more indirect and/or direct factors amongst the following:

- management loss of control and a chain of loss events (Bird, Frank E & Loftus 1976)
- failure of management systems
- loss of motivation
- inappropriate training and instruction provided by senior management (Leather 1987)
- company policy failure
- project management failure
- site management failure
- individual failure (Whittington *et al.* 1992)
- distractions by hazards
- worker stress (Hinze, JW 1996)
- non-compliance with safety rules

- hazards
- loss of control (Rasmussen *et al.* 1994)
- failures caused by management decisions (Reason, JT 1997)
- a failure in the interaction between worker and team work, workplace issues, and materials and equipment (Haslam, RA *et al.* 2005).

In the case of Saudi Arabia, accidents in construction workplaces occur because of the failure of one or more of the following:

- no clear links between safety and engineering and between safety and risk management
- a lack of safety and security planning
- workers who do not follow basic safety regulations. (Almahmoud *et al.* 2012)
- the lack of knowledge or skills
- a conflict between safety rules and practical applications
- unsafe personal choices
- other personal factors
- cultural barriers to safety
- ineffective management systems
- inappropriate rewards
- improper facilities and equipment
- and improper or inefficient feedback (Al-Kudmani 2008).

A poor level of safety culture was identified as the most common contributing factor to major accidents (IAEA 1992). Because safety culture has a dynamic combination of management attitudes and activities, employee behaviour, and site environment (Choudhry, R *et al.* 2007b), a better understanding of safety culture will help organisations improve their safety performance and workplace safety (Blockley 1996).

1.3 The research problem

Since 1959, several theories of accident causation have evolved in an attempt to explain why accidents occur. The most widely known theories and models of accident causation are:

- the domino theory (Heinrich 1959)
- Leather's potential accident subject model (Leather 1987)
- project management accident model (Whittington *et al.* 1992)
- distractions theory (Hinze, JW 1996)
- Rasmussen's work behaviour model (Rasmussen *et al.* 1994)
- the Swiss Cheese model (1997)
- the ConCA model (Haslam, R *et al.* 2005).

These researchers have variously determined that accidents occur in construction workplaces because of a failure of one or more indirect and/or direct factors: management characteristics, human variables, and hazard aspects.

In 1986, the concept of a poor safety culture was introduced as a contributing factor to the Chernobyl disaster. Since then, the idea of a safety culture has increasingly become a part of academic literature. Cooper (1998) argues that an organisation's safety culture influences not only accident rates, but also reflects quality, productivity, absenteeism, commitment, loyalty, work methods, and work satisfaction. Safety culture is often a factor in better outcomes (Cipolla *et al.* 2005). Thus, improving an organisation's safety culture is considered to be one way to improve safety performance and achieve better overall organisational performance (Fang *et al.* 2006).

Although the safety culture concept has been widely used for many decades by academics and practitioners, the actual nature of a safety culture is not precisely clear. According to Choudhry, R *et al.* (2007a), there is a major limitation to the concept of a safety culture since no accepted model of safety culture exists. This is due to both a lack of agreement, and the lack of its integration into general models of organisational culture (Edwards, JRD *et al.* 2013). Edwards, JRD *et al.* (2013) has pointed out, however, that there does exist a synthesised conceptualisation of safety culture, which includes practices and activities, behaviours and attitudes, policies and procedures, and safety performance. This conceptualisation provides a useful starting point for discussion regarding the nature of safety culture, yet still needs a clear justification of its indicators and a conformity analysis to validate the model. Furthermore, safety outcome as safety performance needs more in-depth studies to distinguish between leading indicators and lagging indicators, in order to understand the effect of safety culture on those indicators. The current research presents a comprehensive conceptual model of safety culture to fill this gap.

In Saudi Arabia, some studies have found that there is a weakness in enforcement, or even a complete lack of enforcement, by the owner, contractor, management, or any government authority (Jannadi, A 2008; Jannadi, O & Bu-Khamsin 2002); and poor engagement among designers, architects, planners and coordinators of the projects (Tam *et al.* 2004) in pursuing occupational safety. But the positions of these stakeholders within construction industries are designed to make a valuable contribution (Newcombe 2003; Smith, J & Love 2004), and they are able to influence all aspects of a project (Chinyio & Olomolaiye 2009). Therefore, Parmar *et al.* (2010) suggest that, because stakeholder theory has had a significant impact on academic literature and businesses, both academics and managers need to employ it in order to rethink traditional ways of conceptualising organisational responsibilities.

According to Greenwood and Freeman (2011), stakeholder theory is important for a number of reasons. Firstly, it does not separate the logic of business from human or ethical logic, because all workers are stakeholders and as stakeholders are human beings. Secondly, in any business model, workers often form the core meaning of that model. Therefore, business models have been defined by stakeholder theory as:

> *how an organization makes customers, suppliers, employees, communities and financiers better off, and how making one better off makes the others better off (Greenwood and Freeman 2011, p. 276).*

and defines the purpose, principles and the relationship of the organisation to society. Stakeholder theory suggests that this needs to be a shared process where workers are at the centre, and involved.

In the current research, stakeholder theory and thinking has been adopted and conceptualised with the safety culture model in order to understand the relationship between the stakeholder and safety culture in the construction industry, and discusses the usefulness of their interaction in finding a balance between responsibilities and the prevention of loss.

1.4 Research questions and objectives

The research described in this thesis sought to answer the following research questions:

Q1 *What is the nature of stakeholders' involvement in improving safety culture? (Strong: directive / controlling = Law) or (Weak: loosely involved)*

Q2 *To what extent do stakeholders' influence and enforce the organisation's approach to improving safety?*

Q3 *What are the impacts of stakeholders' involvement, of safety culture, and of safety management system on safety performance?*

Q4 *What are the essential behaviours and attitudes required for effective safety on construction sites?*

The main aims of the research were to determine empirically the extent to which stakeholder involvement impacts on safety culture and safety performance, and the nature of this involvement, along with developing a model that could help to assess the extent of this involvement within the Saudi Arabian construction industry. In the light of this, the following objectives were identified:

- examine the contextual influences, cultural, institutional legal, and economic on safety culture within the construction industry in Saudi Arabia
- identify how stakeholder involvement may be regarded as crucial to the goal of improving safety culture in the context of Saudi Arabian construction projects
- critically review the literature on accident causation, safety culture, and stakeholder theory in order to develop an understanding of the factors influencing safety performance in construction projects
- develop a model based on stakeholder theory and safety culture, and investigate the causal relationship between its components
- investigate the nature of stakeholder involvement in improving safety matters, and the level of safety culture in the Saudi Arabian construction industry
- perform the SEM analyses to confirm the construct validity of the proposed model
- perform the SEM analyses to examine whether statistically significant relationships exist between stakeholder involvement, safety culture, and safety performance

- examine the impact of stakeholder involvement on organisational safety culture in regards to its size by performing a multi-group analysis
- verify and validate the developed model
- identify areas where stakeholder involvement, safety culture, and safety performance in the Saudi Arabian construction industry can be improved.

1.5 Rationale for the research

The costs of workplace incidents during construction projects have a major impact on both projects and workers. Impacts include the loss of productivity, absenteeism, labour turnover, medical expenses, plant or equipment loss, fines and legal expenses and damage to public image (Tang *et al.* 2004). Set alongside other nations, such as Australia and Singapore, the inadequacies of the Saudi system of occupational safety and health characterised by a lack of both a moral and economic duty of care, which ought to be available as a matter of human rights for workers in the construction industry.

In July 2002, the Council of Ministers in Saudi Arabia approved a national strategic plan of science and technology, *The Comprehensive, Long-Term, National Science and Technology Policy*. The plan drew up the broad lines and future direction of science, technology and innovation in Saudi Arabia, along with defining the role of universities, government, industry, and society at large (The King Abdulaziz City for Science and Technology 2002).

The strategic plan is a plan for research and innovation in the building and construction sector of the Kingdom of Saudi Arabia, and will affect independent research organisations, universities, industry, and other organisations related to the construction sector. The plan's time frame covers 20 years, divided into five-year operational phases (The King Abdulaziz City for Science and Technology 2002). In order to fulfil its strategic objectives and Saudi Arabia's needs in the building and construction sector, stakeholders identified the following programs for research development (The King Abdulaziz City for Science and Technology 2002):

- safety
- health
- environment
- new trends

The safety and health research is designed to reduce the incidence of work-related fatalities, diseases and injuries, and to improve performance in the area of occupational health and safety. The National OHS strategy has identified five priorities for achieving the goal of OHS improvement in the both short and long term, and for nurturing longer-term changes in workplace culture:

- reduce the impact of risk at work
- improve the capability of business environments in order to control OHS more effectively;
- prevent work-related diseases more efficiently
- eliminate hazards at the design stage
- increase the government's ability to control OHS results.

However, Saudi Arabia still has an under-developed academic research culture, compared with the USA, UK or Australia, for example. Therefore, this study introduces a workplace safety management plan for the Saudi Arabian construction industry designed to address the urgent moral imperative to improve health and safety, and to improve economic outcomes within the industry, as the country slowly modernises its infrastructure.

1.6 Contribution to knowledge

This study contributes to the theory and practice of stakeholder involvement, to aspects of safety culture, and to safety performance in the workplace as a first, empirically-determined step in raising standards in these areas. Despite the large number of studies having addressed the concept of safety culture and safety performance, only a limited amount of research has focused on stakeholder involvement and safety culture in the construction industry with particular reference to developing countries, or the inter-cultural study of Saudi Arabian culture.

In the majority of existing studies, researchers have either replicated an already tested model in order to improve its adequacy, or developed a new model. To the best of the author's knowledge, none of the existing studies has explored the extent to which stakeholders promote a positive culture within the Saudi Arabian construction industry. For the first time, this study examined the inter-cultural aspects of Saudi Arabian construction stakeholders' and senior management attitudes towards workplace health and safety within their industry, and then attempted to assess the influence and enforcement of the stakeholders on safety culture and safety performance. Therefore, this study adds to a growing body of empirical research related to construction safety culture in developing countries, and its relationship to the stakeholders in the industry. The most notable contribution of this study is in examining the relationships between stakeholders (primary and secondary) and safety culture dimensions with the objective of improving safety within the workplace. In addition, it opens up a future area of research into the clarification of these relationships, in particular by considering stakeholder theory in the context of construction safety culture and vice versa.

1.7 Methodology

The study was conducted in stages. The lack of common empirical indicators and the absence of an appropriate model meant that it was necessary to begin the research with a review of the literature, and to obtain expert opinions prior to developing a research instrument and verifying the extracted indicators, as suggested by García-Valderrama and Mulero-Mendigorri (2005), as well as Jonker and Pennink (2010). Having completed these steps, a pilot test was then conducted to modify the questionnaire.

To achieve the above research objective, a conceptual model was hypothesised and empirically tested using information gathered via a questionnaire covering the main attributes of construction safety culture. The questionnaire was administered within the Saudi construction industry to the three groups of organisations (small, medium, and large), resulting in a total of 384 valid responses. The initial study determined a cross-sectional design to be the most appropriate method for the collection of data. Cross-sectional research is used to collect data on relevant variables simultaneously, which provides a snapshot of the variables (Busk 2005). According to Busk (2005), the advantages of this method are that it fulfils multiple research requirements, such as collecting data on multiple variables, collecting data on behaviours and attitudes, and generating hypotheses for future study.

After data were collected, descriptive statistics, calculation of reliabilities, and checking of outliers and non-normality were undertaken by employing the *SPSS* program. A confirmatory factor analysis and convergent and construct validities were also undertaken using *AMOS*. In addition, composite scores were developed and group analyses were conducted. Lastly, the final results and model were validated by independent experts.

The procedure and applied methods used in the current research were considered appropriate in order to control biases, reduce error, and remove unwanted influence through statistical techniques and measurements, and to validate the research outcomes.

1.8 Outline of the thesis

The study is presented in eight chapters as shown in Figure 1.1.

Chapter 1. Chapter 1 introduces this research, identifying and defining the research problem, presenting the background to the research, rationalising the research and its approach, presenting the research methods and the main contributions, and highlighting the limitations and key assumptions.

Chapter 2. Chapter 2 presents a brief background about the Kingdom of Saudi Arabia in regard to its economic growth. This is followed by presenting the current situation in the construction industry as a result of this economic growth, and shows how much the Saudi Arabian government spent on contracts awarded across the major construction sectors over the last ten years. There follows an explanation of the existing structure of the work environment in Saudi Arabia with regard to occupational health and safety law. The socio-cultural determinants of this industry are presented and discussed, followed by the weaknesses of Saudi's construction industry.

Chapter 3. Chapter 3 presents a comprehensive literature review that emphasises the nature and theoretical underpinning of the major concepts and theories which form the framework for the current study. The chapter reviews three bodies of focal literature: the first related to construction industries, the second related to safety causations and safety culture, and the third to stakeholder theory.

Chapter 4. Chapter 4 provides a foundation for understanding relationships between stakeholder involvement and safety culture. It begins with an examination of the relationships between the level of stakeholder involvement and a safety culture's dimensions by identifying constructs related to stakeholder involvement and safety culture separately. Next, it examines the hypothesised relationships between them that provide positive safety outcomes.

Chapter 5. Chapter 5 provides details of the methodology and fieldwork undertaken to collect the requisite data for analysis of the research questions. In addition, the chapter explains and justifies the research methodology and describes the methods of data collection.

Chapter 6. Chapter 6 includes the statistical analysis undertaken for this research. This included statistical methods for handling descriptive statistics, as well as missing data, the normality test, the outliers test, and the reliability test. Advanced data analyses were also undertaken by using a structural equation modelling package, *AMOS*, which included examining individual variables by using a confirmatory factor analysis. In addition, discriminant analyses, and invariance testing were undertaken.

Chapter 7. Chapter 7 presents first the full structural model, and then a reduced model, where its items are parcelled up by developing composites for the full structural model. This model then forms the basis for undertaking tests of a group moderating variables that evaluated whether the relationships between variables differed for each group. The hypothesis thus developed is analysed, and the results are presented. Finally, although this research is mainly positivist, a quantitative approach has been used in a limited way in the final summation as a form of validation of the main findings.

Chapter 8. Chapter 8 summarises the major findings of the research. The chapter starts with an overview of the significant findings of the study. A detailed discussion of the results is then presented, prefaced by the initial question: *What's is going on in Saudi Arabian construction projects?* Then follows:

- a description of the conceptual model and its components
- an evaluation of the impact of safety culture on safety performance
- the effect of primary and secondary stakeholders on safety culture
- the effect of on safety culture of an organisation's size
- the relationship between organisation size and stakeholder involvement on the improvement of safety culture.

Based on the discussion, knowledge contributions to 'theory building and practical implications' are outlined, providing recommendations to policy makers. In concluding, possible directions for future research are suggested.

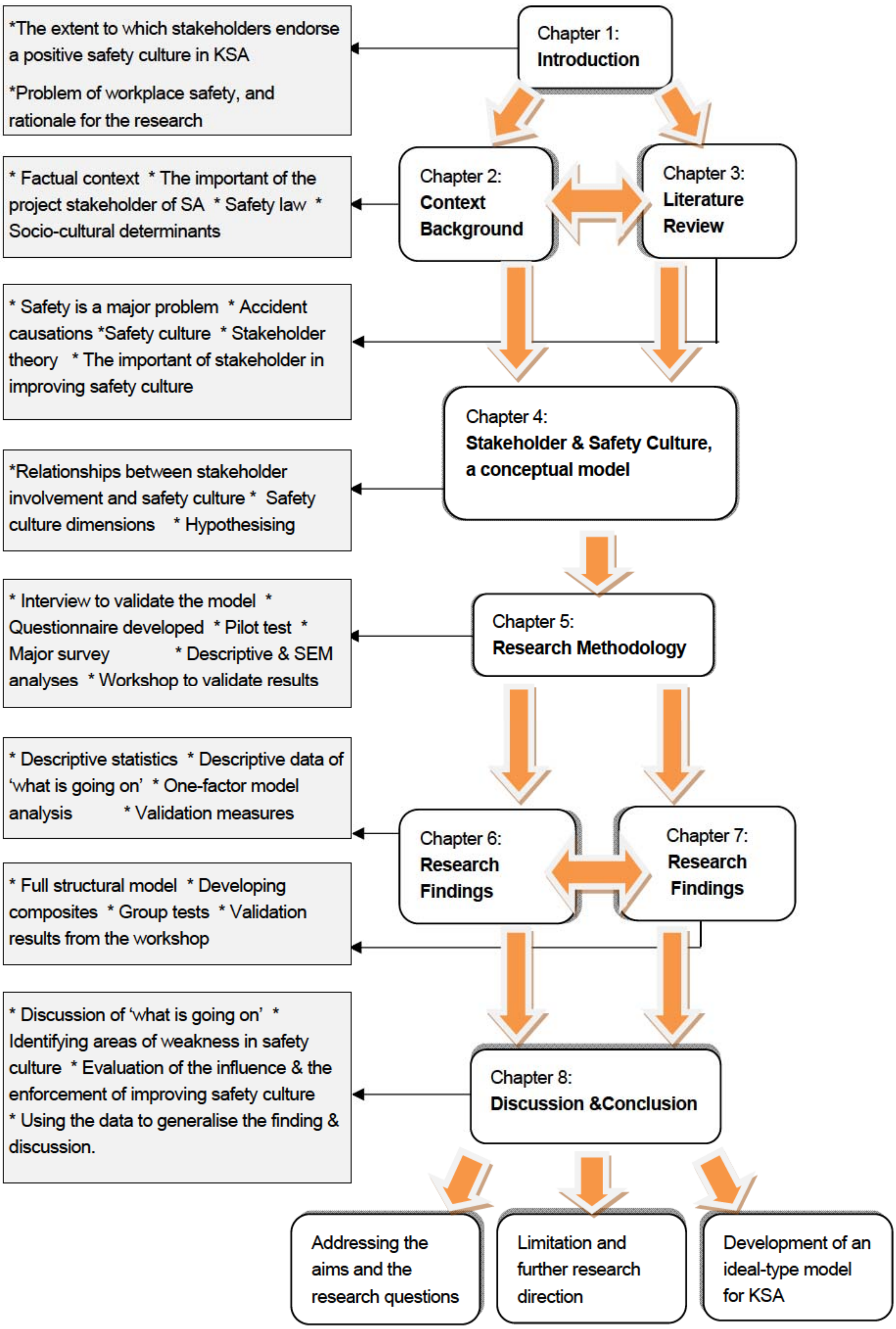

Figure 1.1 **Overview of the research thesis**

1.8 Key assumptions and limitations

Despite the growing body of literature covering safety culture in the construction industry, it is still widely recognised that the empirical validation of stakeholder involvement in safety culture at senior management level is limited, and their contribution to safety performance is rarely studied. The interactions between the aims and objectives of senior management and what is actually being done in relation to safety performance appear to be ignored. This research is an attempt to verify the casual relationship and interaction between stakeholder involvement, safety culture, and safety performance in the construction industry, thus providing a greater understanding of their interaction which, in turn, will facilitate safety performance improvement.

In the academic literature, these ways of elaborating stakeholder theory have been subject to significant debate. However, this research used stakeholder theory and thinking not to debate, but only to investigate the ways in which enforcement, influence, and participation can improve safety culture in Saudi Arabian construction projects.

A limitation of the study is that it focused on organisations within the Saudi Arabian context. Although the sample was randomly selected, some restrictions applied. These restrictions will inevitably have influenced the results, which consequently may not be generalisable to other geographical areas.

1.9 Summary

This chapter introduced the background to, and described the basis for, the research undertaken. It stated the research problem and the research questions that led to this study. The chapter also identified the benefits expected from the study and the justification for the selection of Saudi Arabian construction projects as the subject of the research. This was followed by a description of the research methodology. Then, subsequent chapters are outlined when the structure of the thesis is revealed. Finally, this chapter discussed the key assumptions and research limitations.

Contextual background

This chapter presents a brief background about the Kingdom of Saudi Arabia in regard to its economic growth. This is followed by explaining the current situation in the construction market as result of this economic growth, and shows how much the Saudi Arabian government spent in contracts awarded across the sectors of construction industry relevant to the thesis research over the last ten years. In addition, this chapter discusses how the price of and demand for oil and gas affect the level of investment in new construction.

The Saudi government invests in petrochemical projects, power and water desalination plants, and industrial building and infrastructure projects. The importance of the project stakeholders is explained in this chapter, after which the existing structure of work environment in Saudi Arabia in regards to occupational health and safety law is discussed. The socio-cultural determinants of this industry are presented and discussed, followed by the weaknesses in Saudi's construction industry. The construction sector suffers from many weaknesses, but safety and health are the weakest. Therefore, this chapter presents an in-depth study about occupational health and safety in the construction industry.

2.1 The growth of construction in Saudi Arabia

The Kingdom of Saudi Arabia (KSA) is the largest country in the Arabian Gulf, with a GDP of $711.0 billion USD and a population of 28.29 million as of 2012 (The World Bank 2013). The Kingdom has 13 provinces, each with its own capital. The national capital is Riyadh. The KSA is regarded as the birth place of Islam, and houses two of Islam's holiest cities, Mecca and Medina. It is also one of the world's largest producers and exporters of oils and gas, holding 16.2 percent of the world's oil reserves (US Energy Information Administration 2013).

In the past ten years, the kingdom has experienced an economic boom. Oil and gas products have increased from 70.7 billion USD in 2001 to 205.0 billion USD in 2007 (Tabata 2009). This economic growth has resulted in major economic development through diversification and investment programs, such as those instituted in six economic cities across the country. Accompanying this growth, the construction industry has witnessed unprecedented growth of around 10 percent in all types of construction projects across the economy, such as the oil and gas sector, petrochemical industries, power, water desalination, infrastructure and building, and in the industrial construction sectors (KSA Ministry of Economy and Planning 2013). Therefore, it is crucial to have a long-term national plan to oversee and control this sector.

During the decade 1970-1980, the kingdom experienced a high level of construction activity, which attracted construction companies from all over the world. Therefore, the first national development plan (1970-1975) was established in order to set up the systematic construction of modern infrastructure. In the second national development plan (1975-1980), the government increased the budget and provided the majority of capital investment. Due to an unexpected downturn in the country's revenues and lower levels of economic growth, the third national plan (1980-1985) was mainly focused on completion of project facilities. The fourth national plan (1985-1990) was clearly a corrective stage, strengthening the construction industry, improving quality, reducing the cost of construction projects, and developing industry regulations, such as contractor pre-qualification, safety requirements, and site supervision.

In the fifth development plan (1990-1995) emphasis was shifted toward private responsibilities in the construction industry in order to achieve a positive annual growth in the country through higher spending. The sixth and seventh national plans (1995-2000 and 2000- 2005) focussed on lowering the future capital budget of existing facilities by controlling the cost of services and increasing the life of operating facilities, and also by supporting academic research in the construction sector. The eighth national plan (2005-2010) envisaged implementation of new building techniques and new models, enforcement of mandatory classification of contractors, and provision for all regulations, procedures and transaction forms to appear on the websites of all agencies.

Lastly, the ninth national plan (2010-2014) concentrated on improving the standard of living and quality of life within the nation, spreading development throughout all regions of the country, diversifying the economic base, developing natural resources and rationalising their use for sustainable development, building a highly-skilled knowledge workforce, and enhancing competitive capacities (KSA Ministry of Economy and Planning 1970, 1975, 1980, 1985, 1990, 1995, 2000, 2005, 2010).

2.1.1 The construction market in the Kingdom of Saudi Arabia

The kingdom represents one of the fastest growing construction markets in the world and the largest construction market in the Middle East (UK Trade & Investment 2013). According to Thompson, R (2013) in the kingdom there are around $960bn worth of megaprojects and large master planned developments that promise to transform Saudi Arabia's economy. Figure 2.1 illustrates the trend in contracts awarded across the major sectors of the Saudi construction industry for 2002-2013.

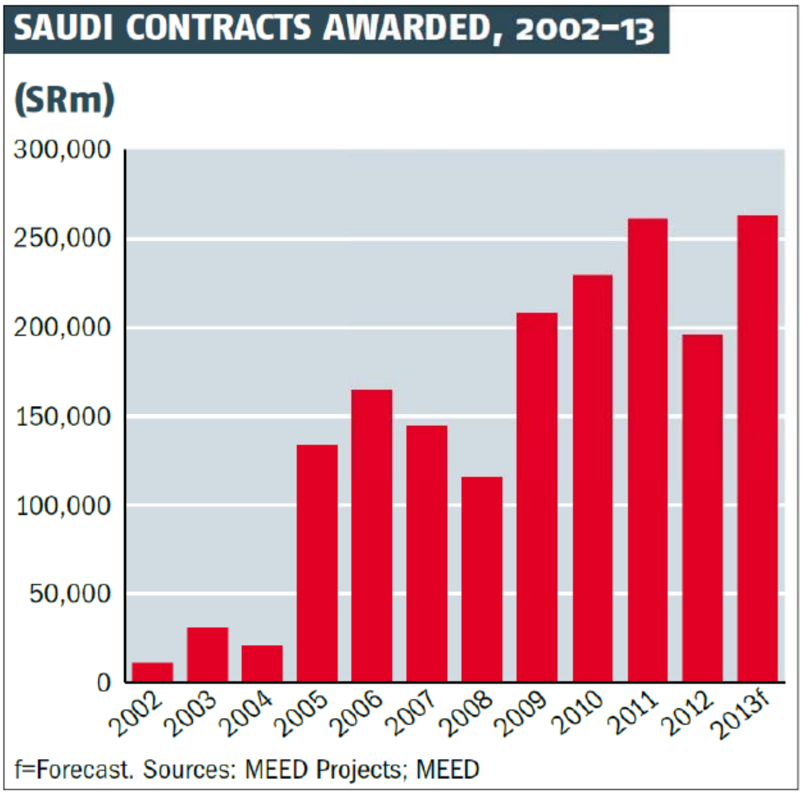

Figure 2.1 Contract awards (Thompson, R 2013, p. 1)

In the oil and gas construction sectors in Saudi Arabia, projects are centred on petrochemical, refinery and exploration activities. The estimated value of contracts awarded was $20.9 billion in 2011. The power and water desalination construction sector is mainly focussed on building and expanding the water desalination and power plants in order to meet the country's high demand for water and energy. The sector attracted an estimated $19.9 billion in contracts, awarded in 2011.

In the building construction sector, emphasis is on building six economic cities around the country. Structures to be built would be both commercial and residential, with an estimated value of $46.8 billion. Infrastructure building has had $19.5 billion assigned to it for the construction of bridges, railways, roads, airports, and the expansion of the Holy cities. In the industrial construction sector, the estimated value of the contracts awarded was $3.5 billion in 2011, and includes projects such as industrial cities, building or expansion of manufacturing plants, warehouses and workshops (Ventures Middle East 2011).

Table 2.1 lists some of the kingdom's mega-construction projects worth about $400 billion from different sectors, while Figure 2.2 shows the distribution of these megaprojects around the country in order to meet the high demand.

Table 2.1 Saudi Arabia's megaprojects boom (Thompson, R 2013, p. 4)

SELECTED SAUDI ARABIA MEGAPROJECTS

Project	Client	Value ($m)
King Abdullah Economic City	Emaar, The Economic City	93,000
Saudi housing programme	Housing Ministry	70,000
Sudair Industrial City	Saudi Industrial Property Authority (Modon)	40,000
Jizan Economic City	Saudi Arabian General Investment Authority (Sagia)	40,000
Riyadh Metro	Arriyadh DevelopmentAuthority	22,480
Sadara chemical complex, Jubail	Sadara Chemical Company	20,000
Kingdom City	Kingdom Holding	20,000
Haramain High-Speed Rail Network	Saudi Railways Organisation	13,743
Security compounds	Interior Ministry	13,000
Yanbu Aramco Sinopec refinery	Yanbu Aramco Sinopec Refining Company	10,000
Maaden/Alcoa aluminium complex	Saudi Arabian Mining Company (Maaden)	9,900
Manifa Arabian Heavy Crude Programme	Saudi Aramco	9,280
King Abdulaziz International Airport	General Authority of Civil Aviation	8,172
Knowledge Economic City in Medina	Knowledge Economic City Company	8,000
Sipchem complex phase 3, Jubail	Saudi International Petrochemical Company (Sipchem)	7,860
Waad al-Shamal Phosphate City	Mosaic/Saudi Basic Industries Corporation (Sabic)	7,225
King Abdullah Financial District	Rayadah Investment Company	7,000
PetroRabigh phase 2	Rabigh Refining and Petrochemical Company (PetroRabigh)	7,000
Wasit Gas Development	Saudi Aramco	5,000
Jabal al-Kaaba	Abdul Latif Jameel Real Estate Investment Company	2,666

Sources: MEED; MEED Projects

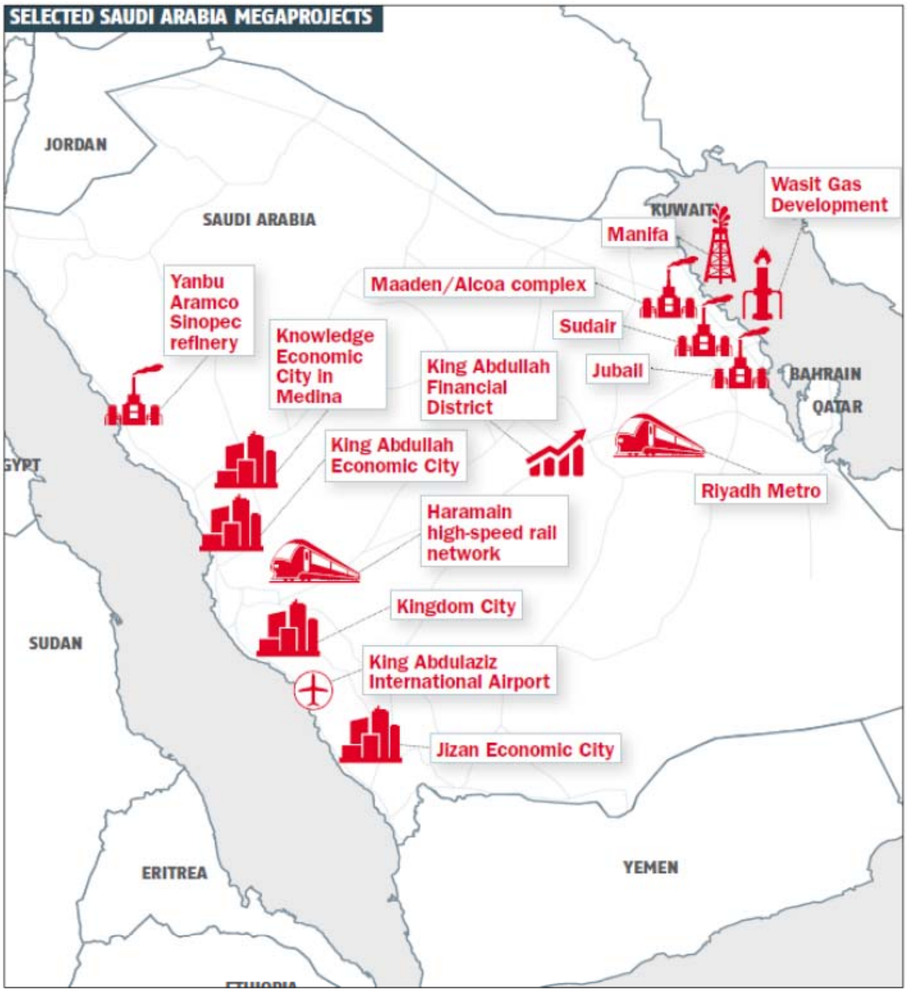

Figure 2.2 **Saudi Arabia's megaprojects boom (Thompson, R 2013, p. 4)**

2.1.2 The organisation of the construction industry in the Kingdom of Saudi Arabia

The Saudi government invests heavily in the construction industry, which, since the increase in gas and oil prices and subsequent boost in production, has developed rapidly in both size and the number of public construction projects. In addition to the increasing price and demand for oil and gas, the changes from traditional desert living to a modern, urban lifestyle for most of the population have also affected the demand for investment in new construction. In order to meet the growing needs of society, oil and gas revenues are invested by the government in the development of the infrastructure necessary to maintain the nation's social and economic growth. Government investment in oil, gas and petrochemical projects, power and water desalination plants, industrial building and infrastructure projects are a core element in the government's strategy for future development.

Construction in Saudi differs from other industries in the following ways:

- its fragmented structure
- the short life of the projects
- diffused responsibility
- a high proportion of self-employed workers
- its prototype nature
- the high turnover of workers
- influences of interest groups
- a transient and itinerant labour force
- a lack of research and development (International Labour Office 1992; Jaafari 1996).

Along with these characteristics, the construction industry also involves many types of activities that depend on human resources to engage in numerous skilled tasks. In terms of health and safety, many researchers refer to its uniqueness as a basis of comparison with other industries because it offers great challenges in regard to leadership, communication, and team integration, all of which have a great impact on health and safety. Therefore, it is not surprising that project stakeholders are the key players in the construction industry. In order to avoid problems with health and safety, the involvement of stakeholders is an essential and critical aspect of any project's success in the kingdom (Loebbaka & Lewis 2009).

Several types of stakeholders are involved in the country's public construction sector. These are outlined below:

Stakeholders. Saudi Arabia has a number of external and internal parties involved in construction projects.

- *Public authority*

  Most of the projects in Saudi Arabia owned by the government reflect the strategic planning related to the country's infrastructure. Therefore, all projects have to be approved before they are executed. According to the Ministry of Economics of Saudi Arabia (2010), the target of the government in this kind of project is to achieve high quality project outcomes without a failure.

- *Project owners*

  Most of the public projects in the kingdom are the responsibility of different ministries, such as Ministry of Public Works and Housing, Ministry of Transport, Ministry of Water and Electricity, Ministry of Health, and Ministry of Municipalities and Rural Affairs. Each is responsible for executing and implementing the strategies of the government, along with holding financial power over their projects.

- *Contractors*

  Contractors in the kingdom are classified into five categories based on their technical and financial capability (Ministry of Municipal and Rural Affairs 2014). Most of the kingdom's projects are carried out by local, regional, or international contractors.

- *The Ministry of Planning*

  The main responsibility of the Ministry of Planning is to evaluate and monitor the outcome from the kingdom's public projects in regard to its strategies. In their five year national plan, the ministry identifies the need for public projects according to location, size, and type. The aim is to reduce the impact of global crises on the Saudi Arabian economy in the future by intensifying the role of internal sources and the driving forces of economic growth.

- *The Ministry of Labour*

  The majority of the labourers in the Saudi construction industry are non-national (Al Omani 2008). Therefore, the construction companies have to follow the procedures and requirements of the Ministry of Labour in order to protect local and foreign workers, discourage labour unions, and create employment opportunities for locals. Along with that, the Ministry of Labour requires employers to provide mandatory health insurance for each worker in their organisation, and to provide a safe workplace (Michael 2010). According to the laws of the Ministry of Labour, the employers must protect their workers against occupational hazards, major industrial accidents and work injuries, and provide health and social services (Ministry of Labour 2006).

- *The General Organisation for Social Insurance (GOSI)*

  Along with labour regulation from the Ministry of Labour, there is a workers' compensation plan, available under the direction of the GOSI. GOSI is a system that covers workers in the private sector, and a group of workers in the public sector. This system is essential for employee and employer because it provides the contributors and their families with compensations and annuities. An employer benefits by transferring all the expenses resulting from work injuries and occupational diseases to this insurance scheme (GOSI 2009-2010; Jannadi 1996).

- *The Ministry of Health*

  Some of the responsibilities of the Ministry of Health are to implement programs related to occupational health and safety, such as medical waste, infection control, and radiation protection. Also, the Ministry of Health participates in preparing regulation and laws on occupational health and safety in the kingdom and collaborates with the Ministry of Labour and GOSI. The ministry must also be prepared to improve existing occupational health and safety programs as part of the national strategy (OIC-VET 2010).

- *The General Directorate of Civil Defence*

  In order to protect workers and civilians from hazards and major industrial accidents, the General Directorate of Civil Defence provides licenses for organisations engaging in the importation, sale, installation, or maintenance of safety equipment, fire fighter equipment, or fire alarm equipment. Organisations must meet the requirements for protection from fire in order to be licensed from the General Directorate of Civil Defence and to carry out their activities (The Civil Defence Saudi Arabia).

In order to understand the relationship between workers, employees, and their obligations, the next section reviews the existing structure of the work environment in Saudi Arabia.

2.2 Existing structure of the work environment in Saudi Arabia

The main statute governing employer-employee relationships in Saudi Arabia is *Labour Regulation*, which came into force on 26th April 2006. Associated with this regulation is a workers' compensation plan available under the direction of the GOSI. Figure 2.3 illustrates the existing structure and relationship of labour law, GOSI, employer, and employee. The labour law regulates labour relations terms and employment conditions, work hazards and accidents, training, women's employment, and punishment. GOSI includes occupational hazards and annuities (GOSI 2010, 2006).

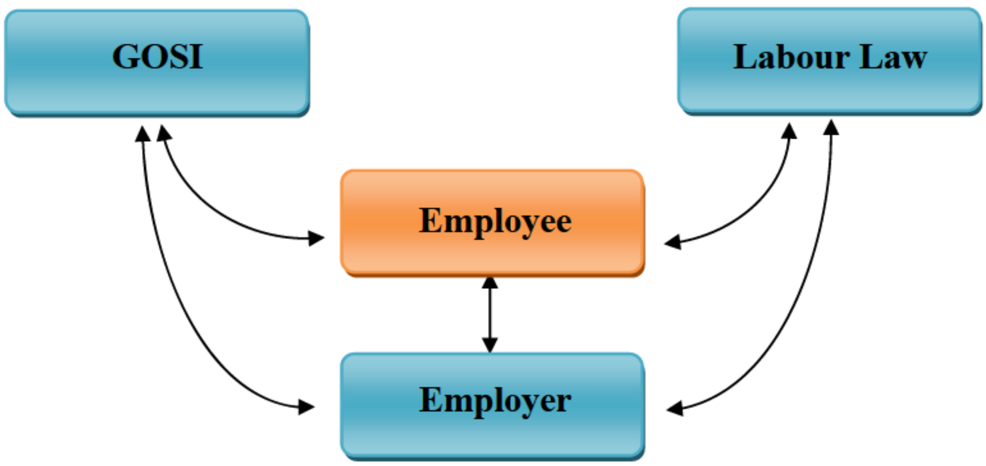

Figure 2.3 The existing structure of employer-employee relationships in Saudi Arabia

2.2.1 Occupational health and safety rules in Saudi labour law

Saudi labour law supports occupational health and safety rules. The rules are divided into four chapters – protection against occupational hazards; protection against major industrial accidents; work injuries; and medical and social services (Ministry of Labour 2006).

Chapter 1

on *protection against occupational hazards* includes six articles as described below

Article 121 An employer shall maintain the firm in a clean and hygienic condition, and he must to comply with other rules, measures and standards of OHS in accordance with what specified in the Minister's decision.

Article 122 An employer shall protect the workers from hazards and diseases, and shall ensure work safety and protection.

Article 123 An employer shall inform the workers before commencing the work, about the work hazards, and shall provide personal protective equipment, and require his worker to use it.

Article 124 A worker shall preserve and use the personal protective equipment, and shall carry out the instruction established in order to protect his health.

Article 125 An employer shall provide the organisation with a fire safety system along with safety exists.

Article 126 An employer shall be responsible for emergencies and accidents involving all people who enter his workplace.

Chapter 2

on *protection against major industrial accidents* includes five articles as described below (Ministry of Labour 2006)

Article 127 This chapter shall apply to *high risk* organisations.

Article 128A The term *high risk firm* means

> *the firm which produces, prepares, disposes of, handles, uses or stores, on a permanent or temporary basis, one or more hazardous substances, or categories of these substances in quantities that exceed allowable limits the exceeding of which results in listing the firm among the high risk firms. (Ministry of Labour 2006)*

128B The term *hazardous substance* means

any material or a mixture of substances that constitutes a hazard on account of its chemical, physical or toxic properties either alone or in combination with other substances. (Ministry of Labour 2006)

128C The term *major accidents* means

any sudden occurrence such as a major leak, fire or explosion in the course of an activity within the high risk firm and which involves one or more hazardous substances posing a great immediate or potential danger to the workers, the public or the environment. (Ministry of Labour 2006)

Article 129 The Ministry shall launch a system to identify the high risk firms.

Article 130 The employers shall coordinate with the ministry to verify the statute applicable to their organisation.

Article 131 The Minister shall establish the regulations and decisions embodying the necessary arrangements in order to prevent losses.

Chapter 3

is about *work injuries* and includes ten articles as described below

Article 132 This chapter shall not apply to the firms subject to GOSI.

Article 133 An employer shall be responsible for all expenses of treating his worker from a work injury or disease.

Article 134 Occupational diseases shall also be considered as work injuries.

Article 135 Any relapse or complication arising from a work injury shall be deemed as work injuries.

Article 136 Occupational diseases shall be determined in accordance with the Occupational Disease Schedule, which is provided from Social Insurance Law.

Article 137 The injured person shall get his full wage of the first thirty days and 75% of the wage for the entire duration of his treatment.

Article 138 The injured person or his family shall receive a compensation equal to his wages for three years and not less than 54,000 SR (AU $15,500), if the injured person has a permanent total disability or death as result from a work injury.

Article 139 An employer shall not be required to comply with the Articles (131),(137), and (138) if any of the following is occurred:

- If a worker injure himself with intention
- If an injury resulted by intentional misconduct on the part of the worker
- If the worker refused to be examined by a doctor without a valid reason.

Article 140 Previous employers shall pay the compensation provided for in Article (138) according to the medical report.

Article 141 The Minister shall determine the procedures for reporting work injuries.

Chapter 4

is about *medical and social services* and includes seven articles as described below

Article 142 An employer shall provide medical aid cabinets and other necessities required for first aid.

Article 143 An employer shall provide a comprehensive medical examination for his workers at least once a year and record the finding.

Article 144 An employer shall provide his workers with health care cover.

Article 145 An employer may establish a saving and thrift fund for his workers.

Article 146 For those who work in remote locations, the employer shall provide food and clothing, educational services, sports facilities, medical arrangements, schools, prayer areas or Mosques, and literacy programs;

Article 147 In remote locations, the employer shall provide his workers with accommodation, camps, and meals.

Article 148 In remote locations, the employer shall provide his workers with transportation from their residence to work and bring them back daily.

According to Saudi labour law (2006) and under the punishment section in Article 236 from the Labour Law, any person who violates the provisions of the above chapters of the labour law shall be subject to:

1 a fine of not less than 3,000 SR (AU $900) and more than 10,000 SR (AU $3,000) for each violation; or

2 closing down the firm for not more than 30 days or permanently.

The fine and closing down may be combined with the elimination of the hazards.

2.2.2 General Organization for Social Insurance in Saudi Arabia

The General Organization for Social Insurance (GOSI) is a system that covers workers in the private sector, and a group of workers in the public sector. This system is essential for employee and employer because it provides the contributors and their families with compensation and annuities. The employer benefits by transferring all the expenses resulting from work injuries and occupational diseases to this social insurance (GOSI 2010; Jannadi, M 1996).

GOSI was issued under Royal Decree No. M/22 on 29th November 2000 with two branches. The Occupational Hazards Branch provides benefits in cases of employment injuries, and the Annuities Branch provides benefits in cases of non-occupational disability, old-age, and death (GOSI 2010).

A workers' compensation and disability plan exists under the Occupational Hazards Branch. For both local employees and non-local employees, employers must contribute an amount equal to 2% of their salary to benefits from the plan for workers' compensation and disability, which is administered by GOSI (GOSI 2010; Jannadi, M 1996).

The retirement system is administered by GOSI for the private sector, but covers only Saudi nationals. Employers and employees contribute to this system by paying an amount equal to 18% of the employee's wages, the employer contributing 9% and the employee contributing 9% (GOSI 2010; Jannadi, M 1996).

2.2.3 Socio-cultural influences on the work environment

Saudi culture has been formed by a combination of features from many different sources, such as religion, tribal systems, and multinational cultures, and it is crucial to consider the dominant national culture when considering influences on the work environment (Kwok, K & Catherine 2009). The construction industry in the kingdom exhibits considerable cultural diversity, with the labour force coming from a variety of cultural backgrounds, such as Egyptian, Bangladeshi, Indian, and Pakistani (Jannadi, A 2008).

This cultural diversity is the result of the general lack of skilled labour in the Saudi market. On the whole, it is skilled employees from Western nations who occupy senior positions, such as planner, designer, or risk analyser in the construction industry. Middle management, such as project managers, engineers, site managers, and supervisor are mainly from Arabian countries, with some from India and Pakistan. Saudi nationals are among this group, working as senior managers or as project owners. This diversity has a significant negative impact on learning safety rules and on project performance because of communication difficulties, personal habits and attitudes to safety among construction employees. Most importantly, the lack of a common attitude, and common experiences, related to work and employment is reflected in a lack of motivation to pursue health and safety issues (Jannadi, A 2008).

The Saudi construction industry, therefore, exhibits a distinctive culture, one not usually observed in Western nations, which share a different common background, educational and industrial history. Organisational culture in Saudi echoes the society of the kingdom where personal relations are paramount, the social structure is based on a tribal system and greatly influenced by the Islamic religion, and behaviour is guided by government policies and pronouncements (Kwok, K & Catherine 2009).

Government system. Saudi Arabia is a monarchy. King Abdullah Bin Abdulaziz is the Kingdom's sixth monarch – known as the *Custodian of the Two Holy Mosques*. His authority is much greater than any modern Western monarch. The king governs with the help of the Council of Ministers. There are 22 government ministries and each ministry specialises in a different aspect of government. There is also a legislative body called the Consultative Council (*Maglis Alshura*) which advises the king. The Council proposes new legislation and amends existing laws (Royal Embassy of Saudi Arabia 2013).

The king is at the top of the legal system, which, according to Vogel (2000) is actually divided into two separate systems – one based on Islamic teaching (*Shari'ah*) and the other is based on secularised laws. Such an arrangement has important implications for the construction industry, its organisational culture and operation.

The country is divided into 13 provinces, each is governed by a governor and deputy governor, and each has its own council to advise the governor and deal with the development of the province (Royal Embassy of Saudi Arabia 2013).

Islamic beliefs and values. The fundamentals of Islam are *aqidah* (belief and faith), *ibiidah* (worship) and *akhliiq* (morality and ethics) (Kamali 1989). These principles are central to the worldview of Islam and are embodied in Islamic *Shari'ah* (Dusuki 2008). According to Sardar (2003) *Shari'ah* is a set of norms, values, and laws that make up the Islamic way of life. *Shari'ah* directs all aspects of human life – personal, economic, social, political, and intellectual.

Central to the understanding of *Shari'ah* is *Taqwd*, which means wariness of *Allah* (God) (Dusuki 2008). A person who adopts a *Taqwd*-paradigm understands that his role in this life is to develop and manage the world in accordance with *Shari'ah*, which provides a number of values and beliefs for shaping the social life of human beings in relation to the rest of creation (Dusuki 2008). Dusuki (2008) emphasises four important points from this *Taqwd*-paradigm:

- *human dignity*

  A human being is not simply supposed to survive at the lowest level of existence, enduring any or all associated harms, but to enjoy a good life with the dignity conferred upon them by *Shari'ah*, and to develop their entire person, spiritually and morally, physically, potentially, intellectually, and psychologically.

- *free will*

  The relativity of the freedom that a person enjoys in Islam means that he will not invade the social limits of individual freedom. The principle of imposing constraints is to prevent humankind from arbitrary social behaviour and is not to diminish human freedom.

- *equality and rights*

  Except for levels of piety and good character, human beings are equal, and human interactions should be based on trust, equity and justice (Parvez 2000). Therefore, shared self-sacrifice and cooperation represent the right way for humans to behave. Their goal should be to fulfil each other's basic needs, and develop each other's human potential, and enrich human life as a whole (Dusuki 2008). According to Iqbal and Mirakhor (2004) *Shari'ah* guarantees the basic rights of individuals, although they must conform to *Shari'ah* ethics and rules, and always consider the interests of the collective well-being.

- *trust and responsibility*

  The concept of trust is inseparably linked with responsibility. In accordance with the wishes of *Allah*, individuals should help the poor and spend moderately, avoiding profligacy and hoarding, both of which are wasteful and a sin (Dusuki 2008).

In summary, the concept of *Shari'ah* considers organisations to be caretakers or stewards, holding their property in trust for the benefit of their workers and society as a whole, and ultimately attaining the blessing of *Allah* (Dusuki 2008). In Islam, health and safety, therefore, are social values, and a violation of the people's rights in either the wider society or the work place is prohibited under *Shari'ah* (Ali, YRH 2011).

2.3 Saudi construction's weaknesses

2.3.1 Strategic priorities for Saudi's building and construction industry

Because this sector suffers from many weaknesses, the King Abdulaziz City for Science and Technology (KACST) was given responsibility more than five years ago for developing the five year strategic and implementation plans for building and construction technology. Among issues that required redress were:

- the use of energy-intense processes
- the lack of advanced experience in the workforce
- lack of commitment to research and innovation in order to develop this sector (KASCT 2009).

After reviewing the status of the building and construction sector with key stakeholders, KACST found that energy, new trends, environment, and safety and health were the weakest areas in the building and construction industry because of the following:

- the slow development and implementation of the Saudi Building Code and Saudi Arabian Standard Organisation
- non-unified and standardised governmental systems, including laws, regulations, and codes
- failure to activate the scientific and technical infrastructure for transferring and developing technologies at appropriate levels
- poor quality scientific research and technology systems at the local level
- fragmentation of the building industry, and lack of investment in research and development, as well as the slow adoption of new technologies

- poor international cooperation and failure to take advantage of opportunities for technology transfer
- shortages of technical research personnel and equipment
- failure to involve national specialists in planning, design and project management in both government and private sectors
- the difficulty of attracting distinguished experts and scholars to live in KSA
- insufficient Saudi colleges or departments specialised in building and construction technologies
- the absence of civil society institutions that would contribute to awareness of the importance of technology development
- lack of clear training policies and structured programs needed to enhance local expertise in required areas
- low income for individuals working in the research field and educational institutions, compared to some other occupations.

These are issues that must be addressed in order to develop innovative solutions for the Saudi building and construction sector, and to reduce contradiction and conflicts among policies and government regulations (KASCT 2009).

Saudi's building and construction industry records the highest number of accidents and the poorest health and safety record of all Saudi industries (GOSI 2010). The next section presents an in-depth study about occupational health and safety in Saudi's construction industry.

2.3.2 Safety in Saudi's building and construction industry

The construction industry records the highest number of accidents in Saudi Arabia (Table 2.2). This reflects the considerable degree of risk in the industry, but such a high accident rate is not acceptable to humanity in general and society in Saudi Arabia in particular. Since human resources are one of the most valuable factors for construction, it is therefore crucial, not only for the construction industry, but for society as a whole, to identify possible factors and establish policy frameworks in order to reduce the number of construction accidents.

Table 2.2 Serious claims: Number and percentage of total by industry, 2009-2010 (Adapted from GOSI, 2011)

Industry	Local	Non-local	Total	%
Agriculture, fishing	67	761	828	1.0%
Mines and Petroleum	465	902	1367	1.6%
Manufacturing	2180	13274	15454	17.9%
Electricity	496	1111	1607	1.9%
Construction	731	42577	43308	50.2%
Trade	1042	15897	16939	19.6%
Money and property	104	1962	2066	2.4%
Social services	301	2584	2885	3.3%
Post and Telecommunications	193	1564	1757	2.0%
Total			**86211**	**100%**
	2009-2010			
	1430H			

Table 2.3 shows that there has been no significant improvement in the rate of accidents in the construction industry.

Table 2.3 The number of workers and accidents in the construction industry in Saudi Arabia, 2006-2010 (Adapted from GOIS, 2011)

Construction industry	Number of workers	Number of accidents
2006-2007	1,055,496	37,427
2007-2008	1,248,774	38,929
2008-2009	1,410,517	44,430
2009-2010	1,599,903	43,308

The impact of accidents in the construction industry in Saudi Arabia have been clearly classified and well documented since 2003 until the present by the GOSI. The general impact of accidents, safety, and health include the following:

- financial implications for the country, companies, and individuals
- loss of employee morale
- psychological consequences for individuals, families, and colleagues
- pain, suffering or death resulting in incalculable consequences to the country, the company, to the individual, families, and society at large.

For example, in 2010, five men were killed in a scaffolding accident on a construction site in Riyadh, Saudi Arabia, due to lack of normal inspection of scaffolding (Roberts, B 2010). In the following year, 11 men were injured and three were killed when a section of scaffolding collapsed on a construction site in Riyadh (ConstructionWeek Staff 2011). According to Berger (2008), in Saudi in 2005 there were 493 deaths and 102,259 injures. In contrast, only 28 deaths and 3,760 injuries were recorded in the UK during the same year. In order to identify factors associated with accidents in the workplace, the next chapter reviews previous research into occupational health and safety at construction workplaces in Saudi Arabia.

2.4 Summary

A brief background about KSA in regards to economic growth is presented in this chapter in order to understand the current situation of the country at macro-level. At micro-level, this chapter includes an explanation and discussion about the construction market in KSA and how it has been affected by the economic growth of the last ten years. As a result of the increasing price and demand for oil and gas, the Saudi government invests in many types of projects, such as petrochemical projects, power and water desalination plants, and industrial building and infrastructure projects.

This chapter emphasised the importance of project stakeholders in the context of Saudi's construction industry. The existing structure of the work environment in KSA was explained. Then, this chapter presented the socio-cultural determinants, and the weaknesses, of this industry. It is evident that the Saudi construction industry suffers from many weaknesses, but safety and health are demonstrably among the weakest.

Literature review

This chapter presents a literature review that emphasises the nature and theoretical underpinning of the major concepts which were the focus of the study. In preparation for the literature review, Cooper's (1988) Taxonomy of Literature Reviews was adopted to organise the review according to the research focus, goals, perspective, coverage, organisation and audience (Randolph 2009).

The literature reviewed dealt with the three topics most important to this study – construction industries, workplace safety and stakeholder theory. The chapter begins with an examination of the historical context of the construction industry worldwide, and the construction industry in Saudi Arabia specifically. It then moves on to safety in the construction industry, and explores ideas of why accidents occur. Empirical studies that deal with a safety culture in diverse settings are discussed, always with a view to understanding how safety performance can be improved.

The benefits of stakeholders' engagement in improving safety culture and reducing accident rates is examined by reviewing stakeholder theories and thinking. The review will demonstrate the influence of stakeholder theory on safety culture. Gaps in the literature which will be bridged by this research are revealed. The overview is presented as a simple diagram in Figure 3.1

3.1 The construction industry

The construction industry plays a vital role in all countries, because it contributes significantly to the economic and social development of any nation. The ancient Egyptians were one of the earliest cultures to develop innovative construction techniques in order to build pyramids, temples, and obelisks. Also, just as we do today, they too had to supervise, mobilise, and feed a labour force.

The economic growth of a nation is often associated with the construction going on in the country, such as housing, industrial complexes, roads, bridges, buildings and other projects. Consequently, the success of construction projects is of particular importance to stakeholders and governments (Wibowo 2009). The Australian construction industry, for example, in 2009-2010, contributed 6.3% to the gross product of all industries, as measured by production-based gross domestic product 'chain volume measures' (Pink 2012). With other developed countries, the case is similar. For example, in 2012, the Canadian construction industry contributed 7.0% to Canada's GDP (Statistics Canada 2013), and the UK construction industry contributed 6.8% to the UK's GDP (Davies 2013).

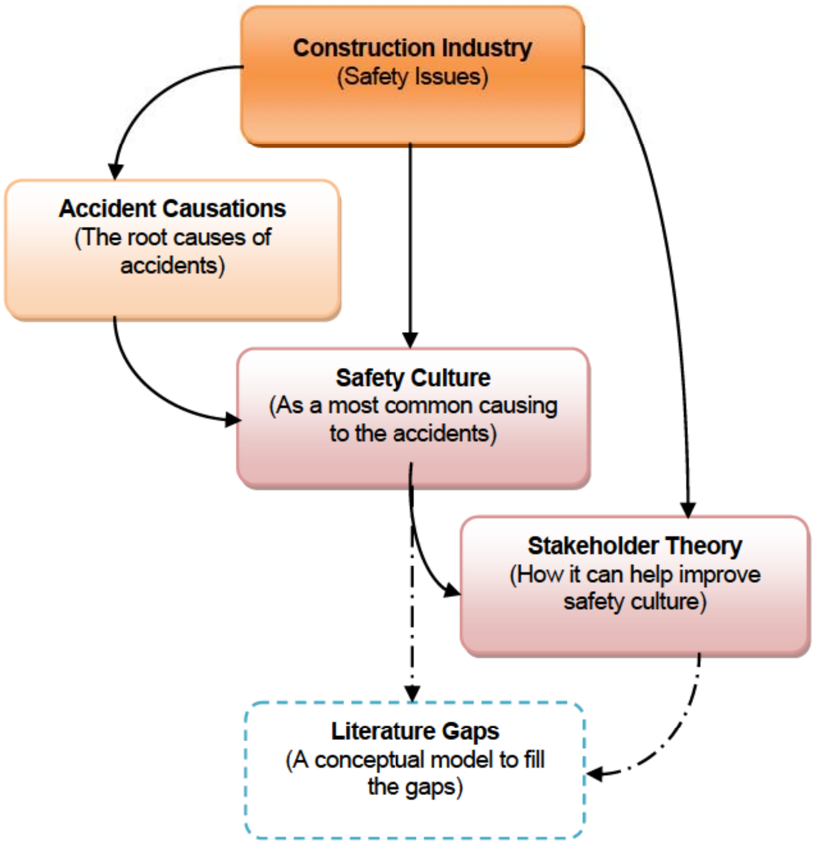

Figure 3.1 An overview of the literature review process

A study carried out in the Australian context has indicated that a 10% gain in the efficiency and productivity of the construction industry could lead to 2.5% gain in GDP (Stoeckel & Quirke 1992). This demonstrates the way in which a thriving, productive construction industry can influence any country's economic growth.

The construction industry involves many types of activities, and in terms of health and safety is considered unique by many researchers in terms of risk to life and limb. Construction industry conditions and organisation present a great challenge in terms of leadership, communication, and team integration, which all impact on health and safety.

3.1.1 The construction industry in the Kingdom of Saudi Arabia

The construction industry in the kingdom is one of the major areas of government investment. It has seen rapid expansion and development in the size and number of public construction projects in response to socio-economic changes in the kingdom. As mentioned in Chapter 2, the main drivers for these changes are the increase in oil and gas price and production, and changes in the country's society from the traditional desert lifestyle to a modern, more urban based one. In order to meet society's needs, the Saudi government is using its oil and gas revenue to invest in all types of modern developments, including oil and gas construction projects, petrochemical projects, power and water desalination projects, industrial projects, and building and infrastructure projects. Construction projects are in fact a core element of the country's modernisation strategy.

In 2008, Murray and Langford (2008) gathered a series of government reports relating to the nature of the construction industry and its productivity that provide data covering more than five decades. The papers indicate that the construction industry is risk averse and stubborn, and has not innovated compared with other advanced industries, such as aerospace and automotive (Lenard 1996; Sundquist 2012).

The industry has a very complex structure and operational pattern, involving different stages of and types of activities, technical processes. Resource suppliers and participants are many and varied, all of which causes considerable fragmentation. Construction organisations involve contractors, subcontractors, and other specialists. Managing the resource inputs and outcomes is a demanding and stressful process, with teams working long hours to meet deadlines that often have financial penalties. Under such conditions it is very difficult for workers to maintain safety standards and avoid hazards, even though they are capable of doing the work (Perez-Alonso *et al.* 2011; Phil 2010).

The nature of the construction industry as compared to other industries has always been a point of discussion. Chan and Chan (1996) refer to the nature of the product, its diversity, and the number of parties involved. Gambatese *et al.* (1997) refer to the diverse skills required, the location of the work, and its outdoor nature. Fredericks *et al.* (2005) refer to the dynamic work environments, multiplicity of operations, and proximity of multiple crews. Gambatese *et al.*

(1997) also point out that the changing environment in the construction industry makes workplace safety more challenging compared to other industries. For these reasons, among others, construction lags behind other industries in terms of productivity, quality, and, more relevant to this research, its poor record regarding occupational safety.

3.2 Safety: Definition and principles

Numerous definitions of safety are available in the literature; according to the Oxford Dictionaries safety is defined as 'the condition of being protected from or unlikely to cause danger, risk, or injury'. Also, British Standards Institution (2007, p. 3) defines occupational health and safety as 'conditions and factors that affect, or could affect, the health and safety of employees or other workers ..., visitors, or any other person in the workplace'.

3.2.1 Safety in the construction industry worldwide

Globally, the construction industry is labelled as one of the most dangerous sectors in terms of work safety, and occupational health and safety have become a major concern of both society and government (Choudhry, RM *et al.* 2008; Iain & Billy 2008; Phil 2010; Zou 2011). The likelihood of accidents is high, in spite of improvements over decades (The UK's Health and Safety Executive 2012). Construction in the 2011/12 data for the UK accounts for 22% of fatal injuries and 10% of reported major injuries throughout all industry, even though the construction industry accounts for only about 5% of the employees in Britain (The UK's Health and Safety Executive 2012). In Australia also, the construction industry records the highest number of fatal injuries of any industry: 17% of all compensated fatalities (Safe Work Australia 2013). In Europe, the construction industry has one of the worst workplace incident records, and around 47% of workers have indicated that they believe that their work affects their safety (EU-OSHA).

Providing a safe workplace is a global issue, and both developed and developing countries are attempting to solve the problem. In developed countries, new regulations and legislation have meant substantial improvement in the accident records. The UK's Health and Safety Executive (2012) reported that in the early 1990s the number of workers killed in the construction industry was around 125. By 1996/97 it was around 90, by 2005/06 around 60. For 2011/12 the fatal accident figure was 50.

3.2.2 Safety in Saudi's construction industry

In the case of the Kingdom of Saudi Arabia, 50.2% of the accidents are related to the construction industry because of the high degree of risk (GOSI 2010). For example, in 2010, five men were killed in a scaffolding accident on a construction site in Riyadh, Saudi Arabia, due to lack of normal inspection of the scaffolding (Roberts, B 2010). In 2011, 11 men were injured and three were killed when another section of scaffolding collapsed on a construction site in Riyadh (ConstructionWeek Staff 2011). According to Berger (2008), in Saudi in 2005 there were 493 deaths and 102,259 injuries among construction workers.

Stakeholders in the construction sector realise this situation is unacceptable and that serious thought must be given to reducing these numbers. However, in order to prevent an accident, there must be an investigation of its root causes. The next section explains several theories of accident causation to have a better understanding on why accidents occur.

3.3 Accident causation

The reasons why accidents occur in the workplace, or anyplace, have been much investigated. It has been largely accepted that accidents are unplanned events which result in physical harm to people and property (Ridley & Channing 2008), but how and why accidents happen has produced different models of causation. The most widely known theories and models of accident causation are:

- the domino theory
- Leather's potential accident subject model
- project management accident model
- distractions theory
- Rasmussen's work behaviour model
- the Swiss cheese model
- the ConCA model.

The section following explains these models in detail.

3.3.1 The domino theory

Heinrich (1959) evaluated over 70,000 industrial accidents when he was an official with an insurance company. He concluded that 88% of the accidents were caused by unsafe acts, 10% by unsafe conditions, and 2% were just unavoidable. He developed a *domino theory* of accident causation based on the assumption that an accident can be seen as the last domino in a sequence of events. The first domino involves the social environment and ancestry; the second, the worker's actions; the third, conditions and unsafe acts; the fourth, the accident itself; and the fifth, the injury.

Heinrich (1959) points out that organisations are at risk of accidents because there is a lack of proactive accident prevention. In addition, he confirmed that more than 90% of accidents are preventable in four ways: personnel adjustment, engineering revision, improving knowledge or skills, and rectifying improper physical environments. Thus, it is apparent that Heinrich's methods mainly focus on personnel management issues and unsafe acts.

The Health and Safety Commission of the United Kingdom (1993) found that most debates about accident causation are blame orientated, focusing on whether the cause was unsafe acts or unsafe conditions. Governments and bodies of regulators tend to favour the unsafe conditions option; their inspectors tend to focus on unsafe conditions and failure to meet legal requirements. Most organisations tend to favour the unsafe acts option because it limits their responsibility and liability. Therefore, investigations tend to focus on blaming somebody, usually the injured worker.

Heinrich's domino theory was further developed by Bird (1974). Bird added management and organisational aspects as causal factors in incidents. In the domino model, management control is the first domino in the accident sequence. Later, Bird and Loftus (1976) identified five dominoes which conclude with an accident:

1 *management loss of control*
failure to control the organisation's activities which lead to accidents

2 *origins*
root causes exist due to poor management

3 *symptoms*

substandard practices and conditions then occur

4 *contact*

incident may result in

5 *a loss event.*

Injecting a new, management control domino into this cascade may exert enough control to prevent an accident. On the other hand, Kjellén (2002) argues that the domino theory does not account for multiple causalities. Accidents in the workplace are rarely the result of some simple chain of events, yet in domino theory no clear distinction is made between the observable facts about the accident sequence and the uncertain relationship at organisational, management, and personal level.

3.3.2 Leather's potential accident subject model

Leather (1987) proposed the *potential accident subject* (PAS) model to illustrate the accident causation process in the construction industry. Both internal and external factors might affect the PAS's acts and lead to accidents. The PAS model stresses the dynamic relationship between different stakeholders and accidents, such as managers and workers. He notes that workers' behaviour and attitudes are affected by management systems, motivation, training, instruction, and so on, as provided by senior management (see Figure 3.2).

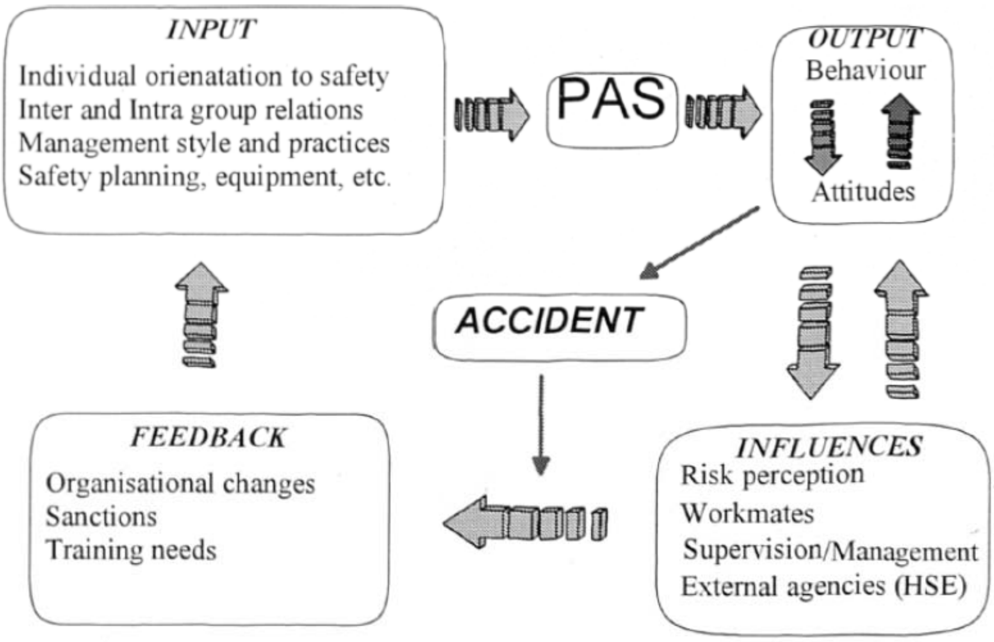

Figure 3.2 Leather's (1987) potential accident subject model (Leather 1987, p. 169)

3.3.3 Project management accident model

For the construction industry, Whittington *et al.* (1992) proposed *project management accident model* of accident causation based on the investigation reports of accidents (see Figure 3.3). Their model focuses on failures in project planning and execution, and illustrates the influence of failures made throughout the life cycle of a construction project. According to the authors, there are four key areas where failures can occur:

- company policy failures, e.g. training policy or methods of procurement
- project management failures, e.g. lack of planning
- site management failures, e.g. lack of communications or supervision
- individual failures, e.g. failure to comply with safety rules.

However, Whittington *et al.* (1992) acknowledged limitations to their research due to the small number of cases and the incomplete information in the accident reports. According to Haslam, R *et al.* (2005), since Whittington *et al.*'s research there have been important changes affecting safety management which demand that appropriate attention be paid to safety within construction design and management processes.

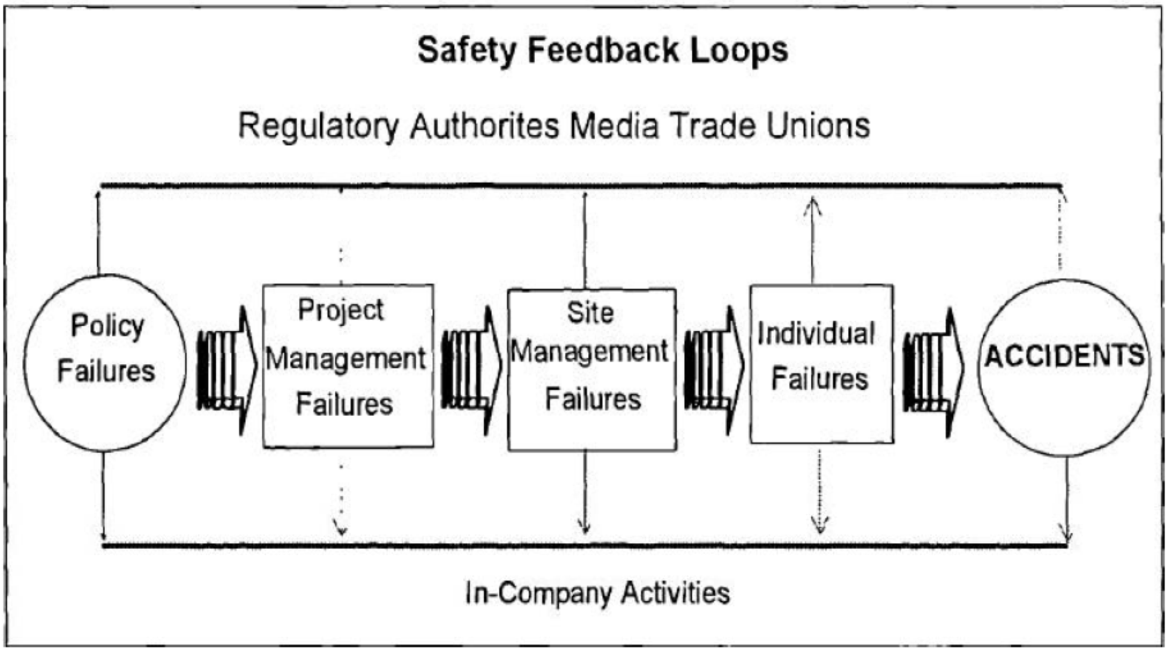

Figure 3.3 Project management accident model (Whittington et al. 1992, p. 97)

3.3.4 Distractions theory

The *distraction theory* of construction accident causation has been proposed by Hinze (1996). He argues that the risk of construction accidents is increased due to worker distractions, and correlates productivity with risks relative to worker stress and the probability of involvement in an accident. Hinze's theory has a site-based focus, and proposes that the probability of an injury will increase and productivity will decrease if the workers are more distracted by hazards. However, when hazards are removed, and the distractions to workers are reduced, then safety and productivity will be compatible. For instance, according to the author, providing a scaffold for workers reduces risks of falls and increases their productivity. Also, positive and negative personal life events such as illness, or celebrations, can distract workers from their tasks. Hazards should be removed from the workplace and managers should always focus on safety first and then productivity (Hinze, JW 1996).

3.3.5 Rasmussen's work behaviour model

Rasmussen's *work behaviour* model identifies three zones associated with levels of safety: a safe zone where workers comply with safety procedures and rules; a hazards zone; and a loss of control zone. Figure 3.4 illustrates how workers tend to move around the boundary of functionally acceptable performance and the limit of loss of control, which brings them into the hazard zone. Therefore, Rasmussen proposes that in order to prevent accidents, organisations should focus on error tolerant work systems which makes the boundary of loss of control visible and reversible (Rasmussen *et al.* 1994).

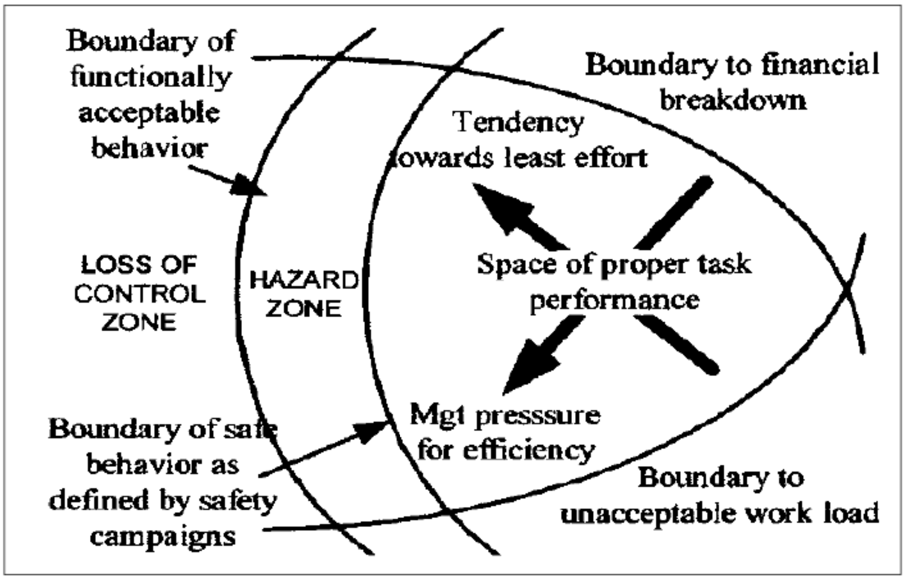

Figure 3.4 Rasmussen's work behaviour model (Rasmussen et al. 1994, p.149)

3.3.6 The Swiss cheese model

Reason (1997) proposed the *Swiss cheese model* to describe the causes of accidents. He argues that a safety system has layers of safeguards to prevent potential accidents. However, all the layers have holes and are not impervious. When these areas of weakness (holes) align, the potential for accidents is manifestly increased. Figure 3.5 illustrates the Swiss cheese model. Employee's activities and management decisions mean that individual holes will remain dormant until a trigger event results in an accident by aligning two or more. Therefore, the potential hazards of *latent* failure must be identified, rather than just reacting in response to active failures.

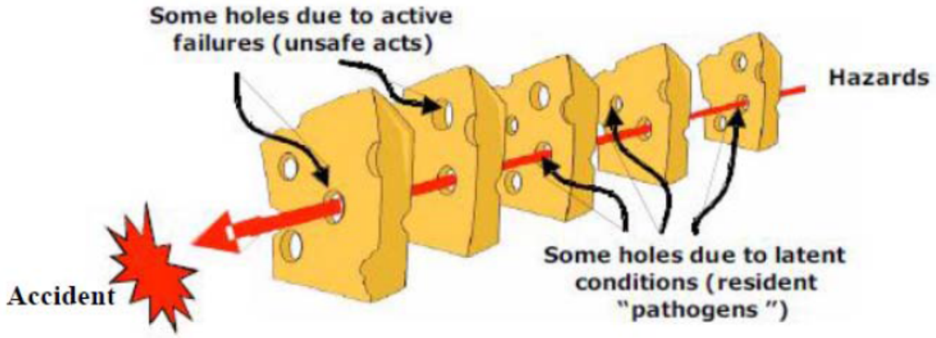

Figure 3.5 Reason Swiss cheese model of accident causation (Reason, JT 1997, p. 9)

3.3.7 The construction accident causation (ConCA) model

Haslam, R *et al.* (2005) developed the *construction accident causation* (ConCA) model with a focus on accident causation in construction projects. The model identifies three layers in injury events: immediate accident circumstances; shaping factors; and originating influences (Khanzode *et al.* 2012).

According to Haslam *et al.* (2005), the **immediate accident circumstances** occur as a result of a failure in the interaction between the employee and the team, workplace issues, and/or problems with materials and equipment. The **shaping factors** include factors based in the employee, such a lack of knowledge, skills, and supervision; workplace factors that include the organisation and hygiene of the workplace; and equipment factors that are a reflection of equipment design and appropriate usage. The **originating influences** include construction design and processes, project management, risk management, safety culture, client and economic influences, and safety education and training.

Haslam *et al.* (2005) note that it is very clear that the originating influences do affect safety on construction sites, but are difficult to trace in accident investigation because of their subtlety. Gibb *et al.* (2006), therefore, use Reason's approach to improve the ConCA model, arguing that Reason's theory strongly supports multi-causality, since the different holes could be located anywhere in the 'cheese' and align spontaneously.

Figure 3.6 illustrates that Reason's theory is based on major incidents and Gibb *et al.* (2006) applied this approach to ConCA accident causality results. As result, the layers become the originating influence, the shaping factors, and the immediate accident circumstances.

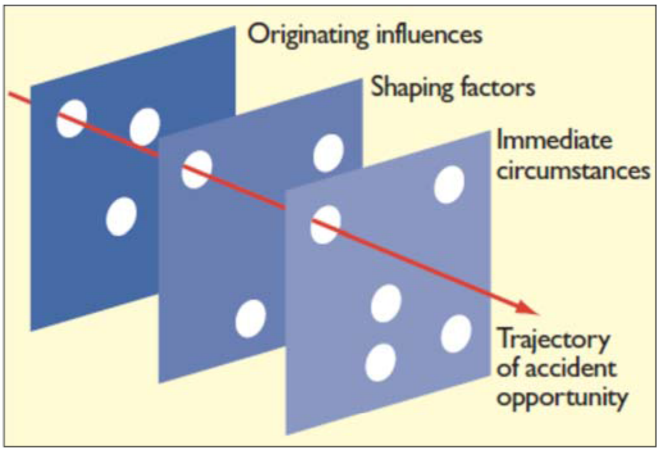

Figure 3.6 The ConCA model, after Reason's model (Gibb et al. 2006, p. 47)

To conclude, accidents in construction workplaces occur because of a failure of one or more indirect and/or direct factors, as summarised in Table 3.1. Accident causation models focus on management characteristics, human variables, and hazard aspects. Unfortunately, accident causation models are not interfaced with hazards identification and risk assessment, and there is a gap in our understanding of how risks become accidents (Khanzode *et al.* 2012).

Table 3.1 Summary of seven accident causation models

Accident causation model	The reason why accidents happen
The Domino Theory	Management loss control and a chain of loss event
Leather's Potential Accident Subject Model	Failure of management system, loss motivation, and inappropriate training and instruction which given by top management
Project Management Accident Model	Company policy failure, project management failure, site management failure, and individual failure
Distractions Theory	Distractions by hazards
Rasmussen's work behaviour model	Not comply with safety rules, hazards, and loss of control
The Swiss Cheese Model	Failures caused by management decisions
The ConCA Model	A failure in the interaction between worker and team work, workplace issues, and materials and equipment. Also it affected by the shaping factors and the originating influences

3.3.8 Root causes of the accidents in the Saudi construction industry

In the case of the Kingdom of Saudi Arabia, Almahmoud *et al.* (2012) conducted an empirical study on construction projects through a comprehensive review of project performance history, using performance indicators to establish the first slice of the Swiss cheese model applied in the Saudi context.

According to the authors, the result was used to develop the *Swiss cheese performance management framework* in order to identify the root causes of any shortcomings in the project delivery process. Their research demonstrated

- no clear direct link between safety and engineering
- no clear direct link between safety and risk management
- that workers do not follow basic safety regulations
- that at the construction sites, there are no safety and security plans.

These points coincide with findings by Al-Kudmani (2008), who recommends the immediate elimination of unsafe conditions by determining the root causes of behaviour that exposes employees to danger. His research strongly points to human factors as the basis for accidents: lack of knowledge or skills; a conflict between safety rules and their practical application; unsafe personal choices; personal factors; cultural barriers to safety; ineffective management systems; inappropriate rewards; along with inadequate facilities and equipment; and inadequate or inefficient feedback.

3.4 The big picture: Organisational and safety culture

Improving workplace safety usually concentrates on individual human failures and technical issues (Gadd, 2002). Most of major accidents, such as the meltdown at Chernobyl, the fire and explosion on the Piper Alpha or the grounding of the Exxon Valdez, all highlight the contribution to major accidents of the organisation's procedures and policies.

For example, when BP's *Deepwater Horizon* oil well spilled oil into the Gulf of Mexico in 2010, the judge ruling on the later litigation commented that BP had acted with 'conscious disregard of known risks' and that 'employees took risks that led to the largest environmental disaster in US history', because the company had allowed a reckless culture to dominate its decision making capacity (Fisk & Feeley 2014).

The organisational safety culture is of critical importance, therefore, and the characteristics of an organisation and safety culture are discussed in more detail in this section.

According to Hofstede, GH (2001), culture is:

> *transmitted and created content and patterns of values, ideas, and other symbolic-meaningful systems as factors in the shaping of human behaviour and the artefacts produced through behaviour. (Kroeber, & Parsons ,1958, p. 583)*

It is a shared mindset that distinguishes one group from another. Miraglia *et al.* (1999) point out that culture works as a template which shapes human behaviours in the form of values and practices; culture is learned and shared, and it is determined by contextual factors.

3.4.1 Organisational culture

An organisation's values, its objectives, and its resources must be congruent with one another. Turner and Pidgeon (2004) demonstrated that:

> *part of the effectiveness of organisations lies in the way in which they are able to bring together a large number of people and imbue them for a sufficient time with a sufficient similarity of approach, outlook and priorities to enable them to achieve collective, sustained responses which would be impossible if a group of unorganized individuals were to face the same problem. (Turner & Pidgeon, 2004, p.47)*

Cooper (2000) defines corporate culture as:

> *... to reflect shared behaviours, beliefs, attitudes and values regarding organizational goals, functions and procedures. (Cooper, 2000, p.112)*

A strong organisational culture, in the view of Tharp (2009), has the ability to reduce ambiguity by creating a proper way to explain problems, create a sense of continuity and expectation, provide an identity and commitment, and provide a future vision for the organisation. Tharp (2009) also notes that organisational culture requires management, because it is an asset that can influence the achievement of organisational targets.

Organisational culture influences how people perform tasks, set targets, and administer the resources required to achieve those targets. It is reflected in how people feel, think, act, and make decisions in response to threats and opportunities affecting the organisation (Thompson, JL & Martin 2010).

Importantly, organisational culture includes subcultures, which can either be in alignment or at odds with the dominant cultural theme (Cooper, MD 2000; Dawson 1992, cited in Cooper, MD 2000). The size of an organisation, its geographical dispersion, the hierarchies of authority, the ways of communication, physical locations of labour, rules and regulations, workers' characteristics, shared experiences between workers, ethnicity, training, education and the ongoing work demands all contribute to the dominant culture and attendant subcultures.

Erez and Gati (2004) point out that the fit between organisational culture and management practices is critical and management behaviour tends to be constrained by an existing culture, which affects overall performance by influencing problem solving and decision making (Christensen & Gordon 1999). According to Deal and Kennedy (1982) certain cultural directions lead to strong and effective performances, while other directions result in failure. Clearly, there is evidence in the literature for the hypothesis that organisational culture and management practices influence the performance of construction projects.

3.4.2 Concepts of a safety culture

In the 1980s, researchers into the science of safety considered human error to be one of the sources of accidents, having already noted the dangers of the physical workplace in the technical phase and moved into the socio-technical phase (Reason, J 1993). At that time, it was agreed that the interaction between technical systems and various social situations caused accidents in the workplace. When analysing the accidents, it was in this context that researchers and practitioners considered social and organisational factors.

The term *safety culture* was introduced in an International Atomic Energy Agency (IAEA) report after their analysis of the nuclear accident at Chernobyl, Ukraine, in 1986 (Cooper, MD 2000; International Safety Advisory Group 1991). According to the agency (1992), a poor safety culture contributed to the disaster. The IAEA defines safety culture as:

> *that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance. (International Safety Advisory Group 1991, p. 1)*

Numerous other definitions of safety culture exist in the literature. Table 3.2 records examples of selected definitions.

Table 3.2 Selected safety culture definitions

Reference	Definition of safety culture
Turner *et al.* (1989)	the set of beliefs, norms, attitudes, roles, and social and technical practices that are concerned with minimizing the exposure of employees, managers, customers and members of the public to conditions considered dangerous or injurious
Cooper, D (1998)	the product of multiple goal-directed interactions between individuals ,jobs, and organization
Guldenmund (2000)	those aspects of the organizational culture that will impact on attitudes and behaviour related to increasing or decreasing risk
Hale (2000)	the attitudes, beliefs and perceptions shared by natural groups as defining norms and values, which determine how they act and react in relation to risks and risk control systems
Harvey *et al.* (2002)	safety culture is viewed as involving perceptions and attitudes as well as the behaviour of individuals within an organization
Richter and Koch (2004)	safety culture as the shared and learned meanings, experiences and interpretations of work and safety – expressed partially symbolically – which guide peoples actions towards risks, accidents and prevention
Fang *et al.* (2006)	a set of prevailing indicators, beliefs, and values that the organization owns in safety
Fernández-Muñiz *et al.* (2007)	A set of values, perceptions, attitudes and patterns of behaviour with regard to safety shared by members of the organization; as well as a set of policies, practices and procedures relating to the reduction of employees exposure to occupational risks, implemented at every level of the organization, and reflecting a high level of concern and commitment to the prevention of accidents and illnesses
Nævestad and Bjørnskau (2012)	safety culture could be defined as safety-relevant aspects of culture in organizations
Choudhry, R *et al.* (2007b)	Construction safety culture could be defined as: the product of individual and group behaviours, attitudes, norms and values, perceptions, and thoughts that determine the commitment to, and style and proficiency of, an organizations system and how its personnel act and react in terms of the company's on-going safety performance in construction site environments

According to Flin (2007), the most widely accepted definition of safety culture was introduced by Advisory Committee for the Safety of Nuclear Installations (ACSNI):

> *The safety culture of an organisation is the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation's 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 preventive measures. (ACSNI & HSC 1993, p. 23)*

According to the IAEA (1991), the definition of safety culture highlights two points, that 1) safety culture is about good safety attitudes, along with a good establishment of safety management; and 2) a good safety culture should be considered a number one priority.

According to Richter and Koch (2004) 'Safety culture is viewed as a focused aspect of the organizational culture'. Haukelid (2008) points out that it is important not to separate safety culture from organisational culture, and Richter and Koch (2004) define safety culture as:

> *... the shared and learned meanings, experiences and interpretations of work and safety – expressed partially symbolically – which guide peoples' actions towards risks, accidents and prevention. (Richter & Koch 2004, p. 705)*

The concept of safety culture has increasingly become a part of academic literature, and the idea of working in a safe work environment is largely embedded in organisations in developed nations. The idea of safety culture and safety management are largely accepted by businesses (Cooper, MD 2000; Guldenmund, FW 2000). Cooper (1998) argues that the organisation's safety culture affects not only accident rates, but also quality, productivity, absenteeism, commitment, loyalty, work methods, and work satisfaction, while being a source of influence in determining outcomes (Cipolla *et al.* 2005), for better or worse.

Safety culture in the construction industry, according to Choudhry, *et al.* (2007b), is considered to be the dynamic combination of management attitudes and activities, worker behaviour, and site environment. Therefore, the authors define safety culture in the industry as:

> *the product of individual and group behaviors, attitudes, norms and values, perceptions, and thoughts that determine the commitment to, and style and proficiency of, an organization's system and how its personnel act and react in terms of the company's on-going safety performance in construction site environments.(Choudhry et al. 2007b, p. 211)*

This comprehensive definition of construction safety culture is the most relevant to the current research because it relates to people's behaviours, attitudes and thoughts, to management style, commitment to safety, and ability to manage safety concerns. It also relates to safety performance through the organisation's safety management system (Choudhry, R *et al.* 2007b).

3.4.3 Safety culture models

Safety culture models have appeared in the academic literature for many years. According to Reiman and Rollenhagen (2013), there is a large difference in their conceptualisation, ranging from descriptive to normative models. The aim of the current research was to study some examples of the multitude of safety culture approaches.

An examination of the models shows that the concept of a safety culture is contested, and therefore opens up other opportunities to enhance safety performance and protect individuals and groups from accident hazards when regulations, procedures, and stakeholder involvement in an organisation are absent or insufficient.

Geller (1996) proposes a model for a total safety culture which recognises the relationship between environment, person, and behaviour. The model is based on the psychology of safety, which focuses on the attitudes and behaviour of the workers on the job. Moreover, the author supports his model with a set of 10 values or principles which form the total safety model. However, the model only helps senior management to empower their employees approach to safety, and the actually relationships between the environment, person, and behaviour are not addressed (Cooper, MD 2000).

Grote and Künzler (2000) propose a safety culture model based on socio-technology, which links the relationships of people, technology, and the organisation to safety. The authors used a quantitative method to assess the organisation's safety management and provide data on workers' perceptions of operational safety, safety design and strategies, and personal job needs. Grote and Künzler (2000) argue that their method allows auditors to diagnose the safety culture of an organisation. However, researchers, such as Choudhry, R *et al.* (2007a) point out that the model is schematic and in reality cannot assess a safety culture.

Cooper, MD (2000) believes that safety culture is a subculture of organisational culture, and that it is the overarching culture which affects workers' attitudes and behaviours in relation to safety performance. He maintains that there is no universally accepted model that effectively accounts for employee behaviour. Therefore, he proposes a safety culture model based on psychological, behavioural, and situational factors. According to Cooper, attitudes can be assessed by safety climate surveys, behaviours can be assessed by checklists, and the situational aspects can be assessed by inspections and audits. The model is similar to the *total safety culture* model, the main difference being the use of the term 'situational' rather than 'environmental', because Cooper's model is based on an engineering approach rather than social cognitive theory (Cooper, MD 2000).

Chinda and Mohamed (2008) developed a model of a construction safety culture based on the internationally recognised European Foundation for Quality Management (EFQM) excellence model. The authors investigated the interactions and relationships among five enablers of construction safety culture – *leadership, policy and strategy, partnerships and resources, people, processes*, and *goals*. The researchers used a questionnaire to elicit workers' opinions of their current organisation's safety practices and performance, and used structural equation modelling to test the hypothesised interrelationships between the enablers.

They found that firstly, the *leadership* enabler directly influences the implementation of *policy and strategy*, and indirectly, *partnerships and resources*. Secondly, *partnerships and resources* was found to indirectly affect *processes* through *policy and strategy*, which likewise appears to be indirectly influenced by the *people* enabler. According to Mohamed and Chinda (2011), the model is based on logical assumptions, and they believe that organisations in the construction industry will improve their safety performance by improving these enablers.

Baram and Schoebel (2007)**.** Because of the importance of the concept, workshops are held on safety culture issues raised by rapidly advancing technologies, with emphasis on accident prevention, organisational learning, and safety management systems (Baram & Schoebel 2007). According to Baram and Schoebel (2007), the 23rd NeTWork Workshop held at the University of Berlin sought to develop collective knowledge resulting from research and practice, with the aim of improving safety culture in the workplace, reducing accidents, eliminating uncertainties, obstacles and boundaries, learning from successful practices, and obtaining an agenda for future research needs.

Twenty-one participants from different disciplines were brought together to determine what had been learned about safety culture. According to the authors, the participants introduced several models of safety culture that focus on the cultural determinants of safety behaviour. The common view among participants was that social processes, mainly power relations within an organisation, are the drivers of safety culture and performance (Baram & Schoebel 2007).

According Baram and Schoebel (2007) the difference between the models relates to the emphases of the various researchers. **Theory-based models** refer to psychological determinants of culture, such as attitudes, values, personal experiences and the basic perceptions of safety among the employees. On the other hand, the **holistic models** refer to the structural aspects of an organisation and its embedded processes, which are associated with the design and function of safety management and compliance programs. Neither type of model illustrates the influence of safety culture on individual or group behaviour, because of the difficulty in drawing firm conclusions solely from observable artefacts (Baram & Schoebel 2007).

Another type of model **evaluates the maturity level of a safety culture**, integrating tangible and intangible elements, including all the many dynamic aspects of culture. The model also measures change, and is tailored towards changing the behaviour of employees. In order to test the readiness for change, **Hudson, PTW and Willekes** (2000) developed tools to measure the safety culture by using Westrum's model (1993) based on the five dimensions of communication, organisational attitudes, health and safety, organisational behaviour, and working behaviour.

The model devised by **Westrum** (1993) also identified the types of organisational culture based on how an organisation processes information, which included pathological, bureaucratic, or generative processes. Four years later, **Reason, JT** (1997) added the additional factors of reactive and proactive to Westrum's model (1993). And in 2001, **Hudson** proposed a *safety culture maturity model* developed from Westrum (1993) and Reason (1997).

Hudson's (2001) model extended to five stages and replaced the *bureaucratic* label with *calculative*[1]. Later, a tool was developed by **Gordon and Kirwan** (2004) to measure the current level of safety culture among designers in air traffic by using the Fleming (1999) and Hudson (2001) models, 21 elements which have been bundled into four main collections:

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[1] An organisation that has struggled to become proactive may easily revert, especially in the face of success. Calculative organisations have many characteristics that are essentially anti-bureaucratic; the hierarchical structures break down under high-tempo operations.

- the nature of the management
- planning and organising for safety
- communication, trust and responsibility
- measuring, auditing and review (Gorden & Kirwan 2004).

In 2006, two empirical studies used Hudson's model (2001) and tangible aspects of safety culture from Zohar (2000), along with a survey from Lawrie (2006), to investigate the development of safety culture maturity in an organisation (Lawrie *et al.* 2006; Parker *et al.* 2006). In 2007 the model, re-labelled as health, safety and environment (HSE) culture leader, has been used to implement a safety culture in a major multi-national firm, and has become the industry standard of the International Association of Oil and Gas Producers (IAOGP).

Lastly, in Brazil 2010, a framework was developed to measure safety culture maturity based on the model of Hudson (2001). It includes five features of a positive safety culture: information, organisational learning, involvement, communication, and commitment (Filho *et al.* 2010) . The researchers believe that from the framework and the model it is possible to identify the levels of organisational safety culture maturity.

Although the idea of a safety culture has been widely used for many decades by academics and practitioners, the concept of safety culture is not precisely clear. According to Choudhry, R *et al.* (2007a), there is a major limitation within the concept of safety culture wherein no accepted model of safety culture exists. This is due to both a lack of agreement, and the lack of its integration into general models of organisational culture (Edwards, JRD *et al.* 2013). Thus, it is beneficial to return to the traditional concept of culture in order to effectively translate it to organisational and safety culture.

3.4.4 Reviews of the safety culture literature

In order to understand the concept of safety culture, a number of past studies were examined. Table 3.3 is a summary of safety culture. A study by Biggs *et al.* (2013) presents leaders' perceptions of safety culture in a large construction organisation in Australia. By using semi-structured interviews and an online survey, they found that leadership is a key factor for a positive safety culture in an organisation, along with being committed to safety, and being seen to be committed. Barriers to a safety culture included the speed of change, subcontractor management issues, and reporting requirements.

Table 3.3 A summary of past studies about safety culture

Reference	Summary of Research
Biggs *et al.* 2013	reports safety leaders' perceptions of safety culture in a construction company.
Zou 2011	reviews safety program related to worker's beliefs and attitudes, safety commitment among top management, stakeholders involvement, safety risk management systems, and incentive program which implemented by five construction companies
Mohamed & Chinda 2011	investigates the interactions among five key enablers of safety culture along with its impact on organisational safety targets
Teo, E. & Feng 2011	examines the safety investment impacts the safety performance of construction projects
Shan *et al.* 2011	examines the impact of management practices such as information system and safety culture on construction productivity
Phil 2010	explores safety attitudes of subcontractors in the construction industry
Teo, Evelyn & Feng 2009	examines the relationship between safety climate and overall safety culture in construction organisations
Andonakis & Loosemore 2007	explores the nature and extent of problems faced by subcontractors in implementing the ohs regulation
Huang, X & Hinze, J 2006a	presents the relationship between project safety culture and the owner's influence, with particular focus on project characteristics, the selection of safe contractors, contractual safety requirements, and the owner's participation in safety management during project execution
Geldart *et al.* 2005	compares the safety policies, practices, and attitudes in 120 firms for over 10 years
Behm 2005	establishes a link between construction fatalities and design for construction safety concept
Tam *et al.* 2004	reveals that the behaviour contractors, lack of provision of ppe, regular safety meetings, and safety training are of grave concern
Siu *et al.* 2004	examines the relations among safety attitudes, psychological strains, and safety performance

Looking for ways to improve safety in construction companies, Zou (2011) conducted qualitative research by reviewing programs implemented by five construction companies in developed countries. He reviewed their objectives and the lessons learned from each. From the five case studies, he found seven elements that were crucial in shaping employees' beliefs and attitudes:

1 the belief that all accidents are preventable

2 a strong commitment to safety by top management

3 extending safety management issues to involve all stakeholders

4 identifying, assessing, and responding to all hazards on-site

5 a clear authority for safety

6 safe behaviour rewarded

7 capturing lessons learned from previous incidents.

Therefore, Zou (2011) suggests that organisations adopt a holistic strategy, incorporating the above seven elements in order to achieve a strong safety culture. Finally, the author proposes a conceptual model for fostering a strong construction safety culture that includes top management commitment and leadership, a safety management system, safety risk management, safety knowledge, rewards and recognition, training, worker empowerment, and supply chain member and stakeholder involvement.

Teo and Feng (2011) found that the effect of safety investment on safety performance is mediated by safety culture. The researchers conducted structured interviews with project managers and safety officers at construction projects. Their result shows that the safety culture mediates the relationships between safety investment and safety performance. As a result of their study, a model was proposed to explain the causal relationship between safety investment, safety culture, and safety performance.

In a review of the safety culture literature, Edwards, JRD *et al.* (2013) identified a synthesised conceptualisation of safety culture, which includes:

- *pragmatic culture (practices and activities)*

  The pragmatic conceptualisation is based strongly upon practice theory, which views culture in terms of the shared safety practices of organisational managers and practitioners (Edwards, JRD *et al.* 2013). This point is highlighted by Zacharatos *et al.* (2005) who discussed common approaches to safety culture. One of these approaches was labelled as management practices, which positively associated with safety culture. Mearns, K *et al.* (2003) point out that safety management practices are a subset of safety culture, which relate to the actual activities and functions associated with remaining safe. Similarly, Cheng *et al.* (2012) explored the effectiveness of safety management practices on employee behaviour and awareness of safety work. They found that safety management practices are associated with safety culture (behaviour and awareness).

  The pragmatic conceptualisation is based strongly upon practice theory, which views culture in terms of the shared safety practices of organisational managers and practitioners (Edwards, JRD *et al.* 2013). This approach has been discussed in safety literatures and labelled as management safety practices, and they are a subset of safety culture (Cheng *et al.* 2012; Mearns, K *et al.* 2003; Zacharatos *et al.* 2005).

- *anthropological culture (behaviours and attitudes)*

  The anthropological conceptualisation is based upon attitudes, beliefs, values, and assumptions shared by members of an organisation (Edwards, JRD *et al.* 2013). The researchers argue that this conceptualisation of a safety culture through behaviours and attitudes means that representatives of the organisation will be able to observe whether safety culture development will be accepted or rejected by employees, and how the safety culture can best be implemented to align with organisational culture. In effect, aspects of safety culture, such as attitudes, values, and basic assumptions enable an organisation to understand how safety in the workplace is viewed by its members, an understanding that can be used to determine ways of improving safety performance, and the safety culture itself (Baram & Schoebel 2007).

  When discussing organisational culture and safety culture, Guldenmund (2000) found that when cognitive, affective or behavioural processes preceded attitudes, then attitudes would yield cognitive, affective as well as behavioural responses. According to Guldenmund (2000) the core of safety culture is the basic assumptions that guide behaviour and determine how group members perceive, think and feel about their workplace (Schein 1996).

  Guldenmund (2010) notes that culture as assumptions and attitudes provides norms of perceptions, actions, thoughts, and behaviour, and supports his argument by citing Spradley and McCurdy's (1975), who saw culture as shared knowledge that determines patterns of thinking and behaviour. From this definition he points out that these assumptions and attitudes influence people's behaviour, Guldenmund (2010) cites Spencer-Oatey's definition (2000):

  > *Culture is a fuzzy set of attitudes, beliefs, behavioral conventions, and basic assumptions and values that are shared by a group of people, and that influence each member's behaviour and each member's interpretations of the 'meaning' of other people's behaviour. (Guldenmund 2010, p. 1472)*

The anthropological approach explores beliefs, assumptions, and shared values of an organisation's members, and seeks to understand the organisation's safety culture in order to meet an estimated benchmark (Edwards, JRD *et al.* 2013). Also, Teo and Feng (2009) found that these assumptions and attitudes are a snapshot of safety culture and can be assessed by questionnaires in order to determine what should be done to improve individual performance and the safety culture itself.

Regarding assessing and measuring safety culture, such as basic assumptions and attitudes, Choudhry, R *et al.* (2007a) found that this assessment should be understood within a specific context, and pay attention to selecting a group or organisational level. Therefore, the current study focussed on the organisation's safety attitudes in order to distinguish the member of one category from another (Hofstede, GH 2001).

- *normative culture (policies and procedures)*

  The normative conceptualisation is based upon organisational safety systems and structures, which measure the strength of safety management systems and utilises the measuring to benchmark an organisation in order to identify weaknesses in the safety culture (Edwards, JRD *et al.* 2013). According to Baram and Schoebel (2007), this type of safety culture is related to the structural and functional aspects of the organisational safety management system, which deals with organisational efforts to formalise positive safety culture. Guldenmund (2010) points out that safety management systems are a part of safety culture. They are dedicated to focussing on organisational structures in order to influence the organisational culture.

  According to Guldenmund (2000) the first normative approach to safety culture was put forward by Glennon (1982) and he describes safety culture as the perception of organisational reality. In 1991, the International Safety Advisory Group also followed a normative approach by applying a safety framework within an organisation at all levels which could benefit both organisations and individuals. Likewise, Edwards, JRD *et al.* (2013) noted that Pidgeon (1991) used the term 'a normative element' when discussing safety culture. The normative approach to safety culture is to evaluate the culture rather than describe and understand it (Guldenmund, F 2010). Also, the normative level of procedure is a contributory factor in safety culture (Fang & Wu 2013; McDonald *et al.* 2000), and it should be employed in order to advance to a more developed level of safety culture (Guldenmund, F 2010).

  The normative approach of safety culture may be used as a solution or tool for an organisation in order to improve or maintain safety outcome by evaluating safety culture (Frazier *et al.* 2013). For example, organisations can use this approach to evaluate their strength of safety culture. If they find out that they have a weak safety culture, they should begin to strengthen it, or if they find out that they have a strong safety culture, then they should begin to maintain that safety culture by implementing a safety management system (Edwards, JRD *et al.* 2013). This type of system will have a positive impact on the safety outcome (Fernández-Muñiz *et al.* 2007).

Termed the safety management system in the current research, this type of safety culture is considered to be a set of integrated aspects of the organisation that specifies objectives, policies, plans, distributes responsibility, procedures, organises, and controls the risks according to safety precautions (Antonsen 2009b; Fernández-Muñiz *et al.* 2007). According to Fernandez-Muniz *et al.* (2009) researchers have previously paid little attention to defining the safety management system, therefore safety management system is defined as:

> *an integrated mechanism in organisations, designed to control the risks that can affect workers' health and safety, and at the same time to ensure the firm can easily comply with the relevant legislation. (Fernández-Muñiz* et al. *2009, p. 981)*

Previous research has debated the content of the safety management system and no consensus has been reached about the key dimensions to making up the system (Fernández-Muñiz *et al.* 2007). Fang and Wu (2013) pointed out that the system represents safety rules and management approaches, whereas Frazier *et al.* (2013) found that it includes actions to use to manage safety, such as assigning safety officials, creating safety committees, creating and performing polices, and developing prevention strategies.

In the same trend, Fernandez-Muniz *et al.* (2009) obtained a combination of the dimensions of the safety management system from both common safety standards and empirical studies that investigate the safety culture. They identified key aspects of safety management systems which include: policy, incentives, competence development, communication and safety information transfer, planning, and control and review. The relationship between safety management system and safety culture, McDonald *et al.* (2000) argue is the main element of the safety management system, which includes policy, standards, planning and organisation, operation, monitoring, feedback, and change.

On the other hand, safety management standards also have common components. AS/NZS 4801:2001 and OHSAS 18001 standards comprises OHS policy, planning, implementation and operation, checking and corrective action, and management review, whereas, Health and Safety Executive HSG65 (1997) standard includes policy, organising, planning and implementing measurement and performance review, and auditing. According to Santos-Reyes and Beard (2002) these standards provide integrated components of safety management elements as a set of management system aspects that provide a systematic process for planning, implementing, monitoring, taking corrective action, and reviewing, along with hazards assessment control measures to prevent incidents. These safety management system aspects are similar to quality and environment control.

- *safety outcomes (safety performance)*

  Finally, safety performance (as an outcome) is about how well the organisation manages its hazards (Reason, JT 1997), since good hazard management can increase the organisation's resistance and lower the risk of accidents (Nevhage & Lindahl 2008). In the current research, safety performance was used to define the quality of the outcomes resulting from safety culture activities carried out to ensure safety in the workplace (Nevhage & Lindahl 2008; Wu, T-C *et al.* 2009).

  The last element of the traditional concept of safety culture is safety performance. Safety performance is about how well the organisation manages its hazards (Reason, JT 1997), which can increase its resistance and lower the risk of accidents by positive safety performance, or decrease its resistance and increase the risk of accidents by negative safety performance (Nevhage & Lindahl 2008). Edwards, JRD *et al.* (2013) view safety outcome or safety performance as if it is merely a representation of a safety culture's interpretation. Other studies, such as Wu, T-C *et al.* (2008), consider safety performance as a subset of organisational performance, and find that the safety culture within an organisation is positively related to safety performance.

  There is no common definition for safety performance (Wadsworth & Smith 2009), but in the current research safety performance defines the quality of the outcome resulting from safety culture activities, when an organisation carries these activities out in ways that ensure safety (Nevhage & Lindahl 2008; Wu, T-C *et al.* 2009).

  Safety performance is difficult to measure (Wadsworth & Smith 2009). Self-reporting, accident rate, and compensation costs, and officially recorded accident date are poor measures of safety performance, because accidents can be rare events, the accident may not be recorded accurately, and the inherent risk may not be taken into account (Choudhry, R *et al.* 2007a; Wadsworth & Smith 2009). Choudhry, R *et al.* (2007a) found that many studies advocate for the use of proactive measures that focus on safety activities to attain system success rather than system failure, which mean that organisations can identify problem areas before a system failure (Wadsworth & Smith 2009).

  Choudhry, R *et al.* (2007a) point out that the measurement of safety performance can be categorised into two approaches: lagging indicators and leading indicators. Lagging indicators basically measure an historical event of safety in terms of reactive and downstream effects, such as compensation costs and accident rates, which measure the level of safety failure. Leading indicators are proactive measures and upstream which measure safety culture, hazard identification, safe behaviour, and safety activities that assure the success of a safety management system.

Regarding the dimensions of safety performance, Wu, T-C *et al.* (2009) found that many authors (Downs 2003; Schneid 1999; Swartz 2002; Wu, T 2005) have recommended safety performance's dimensions at the organisational level, such as: safety training and education, hazard control, communications, safety motivation, safety planning and administration, and accident investigations and statistics. At the group level, Wu, T-C *et al.* (2009) point out that Petersen (2005) suggested that the safety performance of top management could be measured by inspections, training, accident investigations, and motivation.

According to Wu, T-C *et al.* (2009) safety inspections are indicated in order to inspect employees' behaviour toward safety and safety equipment in the workplace, and involve observation, evaluations, and strict oversight. Accident investigation refers to identifying the causes of accidents at workplaces by safety professionals and using their judgment to avoid accidents in future. Safety training refers to a continuing safety education program for all employees within an organisation, which includes necessary knowledge, prevention techniques, and positive attitude in order to improve safety behaviour. Safety motivation refers to stimulating employees' attitudes towards making an effort to attain organisational safety objectives by use of incentive or reward.

The negative impact of accidents at workplaces demands that management safeguard workers from hazards in the workplace by ensuring positive employee behaviour (Cheng *et al.* 2012). Management safety practices should be implemented by senior management to enhance safety behaviour and self-efficacy (Al-Refaie 2013). The current research clearly indicated that management safety practices, such as a commitment from senior management, significantly affects workers' attitudes and their own commitment to occupational health and safety. Both studies conclude, however, that determining which management safety practices improve safety performance still needs more empirical research.

Mearns, K *et al.* (2003) argue that management safety practices as an indicator of the safety culture within upper management should be considered an adjunct to the assessment of the safety culture within an organisation. The researchers found that the best management safety practices should include not only commitment from senior managers, but also policy compliance, governance of safety implementation, and the linkage of health and safety into the business. Mearns, K *et al.* (2003) discovered a positive association between the rate of accidents in the workplace and changes among management from a reactive to a proactive approach to safety. In order to enhance safety in the long-term, management safety practices should be measured to increase the level of trust in top management (Zacharatos *et al.* 2005).

Kheni *et al.* (2010) found that the implementation of safety roles by management, management involvement in improving safety in the workplace, and providing proper safety resources had an impact on the prevention of accidents. And Mearns, K *et al.* (2003) found that satisfaction with management safety activities (such as safety meetings, emergency responses), involvement in safety, communication about safety, competence, and commitment are regarded as essential components of management safety practices.

Leading an organisation to a positive safety culture requires a strong interpersonal style and a good knowledge of safety (Cipolla *et al.* 2005). Wu, T-C (2005, p. 28) defines safety leadership as:

> *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.*

Senior management can develop and facilitate the achievement of their safety strategic goals by their safety leadership and commitment, which it recognised as a fundamental component of the safety culture of an organisation (Chinda & Mohamed 2008). According to Wu, T-C (2005) safety leadership mainly includes three dimensions scale: safety coaching, safety caring, and safety controlling.

3.4.4 Safety culture vs safety climate

The concept of a safety culture and a climate of safety in an organisation have been widely recognised for more than two decades, but they are not well defined separately (Fang *et al.* 2006). Many researchers make distinctions between a safety culture and safety climate. For instance, according to Cooper and Philips (1994), a *safety climate* is concerned with the shared perceptions and beliefs that workers hold regarding safety in their workplace, while it is the beliefs and values that the organisation holds with regard to safety that represent *safety culture* (Fang *et al.* 2006). Other research has described the safety climate as reflective of the organisation's safety culture (Gadd 2002; Fang *et al.* 2006).

Mohamed (2003) suggests that safety culture is part of the ability to manage safety, whereas safety climate is part of a worker's perceptions of safety roles in the workplace and how much safety is valued. Indeed, the concepts of safety culture and safety climate often interact (Reiman & Rollenhagen 2013). According to Choudhry, R *et al.* (2007a), a climate of safety relies on the organisation's safety culture. The relationship between the two ideas has been much debated, therefore, but, upon reflection, the researcher favours the view that safety culture is a more inclusive concept than safety climate, and that safety climate can be regarded as an indicator of safety culture.

3.4.5 Previous studies on safety in Saudi construction industries

There are many studies in the area of occupational health and safety at workplaces in the Saudi construction industry which have been done to look for ways to improve safety. Table 3.4 presents a summary of previous studies on safety in the Saudi construction industries.

According to Al Haadir, S *et al.* (2013), accidents in the construction sector can be as high as at least 50% of all accidents in others sectors in Saudi Arabia. Their safety culture model based on safety motivation, safety climate, and safety behaviour found that safety climate plays a key role in safety behaviour by mediating the relationships between safety motivation and safety behaviour.

Ali, Haem *et al.* (2013) measured the performance of building construction companies in Saudi Arabia, and recommended that more in-depth studies should be done to better understand performance indicators.

In another construction study in Saudi Arabia, Almahmoud *et al.* (2012) investigated the relationship between project health and project performance in project delivery, finding that some of the low performances related to the number of accidents. They found that there were no safety and security plans in place overall in the sector and concluded that workers in the construction sector do not follow basic safety regulations, having none to follow.

Al Haadir, S. and Panuwatwanich (2011) pointed out critical factors missing from industries in the sector, indicating that industries were not, on the whole, managing for safety. The factors included a commitment to safety throughout the organisation, poor safety arrangements, hazard prevention and control and a lack of employee participation in establishing a climate of safety.

Leading and lagging indicators are part of safety performance. Al-Kudmani (2008) suggests that in order to create a safety culture, it is better to focus on leading indicators rather than lagging indicators. Furthermore, he points out some of the root causes of critical behaviour, such as lack of knowledge or skills, a conflict between safety rules and practical application, unsafe personal choices, individual factors, cultural barriers to safety, ineffective management systems, inappropriate rewards, improper facilities and equipment, and improper feedback.

Construction activities also involve difficult and dangerous conditions which can lead to accidents in the workplace (Jannadi, A 2008). According to Jannadi, A (2008), in Saudi Arabia there are different types of potential risk that face contractors when carrying out construction activities. He found that there is a weakness of enforcement, or no enforcement, by owner, contractor, management, or any other government authority to improve occupational health and safety.

According to Jannadi, O and Bu-Khamsin (2002), the Saudi construction industry employs 15% of the total workforce and accounts for 14% of the total energy consumption in the country. They gathered data on important factors that influence the safety performance in the sector. They found that the safety performance was affected by owners, contractors, government involvement, human behaviour, site conditions, poor safety management, management involvement, housekeeping, health and welfare, safety equipment and tools, training, and safety programs.

Creating an extraordinary safety culture is an essential element for improving safety in the workplace in Saudi Arabia, and could be created by commitment to safety at all levels, implementation of best practices, and top management support (Edwin & Joan 2000). Jannadi, MO and Assaf (1998) also assessed the safety procedures on construction sites in Saudi Arabia. They found that the safety level varies with the project size. Large projects, constructed by large international firms have much better safety records than smaller ones. This indicates that a safety code in Saudi Arabia is needed to monitor and enforce safety requirements at workplaces (Jannadi, MO & Assaf 1998).

Furthermore, according to Jannadi, MO and Al-Sudairi (1995), safety programs are affected by hiring safety representatives, by safety training, safety directors reporting to the president, by formal safety orientation for new workers, and by establishing worker incentives.

Table 3.4 Previous studies on safety in the Saudi's construction industries

Researchers	Summary	Problem	Findings
Ali, HAEM et al 2013	Indicators for measuring performance of building construction companies in Kingdom of Saudi Arabia	A strong pressure on construction companies to continually improve their productivity and performance	It is recommended that more in-depth studies should be performed to better understand KPIs (Such as safety performance)
Al Haadir, S et al 2013	The author developed a conceptual model depicting the relationships between three main constructs: safety motivation, safety climate, and safety behaviour	The rate of total workplace injuries from construction activities can be as high as at least 50%	It indicates that safety climate appears to play a key role to safety behaviour by mediating the relationships between both safety motivation and behaviour
Almahmoud et al 2012	It presents an empirical study of the relationship between project health and project performance in the project delivery context	Safety in the project and the number of accidents	• Workers don't follow basic safety regulations • There is no clear direct link between safety and engineering • There is no clear direct link between safety and risk management • There aren't safety and security plans
Al Haadir, S & Panuwatwanich 2011	It aims to identify the critical factors affecting the successful implementation of safety programs	The overall level of construction safety in Saudi Arabia has been relatively low	Critical factors associated with safety management: (1) worker participation (2) safety prevention and control system (3) safety arrangement (4) safety commitment

Researchers	Summary	Problem	Findings
Al-Kudmani 2008	Creating a safety culture by focusing on leading indicators rather than lagging	Changing the culture is the only way to achieve excellence in environment, safety & health	Determine root causes of critical behaviours: • lack of knowledge or skills • a conflict between safety rules and their practical application • unsafe personal choices • individual factors • cultural barriers to safety • ineffective management system • inappropriate rewards • improper facilities and equipment • improper feedback
Jannadi, A 2008	It aims to explain the different types of potential risk that face contractors in carrying out trenching work in Saudi Arabia	Construction activities involve difficult and dangerous conditions which can lead to injury and/or additional expense	Found that there is a weakness of enforcement, or no enforcement, by client or contractor management or any other government authority
Jannadi, O & Bu-Khamsin 2002	It aims to gather data on significant factors that influence the safety performance of industrial contractors	The construction industry in Saudi Arabia employs 15% of the total labour force and accounts for 14% of the total energy consumption in the country	Found that safety performance affected by: • owners, contractors, government involvement • human behaviours • site conditions • poor safety management • management involvement • housekeeping • health and welfare • equipment & tools • training • PPE • safety program

Researchers	Summary	Problem	Findings
Edwin & Joan 2000	Creating an extraordinary safety culture		A good safety culture by: • commitment to safety at all level • best practices • a culture that valued workers and focused on protecting people • top management support
Jannadi, MO & Assaf 1998	The aim was to assesses the safety procedures on a construction job site in Saudi Arabia		It concludes that safety level in construction sites varies with the project size This indicates the need for implementing a safety code in Saudi Arabia to monitor and enforce safety requirements at work sites Large projects, constructed by large international firms, have much better safety records than smaller ones
Jannadi, MO & Al-Sudairi 1995	The safety programs become more and more formal The intention of this research was to study those formal safety programs and see how the safety performances are affected with the different components of the programs		It was found that safer firms had the following practices: (1) the corporate safety director hires the field safety representatives (2) the field safety director trains their subordinate workers (3) the safety director reports directly to the president or vice-president (4) new workers receive formal safety training (5) safety awards are given to workers and foremen

3.5 Stakeholders and stakeholder theory

The main factors affecting safety in construction projects include the leaders of the company having a low awareness of the importance of safety in the workplace and the poor engagement among designers, architects, planners and coordinators of the projects (Tam *et al.* 2004). Thus this section focuses on the benefits of stakeholders' engagement on improving safety culture and reducing accident rates, beginning with stakeholders' definitions and theories.

3.5.1 The stakeholder

Freeman's (1984) book is generally acknowledged to have brought stakeholder theory into the forefront of management literature, and his discussion of the history of the concept of stakeholders provides an overview of the various theories to which its early development is attributed. Then in 1988 and 1993, Evan and Freeman elaborated the stakeholder concept in editions of Beauchamp and Bowie's text *Ethical theory and business* by introducing two principles – the principle of corporate legitimacy, and the stakeholder fiduciary principle (Evan, William M & Freeman 1988/1993).

The principle of *corporate legitimacy* relates to the ways in which senior managers should manage their organisations for the benefit of the stakeholders, such as suppliers, employees, or local communities. Their rights must be ensured and welfare protected (Friedman, AL & Miles 2006).

The stakeholder *fiduciary principle* views the organisation as an abstract entity and its top-level managers as being entrusted with acting in the interests of the stakeholders and the organisation as their agent in order to ensure the survival of the organisation (Friedman, AL & Miles 2006). This principle requires care, honesty, transparency, and trust to avoid harming the interests of the stakeholders (Chinyio & Olomolaiye 2009).

Stakeholder definitions. Stakeholders therefore are a group of individuals or a single person whose activities can affect, or are affected by, the organisation (Freeman 1984, 2010; Loebbaka & Lewis 2009). Stakeholders have the power to benefit or threaten an organisation (Gibson 2000), and influence an organisation's goals, activities, improvement and functions (Chinyio & Olomolaiye 2009).

Table 3.5 presents a summary of stakeholder definitions. The earliest one was produced in 1963 by the Stanford Research Institute.

Table 3.5 A summary of stakeholder definitions

Authors	Stakeholders are
Stanford Research Institute, 1963 as cited by Friedman, AL & Miles 2006	groups without whose support the organisation would cease to exist
Freeman 1984	any group or individual who can affect or is affected by the achievements of the organizations objectives
Freeman & Gilbert 1987	individuals or groups who can affect or are affected by business
Evan, William M & Freeman 1988	those who benefit from or are harmed by, and whose rights are violated or respected by, corporate actions
Alkhafaji 1989	groups to whom the corporation is responsible
Carroll, A 1989 as cited by Mitchell *et al.* 1997	those with an interest in or a right (legal or moral) to ownership or legal title to the company's assets or property
Savage *et al.* 1991	those with an interest in the actions of an organisation and have the ability to influence it
Brenner 1993	individuals or groups with some legitimate, non-trivial relationship with an organisation [such as] exchange transactions, action impacts, and moral responsibilities
Langtry 1994	groups or individuals who either are such that the firms decisions to act, or decisions to not act, have been or will be to a significant extent causally responsible for their level of well-being, or else have some independently identifiable moral or legal claim on the firm which the firm's actions violate or respect
Jones 1995	groups and individuals (stakeholders), each with (a) the power to affect the firm's performance and/or (b) a stake in the firms performance
Gray *et al.* 1996	any human agency that can be influenced by, or can itself influence, the activities of the organization in question
Carroll, Archie B. & Näsi 1997	any individual or group who affect or are affected by the organisation and its processes, activities, and functioning
Argandoña 1998	those who have an interest in the company (so that the firm, in turn, may have an interest in satisfying their demands)
Gibson 2000	Those groups or individuals with whom the organisation interacts or has interdependencies and any individual or group who can affect or is affected by the actions, decisions, policies, practices, or goals of the organisation
Freeman 2004 as cited by Fontaine *et al.*, 2006	those groups who are vital to the survival and success of the organisation
Loebbaka & Lewis 2009	anyone who can affect or influence the outcomes of the firm, or anyone who can be affected by the firms actions

3.5.2 Stakeholder theory

Understanding and managing the complexities of business today is a challenge. Stakeholder theory has appeared as a new narrative to understand three interconnected problems related to organisations:

- the problem of how value is created
- the problem of connecting ethics and capitalism
- the problem of managerial mindset (Parmar *et al.* 2010).

In the academic literature, these ways of elaborating the stakeholder theory have been subject to significant debate. However, this research used stakeholder theory and thinking not to debate, but only to use the concept in order to improve safety culture.

According to Parmar *et al.* (2010) organisation executives pursue profit and care little for ethics. Since managerial activities have a broad impact on a range of people (Clement 2005), Parmar *et al.* (2010) suggest that academics and managers need to rethink the traditional ways of conceptualising the responsibilities of the firm.

Stakeholder theories/models. A number of authors have advanced stakeholder theories or models during the last 30 years. Some of these theories and models have been selected and are discussed below because they underpin the theme of this research.

Stakeholder identification and salience: Mitchell et al. (1997)

Mitchell *et al.* (1997) categorise the relationship between stakeholders and an organisation in order to prioritise stakeholder relationships as shown in Figure 3.7. They propose that stakeholders be classified according to how many of three particular attributes they exhibit. These are:

- the power of the stakeholder to influence the activities of the firm, i.e., how effectively can the stakeholder impose their will on other stakeholders and thus on the firm
- the legitimacy of the stakeholder's relationship with the firm, i.e., the relationship between the stakeholders and the firm is based on a mutual perception of the firm in terms of the dominant norms and values
- the urgency of the stakeholder's claim on the firm, i.e., the rapidity with which the stakeholder can have their point of view acted upon.

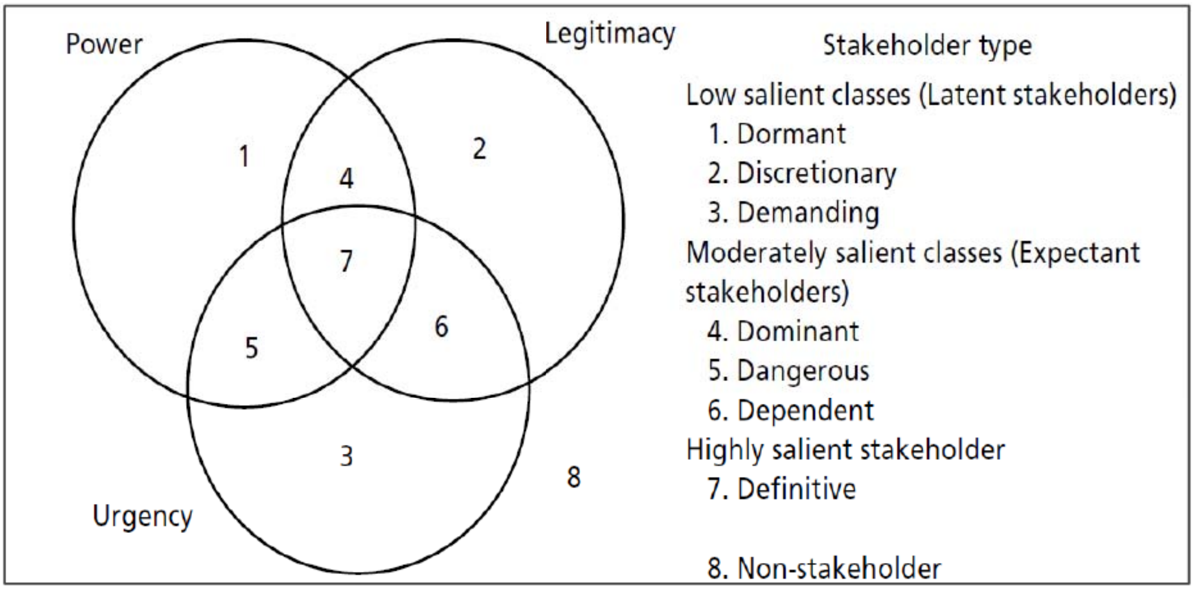


Figure 3.7 Classes of stakeholders (adapted from Mitchell et al. 1997, p. 872)

As shown in Figure 3.7, stakeholders can be recognised as certain types according to their interaction with the firm and one another (Mitchell *et al.* 1997; Loebbaka & Lewis 2009).

- ***dormant stakeholders***

  their only attribute is power without a legitimate relationship or an urgent claim

  The dormant stakeholders, such as injured workers and their families have only power, but lack of urgency and legitimacy attributes.

- ***discretionary stakeholders***

  their only attribute is legitimacy without power to influence an organisation and no urgent claim

  The discretionary safety stakeholders maintain only legitimacy, but they have no power or urgency attributes and they cannot press their claims and engage management to improve safety performance, unless management chooses to recognise them.

- ***demanding stakeholders***

  their only attribute is urgency, with no power and legitimacy

  The demanding stakeholders have only urgency and cannot advance their cause within an organisation except through public perception and the media.

- ***dominant stakeholders***

  they have power and legitimacy, and their influence in an organisation is affirmed (e.g. government, investors, directors, creditors)

  The dominant stakeholders, who have both powerful and legitimate attributes, can hold sway over safety in the workplace. However, if there is a need to change safety procedures or practices, such as safety programs, material selections, and technological processes, they do not have any urgent voice, such as safety programs.

- ***dangerous stakeholders***

  they have power and urgency, but lack legitimacy; a type of stakeholder that could be dangerous to the organisation (e.g. worker sabotage, wildcat strikes)

  The dangerous stakeholders have both urgency and power, but lack legitimacy attributes, such legal process and lawyers.

- ***dependent stakeholders***

  have urgent legitimate claims, but lack power, such as local residents

  The dependent stakeholders, such as the organisation's employees, have both urgency and legitimacy attributes, but lack power. Therefore, they rely on the encouragement of other stakeholders to satisfy their goals.

- ***definitive stakeholders***

  all three of the attributes are present

  Definitive stakeholders have the power, urgency, and legitimacy to make immediate impact upon an organisation financially, such as workers compensation insurance companies and safety regulations created by national and international organisations.

- ***non-stakeholders***

  their legitimate interests are not being served.

Table 3.6 Stakeholder attributes and levels of influence on safety management (Adapted from Loebbaka & Lewis 2009)

Stakeholder classification	Attributes	Perceived status
definitive	power/urgency/legitimacy	high
dominant	power/legitimacy	moderate
dangerous	power/urgency	moderate
dependent	urgency/legitimacy	moderate
dormant	power	low
demanding	urgency	low
discretionary	legitimacy	low
non-stakeholder	none	none

Mitchell *et al.*'s (1997) model provides concepts that help to explain the importance of the stakeholder in valuing and managing safety in the workplace, while Loebbaka and Lewis (2009) point out that the safety stakeholder attributes are highly dynamic and not fixed. They differ through time and place. Therefore, they indicated that their safety performance is strongly linked to the organisation's social responsibilities as embodied in its stakeholders.

The corporate social responsibility

As the focus of this study was aimed at understanding stakeholder involvement and participation in providing a positive safety culture using stakeholder theory approaches, this section explains the corporate social responsibility (CSR) literature and discusses the usefulness of the stakeholder concept in finding a balance between social responsibility and safety culture.

A conceptual model of CSR activities has been developed by Ullmann (1985) from Freeman's stakeholder theory. Ullmann (1985) provides a conceptual basis for studying CSR activities in a stakeholder framework (Roberts, W 1992). Corporate social responsibility is not a legal concept. It is the degree of moral or social obligation that is accepted by corporations beyond their unspoken pledge to obey the laws of the state. The behaviour of firms in relation to their labour force, to the environment in which their operations are embedded, and towards authority and civil society reveals their sense of CSR (Kilcullen & Kooistra 1999; Foran 2001).

The concept of social responsibility refers to the firm's consideration of, and response to, issues beyond the narrow economic, technical, and legal requirements of a business. It is the firm's obligation to evaluate the effects of its decisions on the external social system in a manner that considers the social impact along with the traditional economic gains which the firm seeks

(Davis & Blomstrom, 1971, p. 85). In anticipation of the four most important components of CSR (according to Fontaine *et al.* in 2006), Carroll (1991) elaborated a model which consists of a four level pyramid.

According to Carroll, A.B. (1991), the model shows the four components of CSR, starting with economic responsibilities; followed by legal responsibilities; ethical responsibilities; and philanthropic responsibilities. Of the four, ethical and philanthropic responsibility have gained significant attention (Carroll, A.B. 1991; Fontaine *et al.* 2006).

Carroll, A.B. (1991) explains the four components (Figure 3.8) as follows:

Figure 3.8 The pyramid of corporate social responsibility (Visser 2006, p. 34)

- Economic responsibilities are about performing in a manner consistent with a commitment to maximise the profit, and attain a strong competitive advantage, along with high efficiency of operation.
- Legal responsibilities reflect the organisation's operations according to the relevant laws and regulations. The organisation is obliged to obey the rules and various regulations in order to run their business.
- Ethical responsibilities represent fairness, justice, and protection of stakeholders' moral rights, even though not legally required.
- Philanthropic responsibilities includes business engagement in welfare programs or goodwill, such as financial or educational contributions (Carroll, A.B. 1991).

Carroll (1979) maintains that to reconcile the economic, legal and ethical problems involved in running an organisation, and to establish which issues should be of most importance, many factors must come into play, including the interests of both the top executives, and of the government.

Concepts of stakeholder theory and corporate social responsibility are clearly related (Garriga & Melé 2004; Neill & Stovall 2011; Zhao *et al.* 2012). Theoretically, CSR means that organisations will interact with their stakeholders in ethical, socially and environmentally responsible ways, while being profitable (Gray *et al.* 1996); Deegan & Blomquist 2006).

Occupational safety falls into both the legal and the ethical paradigm. According to Schwartz and Carroll (2003), few organisation's activities voluntarily fall into this category; for instance, the adding of a safety feature when there is no long term economic benefit, not because it is legally required, but because it is regarded as an ethical action, is rarely encountered.

In regard to health and safety, Freeman *et al.* (2010) maintain that stakeholder involvement is growing and inevitable in decisions regarding health and safety issues, and the reasons may be because of growing expectations for accountability and transparency, a greater desire for participation by stakeholders, or a decline in public trust.

Clarkson's (1995) social performance theory

Friedman, AL and Miles (2006) focus on an article by Clarkson (1995) and discuss a theory that provides a framework to assess and analyse corporate social performance (CSP). Clarkson's position is that it would be more effective to evaluate relations with stakeholders using corporate social performance principles than those of CSR. Clarkson (1995) suggests that managers should have knowledge of obligations, accountability, and responsibilities to their stakeholders and formulated what he called a 'reactive-accommodative-defensive-proactive (RADP) scale' (Clarkson 1995, p. 105), demonstrated in Table 3.7.

Table 3.7 The reactive–accommodative–defensive–proactive scale (based on Clarkson 1995)

Rating	Posture or strategy	Performance
Proactive	Anticipate responsibility	Doing more than is required
Accommodative	Accept responsibility	Doing all that is required
Defensive	Admit responsibility but fight it	Doing the least that is required
Reactive	Deny responsibility	Doing less than required

Clarkson's scale suggests that the first group of stakeholders rated as proactive are those who will be willing to go beyond expectation in performing their tasks. The second group, namely the accommodative group, will accept the responsibility of performing their tasks to the optimum level without exceeding expectations. The third group, rated as defensive, will admit their responsibility, but they are doing the least that is required. The fourth group, rated as reactive, in terms of posture and performance, deny responsibility and do less than is required. Clarkson (1995) points out that social issues can be taken into account even if they are not regulated or legislated, but for enforcement purposes, alternative measures are necessary. Finally, in order to analyse and anticipate stakeholder involvement and performance, this scale is helpful.

Islamic principles and social responsibility

In regards to Muslim countries, the concern about CSR is also relevant to Islamic principles, which include ethics and social responsibility because Islam adopts the stakeholder perspective regarding the relationship between an organisation and its key stakeholders (Dusuki 2008; Lingard & Rowlinson 2005). Islam covers all aspects of human life from the personal, to the social, political, and intellectual, and defines the nature of human relationships with *Allah* 'God', with each other, and with nature and the environment (Dusuki 2008; Lingard & Rowlinson 2005). Islam is concerned with four important points: human dignity, free will, equality and rights, and trust and responsibility (Dusuki 2008). For instance, Islam insists that workers are not exploited, their working conditions must be suitable to perform their duties, and the organisation most look after the welfare of its workers (Lingard & Rowlinson 2005).

There are two sources in Islamic teaching. The first source is the Holy Qur'an 'the words of *Allah*', and the second source is called Sunnah 'the words, actions, and approvals of the Prophet Muhammad (peace be upon him)' (Dusuki 2008; Lingard & Rowlinson 2005). Therefore, according to Dusuki (2008), Lingard and Rowlinson (2005), Islam is a way of life, not just a religion; it combines both permanent features and mechanisms for adapting to change and cannot be separated from ethics in other aspects of Muslims' daily lives.

Donaldson and Preston (1995) have attempted to classify the concept of stakeholder theory since Freeman's landmark book was published in the early 1980s. They developed a typology based on a division of stakeholder theories into *descriptive/empirical, instrumental,* and *normative* (see Figure 3.9).

The *descriptive/empirical approach* is used to describe and explain certain characteristics and behaviours of an organisation, for example, the nature of the organisation, how stakeholders and managers truly behave and how they view their actions and roles. The *instrumental approach* is used to identify the connections between stakeholder activities and the achievement of economic objectives, such as profit maximisation or maximisation of stockholder value, either by using conventional statistical methods or direct observation and interviews. The *normative approach* addresses the moral justification of an organisation and the ethics of stakeholder management, meaning theories of how managers and stakeholders should act and view the purpose of the organisation based on ethical principle. They conclude that all three approaches are essential to stakeholder theory but the normative approach is fundamental to all.

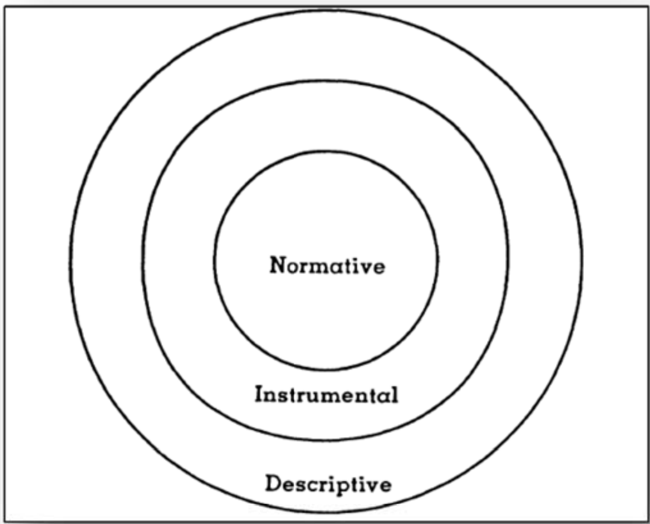


Figure 3.9 Three approaches of stakeholder theory (Donaldson & Preston 1995, p. 74)

Donaldson and Preston (1995) summarised Freeman's stakeholder theory in four central themes:

- Stakeholder theory is essentially a descriptive model.
- Stakeholder theory is also instrumental in offering a framework for examining the connections between the practice of stakeholder management and the conventional corporate performance goals.
- Stakeholder theory is also fundamentally normative; it takes into account the interests of all who are considered to be intrinsically valuable.
- Stakeholder theory is also managerial, recommending attitudes, structures and practices, and attending to varied interests of all legitimate stakeholders.

Donaldson and Preston (1995) suggest that the three approaches overlap each other as shown in Figure 3.9. The last level has a descriptive approach which presents the relationships of the stakeholders in the external world. The second level has instrumental and predictive value, which delivers certain results when certain practices are carried out. The central core of the three approaches is the normative approach, which describes the moral values and obligations of stakeholder management.

A number of researchers have attempted to contain their studies within the parameters of one of Donaldson and Preston's (1995) three approaches (Jawahar & McLaughlin 2001). Consistent with descriptive stakeholder theory, Jawahar and McLaughlin (2001), for instance, argue that depending on the organisation's resource needs, it chooses from among several different strategies for dealing with their stakeholders. These researchers rely on *resource dependence theory* in order to make their argument. They observe that decision makers deal proactively with their stakeholders who can provide the resources necessary to the survival of the organisation, and engage adversarially with some stakeholders during periods of the organisation's lifecycle if the survival of the organisation is in question.

The issue of stakeholders who control resources critical to a start-up organisation will be addressed. On the other hand, where stakeholders have no control over resources, their interests may be ignored (Jawahar & McLaughlin 2001). For example, where start-up requirements indicate a critical need to obtain a licence or permit from a stakeholder, such as the government, the decision makers are likely to pursue a defensive strategy by only satisfying the minimum requirements. In order to avoid any legal penalties or otherwise undesirable consequences, the organisation ignores other, less critical stakeholders (Jawahar & McLaughlin 2001).

Stakeholder influence strategies

Stakeholders have a significant impact on organisational behaviour (Frooman & Murrell 2005), but their attitudes may not stay consistent throughout a project (Aaltonen & Kujala 2010). Frooman (1999) agrees that the stakeholder theory proposed by Freeman (1984) has enabled managers to understand their stakeholders, and consequently to manage them strategically, but he argues that there are three questions about stakeholders which must always be answered: *Who are they? What do they want, and how are they trying to get it?* The author suggests that while many studies have addressed the first two questions, they have been ignoring the third, which it is all about relationships between stakeholders and organisations. Frooman and Murrell (2005) point out that stakeholder theory uses a demographic approach to identify key stakeholder attributes and assess their impact. In reality, it is more meaningful to examine how the structure of the organisational setting determines how stakeholders can influence organisational strategy (Frooman & Murrell 2005).

Most researchers consider both the stakeholder attributes and the structural setting to be valid approaches for understanding an organisation's behaviour, so it is worthwhile to look at another dimension of the stakeholder-organisation relationship and the inherent power structures. *Resource dependence theory* holds that stakeholders may control essential resources, and thus have the power to demand something in return from the organisation (Aaltonen & Kujala 2010). Based on resource dependence theory, Frooman and Murrell (2005) identified two types of influence strategy that could be used to change an organisation's behaviour:

1) manipulation strategy (*how an organisation is influenced*)

2) pathway strategy (*who does the influence*).

When a stakeholder controls vital resources, they can manipulate their flow into the organisation in order to maintain control and influence, a corporate form of punishment and reward (Frooman & Murrell 2005). Pathway strategies relate to who does the actual resource manipulation, and to whom it is done. The operation of the strategies can be both direct and indirect. Direct means that the stakeholder does the manipulation themselves. Indirectly means that a partner of the stakeholder does the manipulation (Frooman & Murrell 2005).

According to Frooman and Murrell (2005), understanding the use of influence strategies may enable an analyst to predict which type of strategy a stakeholder might use and allow the organisation to gain a sense of its resource relationship with the stakeholder.

In the current research, a review of the major adoption and uses of stakeholder theory across a broad range of disciplines and schools was conducted to find the usefulness of stakeholder theory adoption, as explained in the next section.

3.6 Application of stakeholder theory

In the latter half of the 20th century, stakeholder theory and thinking had a significant impact on the academic literature, and is recognised as a management tool to improve an organisation's performance outcome (Carroll, A.B. & Buchholtz 2009; Donaldson & Preston 1995; Freeman 1984; Garriga & Melé 2004). This section examines how stakeholder theory has been applied in the four major business disciplines: management, marketing, finance and accounting, and strategic management, by pointing out the main findings from Parmar *et al.*'s (2010) literature review of stakeholder theory.

3.6.1 Stakeholder theory in management

Management includes behavioural areas. Parmar *et al.* (2010) examined contributions in areas such as *organisational behaviour and theory, human resource management, management science, and manufacturing and operations management.*

Organisational behaviour. The organisational behavioural topic, according to Parmar and his colleagues, has been influenced by stakeholder theory. They found that the concept of the stakeholder has been employed to study leadership (Taylor 1995), executive succession processes (Friedman & Olk 1995), developing leadership skills (Nwankwo & Richardson 1996), and leader power-sharing (Heller 1997). In addition, the authors found that a stakeholder approach has also been used to assess organisational effectiveness (Cameron 1980, 1986; Daft 2001; Gregory & Keeney 1994; Hellriegel *et al.* 2001; Kuman & Subramanian 1998).

Human resources management (HRM). The researchers found that HRM has also been influenced by stakeholder theory. They found that the stakeholder concept has been used to attract a high-quality workforce (Albinger & Freeman 2000; Greening & Turban 2000; McNerney 1994). Also, they found that the stakeholder theory has been helpful in creating strategic human resource development systems (Garavan 1995; Stewart 1984), in managing change (Hussain & Hafeez 2008; Kochan & Dyer 1993; Lamberg *et al.* 2008), in handling crises (Ulmer 2001), in managing downsizing (Guild 2002; Labib & Appelbaum 1993; Tsai *et al.* 2005), and in assessing the effectiveness of human resource systems (Ulrich 1989).

The science of management. The science of management is another area which has been examined by the authors. They found that the stakeholder theory has been used in the development of a group decision support system (Nunamaker *et al.* 1988), and in development of a problem-solving procedure (Keeney 1988). Additionally, they found that the stakeholder theory has been applied to project selection (Oral *et al.* 2001), the project management process (Cleland & Ireland 2002; Karlsen 2002), and global project management (Aaltonen *et al.* 2008).

Manufacturing and operations management. Similarly, stakeholder theory, according to the authors, has been applied to manufacturing, in areas such as quality management (Foster & Jonker 2003), new manufacturing technologies (Steadman *et al.* 1996), strategic manufacturing development (Riis *et al.* 2006), the implementation process of production manufacturing (Maull *et al.* 1990), implementation of operational efficiencies (Sachdeva *et al.* 2007), development of a new product (McQuater *et al.* 1998), and improving research and development projects (Elias *et al.* 2002).

The researchers conclude that this review is useful for the purpose of analysis. Also, they demonstrate that stakeholder theory can be applied easily to a wide variety of management topics (Parmar *et al.* 2010).

3.6.2 Stakeholder theory in marketing

The marketing discipline is focused mainly on the relationship between an organisation and its customers (Parmar *et al.* 2010). According to Parmar *et al.* (2010) marketing scholars have either included or advocated a wide group of stakeholders in their studies. For example, they found that a model called *six markets* was developed by Christopher *et al.* (1991) in order to define relationships with traditional stakeholders. They also note that another study has been done by Polonsky *et al.* (1999) who argues that organisations should use stakeholder theory to integrate a broad set of relationships into a marketing model in order to create value.

The marketing discipline has also used systems for measuring stakeholder outcomes (Parmar *et al.* 2010). For example, according to Parmar *et al.* (2010) a 'stakeholder-performance scorecard' (Parmar *et al.* 2010, p. 35) has been recommended for organisations by Kotler (2005) to track the satisfaction of their stakeholders.

In regard to marketing schools and stakeholder theory, Parmar *et al.* (2010) believe that marketing scholars could help to develop measurements of stakeholder orientation, or how organisations work with stakeholders proactively to improve businesses.

3.6.3 Stakeholder theory in finance and accounting

Finance scholars now recognise the importance of stakeholders in explaining high financial returns (Parmar *et al.* 2010). Parmar *et al.* (2010) reviewed work that establishes the place of stakeholder theory in the finance literature. For example, they found that Zingales (2000) provided a strong rationale for a stakeholder perspective in finance research, while, according to the author, finance scholars have found that non-financial stakeholders influence the structure of firms (Istaitieh & Rodriguez-Fernandez 2006). Parmar *et al.* (2010) point out that finance scholars have barely employed the potential of the stakeholder perspective in improving financial decisions. They believe that stakeholder theory could help finance scholars to better explain phenomena such as why some initial public offerings are more successful than others, why two organisations with a very similar financial structure get a different interest rate from the same bank, or how stakeholder bargaining power influences residual returns.

In the past half century stakeholder theory has contributed to the accounting literature (Parmar *et al.* 2010), and accounting has become a tool used by stakeholders to assess the risks of committing to firms or projects (Parmar *et al.* 2010; Dermer 1990). Furthermore, stakeholder theory was used by Roberts (1992) to predict levels of corporate social disclosure, such as stakeholder power, strategic posture, and economic performance. Similarly, they found that stakeholders' influence financial information, such as:

- the timing of earning announcements (Bowen *et al.* 1992)
- earnings management (Burgstahler & Dichev 1997; Richardson 2000)
- financial reporting methods (Scott *et al.* 2003)
- 'creative accounting' practices (Shaw 1995)

- the setting of international accounting standards (Kwok, W & Sharp 2005)
- creation of the goodwill standard in the UK (Nobes 1992)
- selection of a firm auditor (Ashbaugh & Warfield 2003)
- the voluntary dissemination of interim financial information (Chen, L *et al.* 2007).

Likewise, according to Parmar *et al.* (2010), the concept of stakeholder theory has also been used to understand the relationship between accounting practices and governance (Ghonkrokta & Lather 2007; Joseph 2007; Keasey & Wright 1993; Richard Baker & Owsen 2002; Seal 2006). The authors also stated that there is another indication of interest in using stakeholder theory in accounting education (Stout & West 2004).

Finally, Parmar and his colleagues argue that there are a great opportunities for finance and accounting scholars to play an important role in understanding how to solve the most difficult issues associated with stakeholder finance and accounting by using stakeholder theory and thinking.

3.6.4 Application of stakeholder theory in strategic management

While stakeholder theory includes both economic and social aspects of business, strategic management includes economic performance as a primary dependent variable (Parmar *et al.* 2010). Parmar *et al.* (2010) reports that some empirical research supports the view that organisations can serve the interests of stakeholders through higher financial performance, reputation and organisational performance (Fombrun & Shanley 1990; Preston & Sapienza 1991; Greenley & Foxall 1996; Sisodia *et al.* 2007).

From their examination, Parmar *et al.* (2010) found that some researchers have focused on the influence stakeholders have on the organisation and its strategies, for example, Dill (1975) and Freeman and Reed (1983). Mitchell *et al.* (1997) identified urgency, power, and legitimacy as factors that explain how much attention an organisation will give to various stakeholders. Frooman (1999) uses *resource dependence theory* to identify four types of stakeholder who influence strategies – withholding, usage, direct and indirect.

As noted by Parmar *et al.* (2010), as the strategic management field moves more towards stakeholder theory, this theory is well-placed to contribute to the future strength of strategic management concepts and equally, to benefit from the conversation.

Conclusions drawn from Parmar *et al.* (2010) are:

- They believe that the three problems (value creation and trade, the ethics of capitalism, and managerial mindset) outlined in their article can be best solved by moving stakeholder theory into the centre of research thinking about management and business.
- They state that:

  > *stakeholder theory is a living 'Wiki' constantly evolving, as stakeholder theorists attempt to invent more useful ways to describe, re-describe, and relate our multiple conceptions of ourselves and institutions such as business. (Parmar et al. 2010, p. 45)*

- They propose that researchers and business put ethics at the centre of business and business at the centre of ethics in order to understand business and pay attention to the actual practice of business, thus taking a lead in the area.

3.7 Stakeholders in the construction industry

The current study sought to understand the relationship between the stakeholders in the construction sector and the sector's safety culture, and explains the types of stakeholders to be found in the literature of the construction industry, and discusses the usefulness of their interactions in finding a balance between their responsibilities and prevention of loss.

3.7.1 A wide array of stakeholders

Stakeholders in the construction industry include owners or clients, shareholders, project managers, employees, designers, contractors, subcontractors, suppliers, governments and legal authorities, insurance companies, competitors, customers and visitors (Newcombe 2003; Smith, J & Love 2004). At some point, each of these stakeholders has influence on the development of the project (Chinyio & Olomolaiye 2009).

Much of the literature identifies primary and secondary stakeholders. Primary stakeholders are those who have a direct impact upon an organisation and have formal or contractual relationships. Secondary stakeholders are various, and include those who are indirectly engaged in the organisation's activities, but are able to influence the organisation's decisions (Savage *et al.* 1991).

According to Carroll, A.B. and Buchholtz (2006), primary stakeholders are those whose continuing participation in an organisation is essential to its survival, whereas secondary stakeholders are those who influence, or are influenced by, the organisation, but whose participation is not necessary to its survival.

Evan, WM and Freeman (1993) classify stakeholders as being either 'wide' or 'narrow' depending upon the stakeholders' relationship with the organisation or the industry. Wider stakeholders usually include government, less-dependent customers, community, and other peripheral groups. Narrow stakeholders typically include management, suppliers, dependent customers, and employees. Other authors use different terms for similar types of stakeholders. For instance, Goodpaster (1991) talks about strategic stakeholders, who can affect the firm, and whose interests must be dealt with, and the moral stakeholders, meaning those who are affected by the firm and its activities.

Chinyio and Olomolaiye (2009), on the other hand, group stakeholders into two categories and three levels, according to their influence on the construction project. The following paragraphs explain these categories and levels of influence.

Primary stakeholders

The client, whether a public or private organisation, acts as the promoter, and is the first level primary stakeholder. They establish the requirements for a project, such as scope, quality, and budget, and exercise ultimate control. At the second level, the project leaders and managers, such as contractors, architects and designers, and engineers have prime responsibility for executing and organising the project in order to meet time, cost, and quality parameters that are set by the client. At the third level, subcontractors, suppliers, employees, transport vendors, and other partners have responsibilities to perform the project's activities according to the project's plan and requirements (Chinyio & Olomolaiye 2009).

Secondary stakeholders

At the first level, building inspectors, unions, regulatory and standards authorities, health and safety inspectors, local government and agencies exercise influence on the construction process beyond the direct control of the primary stakeholders. At the second level, shareholders, education and training providers, professional societies, individuals, groups, or organisations concerned with environmental, social responsibility and human rights issues are generally not involved, but exercise some influence on associated areas, such as environmental issues, occupational welfare, health and safety, and employment conditions and qualifications. At the third level, private organisations' interests, innovators and entrepreneurs, public body interests, visitors, competitors, communities, trade associations and manufacturers, and general users are not directly involved, but they can cause considerable disruption to the project's progress (Chinyio & Olomolaiye 2009).

3.7.2 Stakeholder and safety culture in the workplace

Organisations demonstrate their social responsibility to their employees through their vision statement which expresses their commitment to follow health and safety practices. This commitment refers to managerial safety practices, employees' well-being, protection of the community, and the creation of a safe and healthy environment, which is to be created and influenced by senior management (Sonja 2010).

Primary stakeholders and safety culture. As primary stakeholder at the first level of involvement, the client can be regarded as the key to safety performance improvement as the agent best positioned to determine safety processes and outcomes (Briscoe *et al.* 2004; Wild 2005). The client is responsible for assigning a qualified company or individual to administer and coordinate safety management [International Labour Office (ILO) 1992], or may even be considered responsible for safety management on construction sites (European Union Construction Site Directive). In addition, the majority of European Union member states believe that the client can influence the safety performance of a construction project through the financial arrangements and contracts, along with the allocation of the funds needed to implement a safety management system in a comprehensive manner (Bluff 2003).

Huang and Hinze (2006) pointed out that the client is an owner for a project. The researchers examined the role of owners in construction safety and the impact of this role on safety performance, focusing on project characteristics, safety requirements, and owner participation in safety management during the execution of a project. The researchers found that owners have the capacity to influence project outcomes in a positive way. In large construction projects, the researchers found that owners participated more actively in safety management at each phase of the project from project design, contractor selection, to project execution (Huang, XY & Hinze, J 2006).

According to Huang and Hinze (2006), owners with safer projects usually allocated higher funds to safety, assigning full-time safety representatives, funding safety recognition programs, and supporting a safety orientation. The researchers observed that owners can influence construction project safety in a positive way by setting safety objectives, selecting safe contractors and participating in safety management during the execution of a project.

As primary stakeholder at the second level of involvement, according to Carrillo (2005), project managers should concern themselves with safety leadership. Carrillo points out that failed implementation of a safety management system is not necessarily the result of a lack of management safety commitment, but that of mismanaged polarities, misunderstanding of the concept of polarity, and the inability to speak intelligently about ethical dilemmas underlying polarities. Polarities are defined by Carrillo as paradoxes, such as the trade-off between production and safety, or cost and quality (Carrillo 2005).

The effects of leadership dimensions, safety culture and assigned priorities on minor injuries in the work group were also the focus of Zohar's survey (2002) of 411 production workers. The researcher concluded that the effectiveness of any safety management system depends on the priorities established by upper management (Zohar 2002).

In addition to a commitment to safety on the part of senior management, project managers should also demonstrate this commitment. Wild (2005), for example, has pointed out that neither time, budget nor competition result in a poor safety performance in the Australian building and construction industry. It is, instead, inferior safety management due to poor commitment to a safety culture that lowers safety outcomes. OHS issues are inherent in varying commitments to safety across different construction operational levels:

> *Where senior management may in fact be strongly committed to safety, supervisory level personnel may well be the point of disconnect between management's commitment to safety and the regular application of safe work practices by workers. (Hislop 1999, p. 7)*

At the same level of involvement, designers and architects have primary responsibilities to improve safety at construction projects. The National Occupational Health and Safety Commission (NOHSC) (NOHSC 2005) defines a designer as 'a person whose … involves … in preparing designs for structures, including variations to a plan or changes to a structure, or arranging for people under their control to prepare designs for structures' (NOHSC 2005, p. 6). It has been argued that it is beneficial to integrate safety measures into the entire process of a construction project. Recommendations 24 and 27 of the Cole Report (2003) propose that safety measures should be compulsorily integrated into the design and management of a construction project.

According to Behm (2005), design professionals, such as design engineers and architects, have the most influence in organisations in order to make decisions that have the potential to improve safety performance. The author explored the relationship between construction fatality rates and safety by design. He examined 224 fatality investigation reports in the United States. The researcher found that if the practice of safety by design had been adopted, it could have eliminated or mitigated 42% of those fatalities (Behm 2005). Therefore, Behm (2005) suggests that safety by design principle can be used in a construction project in order to increase the safety of workers during the life cycle of a project. The following section explains the involvement and influence of secondary stakeholders on safety in the workplace.

Secondary stakeholders and safety culture. In order to enhance construction safety, Kartam *et al.* (2000) suggest that there is a need to conduct safety inspections in construction projects, and for the introduction of roles for government in safety in the workplace. These authors point out that the current government safety programs in Saudi Arabia are ineffective due to the insufficient numbers of experienced and trained staff. Therefore, the authors suggest that a competent person with appropriate certifications and credentials should conduct an inspection in order to review the safety plans of a construction project, and sign it off before work commences (Kartam *et al.* 2000).

According to Kartam *et al.* (2000), government roles should involve the development of policies requiring safety planning for construction, the development of a safety information manual on prevention methods and construction accidents, a shift from routine construction safety inspections or audits to competent safety engineers, introduction of a proper safety fine system for non-compliance with safety initiatives, and funding of a safety information program from safety fine-generated revenue (Kartam *et al.* 2000).

3.8 The research problem and contribution

The construction industry plays a vital role in all countries, especially in the Kingdom of Saudi Arabia, but still lags behind other industries in terms of its record of occupational safety. Consequently, workplace safety has become a major concern for both society and government (Choudhry, RM *et al.* 2008; Iain & Billy 2008; Phil 2010; Zou 2011). And serious thought is needed in order to reform the safety climate and culture in the sector.

In the safety research, it has been established that accidents occur because of one or more of the following situations (principle researchers for this study noted in parentheses):

- management loss of control
- chain of loss events (Bird, Frank E & Loftus 1976)
- failure of management system
- loss of motivation
- inappropriate training and instruction given by top management (Leather 1987)
- company policy failure
- project management failure
- site management failure
- individual failure (Whittington *et al.* 1992)
- distractions from hazards
- worker stress (Hinze, JW 1996)
- non-compliance with safety rules
- hazards
- loss of control (Rasmussen *et al.* 1994)
- failures caused by management decisions (Reason, JT 1997)
- a failure in the interaction between worker and team work
- workplace issues
- materials and equipment (Haslam, RA *et al.* 2005).

Moreover, in the case of KSA, accidents in construction workplaces occur because of one or more of the following:

- no clear links between safety and engineering, and between safety and risk management
- no safety and security plans
- workers who do not follow basic safety regulations (Almahmoud *et al.* 2012)

- lack of knowledge or skills
- a conflict between safety rules and practical applications
- unsafe personal choices
- personal factors
- cultural barriers to safety
- ineffective management systems
- inappropriate rewards
- improper facilities and equipment, and improper or inefficient feedback (Al-Kudmani 2008).

However, a poor level of safety culture was identified as a most common causal and contributing factor to major accidents (IAEA 1992), because safety culture is the result of a dynamic combination of management attitudes and activities, employee behaviour, and site environment (Choudhry, R *et al.* 2007b). Nevertheless, there is still a large difference in conceptualisations of safety culture, ranging from normative models of safety culture dimensions to descriptive models on social constriction (Edwards, JRD *et al.* 2013; Guldenmund, FW 2000). This is due to both a lack of agreement, and the lack of safety culture's integration into general models of organisational culture (Edwards, JRD *et al.* 2013).

Edwards, JRD *et al.* (2013) propose a conceptual model of safety culture, which includes pragmatic culture, anthropological culture, normative culture, and safety outcomes. This model provides a useful starting point for explaining the nature of safety culture, yet still needs a clear justification of its indicators and a conformity analysis to validate the model. In addition, safety performance needs more in-depth studies to distinguish between leading indicators and lagging indicators, in order to understand the effect of safety culture on those indicators. Therefore, in this research, a comprehensive conceptual model of safety culture is proposed to fill this gap (see next chapter).

Some of the studies found that in relation to workplace safety there is a weakness of enforcement, or no enforcement, by owners, contractors, management, or any government authority (Jannadi, A 2008; Jannadi, O & Bu-Khamsin 2002), and poor engagement among designers, architects, planners and coordinators of the projects (Tam *et al.* 2004). But the positions of those stakeholders in the construction industry would enable them to make a valuable contribution to a project (Newcombe 2003; Smith, J & Love 2004), over which they already have influence in a variety of ways (Chinyio & Olomolaiye 2009). Therefore, Parmar *et al.* (2010) suggest that academics and managers need to rethink the traditional ways of conceptualising the responsibilities of the firms by using stakeholder theory and thinking, since both academics and businesses have found the theory helpful.

According to Greenwood and Freeman (2011), stakeholder theory is important for a number of reasons. Firstly, the theory does not separate the logic of business from human/ethical logic, because all stakeholders are, after all, human beings. Secondly, in any business model, workers are usually at the core. It is for this reason that stakeholder theory emphasises that business models should represent the ways the organisation intends to make employees, customers, suppliers, communities and financiers better off in the understanding that making one better off will make the others better off as well. Furthermore, stakeholder theory suggests that the organisation's relationship with the community and society in general needs to be a two-way process with workers at the centre, and involved.

In the research described in this thesis, stakeholder theory and thinking were conceptualised using the safety culture model in order to understand the relationship between the stakeholder and safety culture in the construction industry, and the usefulness of their interaction in finding a balance between responsibilities and prevention of loss.

3.9 Summary

In this chapter, the extant literature on safety in the construction industry was reviewed. The importance of the construction industry at both general and specific levels in the context of Saudi Arabia was considered. It was demonstrated from the prevailing research that safety in the construction industry is a major problem worldwide, and especially in the Kingdom of Saudi Arabia. Reasons for poor workplace safety were canvassed, including the nature of the workplace in Saudi Arabia, and why accidents occur. In this context, the concepts of organisational culture and safety culture were examined, along with their relationship to improved safety performance. Upon examination of how stakeholder theory has been developed, it emerged strongly that stakeholders can be instrumental in improving the safety culture in an organisation.

The next step in this research was to develop a model based on the logical assumptions drawn from the literature review. This is explained in Chapter 4.

The conceptual model

This chapter begins with an examination of the relationships between the stakeholders, their involvement with the organisation and the dimensions of the organisation's safety culture, i.e., organisational safety attitudes, management safety practices, safety systems, and safety performance. Constructs related to stakeholder involvement are considered first, after which the relationship between stakeholder involvement and a positive safety culture are hypothesised. Before elaborating on the nature of conceptual models in this research, it is worthwhile to understand the characteristics of models in general, and how they relate to theory.

The word model is quite common in everyday language, and in management-talk, such as *business models, quality models, stakeholder models,* or *value chain models*. In general, a conceptual model is only an abstraction of the way researchers choose to perceive a specific part, function, property, or aspect of reality (Jonker & Pennink 2010). It is a representation of a 'system' that is deliberately constructed to study some aspect of that system, or even the system as a whole (Cooper, D & Schindler 2010). As Jonker and Pennink (2010) point out:

> *most models serve to visualise ideas, bring to the fore key properties of a phenomenon and help to guide a specific pattern of actions or how things hold together in illustrating relationships. (Jonker and Pennink 2010, p. 44)*

A **conceptual model** is used, therefore, as a framework through which the relationships of the different constructs under investigation can be revealed, along with the focus and direction of the study. It relates strongly to the theories developed during the literature review to form a **theoretical framework or model** to initiate the subsequent research. Both frameworks are attempts to understand either abstract or observable phenomena, and the words are used interchangeably, although in practice, the conceptual model deals more with specifics of the research process than the broader, theoretical framework, which tends to focus on more abstract concepts.

4.1 The conceptual model

4.1.1 Principal functions of the model

The three principal functions of a conceptual model in research design are (Jonker and Pennink 2010):

1. The conceptual model relates the study to the existing body of literature. The researcher selects factors relevant to their area of research while studying the literature, but which need further investigation. At a theoretical level, the researcher must then connect his study with others' results and theories.

2. Building a conceptual model can be helpful in identifying relevant factors, and providing the connection between these factors in order to make it easy to construct and map the problem and methods of investigation, and to focus on the essentials.

3. Linking the conceptual model to a theory means that each is supported by the other. Understanding the theory means identifying the elements of it, describing the relationship among the elements, and understanding the dynamical relationships from within the conceptual framework formed during the literature review.

4.1.2 Design of the conceptual model

It is important to note that the concepts discussed in the previous chapter are used to describe the composition of a safety culture and type of support provided by stakeholder theory, while the model illustrates several modes of connection that may influence safety at workplaces.

The previous chapter showed that the conceptual model provides a connection between the safety culture's constructs (management safety practices, organisational safety attitudes, safety management system, and safety performance) as highlighted in Edwards *et al.*'s study (2013), and stakeholder involvement. The research gap lies in the absence of a model that assesses the influence of the various stakeholders on workplace safety, a gap largely ignored by previous studies.

In an attempt to overcome the several shortcomings that exist in previous safety culture assessment models, a model encompassing all factors affecting safety outcomes was developed, consisting of the following five dimensions:

- stakeholder involvement
- management safety practices

- organisational safety attitudes
- safety management system
- safety performance.

Four dimensions of the five (safety practices, attitudes, system, and safety outcomes) are highlighted in Edwards *et al.*'s study (2013) to provide greater depth and practical applicability of safety culture, but does not show the kinds of influence stakeholders have on safety culture.

The conceptual model (Figure 4.1) was developed based on the logical assumption that by improving how the organisation operates, there will be inevitable improvement in the results. This proposed conceptual model also seeks to assess safety culture at Saudi Arabian construction sites. The following section provides details of the proposed conceptual model and its hypothesis.

Figure 4.1 The suggested conceptual model

The model variables. Measuring safety culture and stakeholder involvement is a complex task. Thus, the model consists of 36 variables grouped under seven latent variables, which are:

- stakeholder participants (St_Part)
- influence on stakeholders (St_Influen)
- enforcement on stakeholders (St_Enforc)

- management safety practices (MSP)
- organisation safety attitudes (OSA)
- safety management system (SMS)
- safety performance (SP).

The latent variables represent how the organisation behaviourally operates, while the results concentrate on achieving a positive safety performance.

Questionnaire. Each dimension in the conceptual model contains a number of measuring constructs derived from the literature. A questionnaire was developed by which to gather data, and was then distributed to managers working in construction projects in Saudi Arabia to get their feedback regarding stakeholder involvement, safety practices, safety attitudes, safety systems, and safety performance within their organisations.

The questionnaire consisted of eight parts (see Appendix C in English; Appendix E in Arabic). The first part contained demographic questions about each subject (general information, type of organisation, type of project, number of employees, number of incidents, and the age of the organisation). Another seven parts contained questions requesting employees to express their views regarding their organisation in relation to the seven suggested dimensions of the model. In each part, each question reflected a measurement construct related to the dimension corresponding to the section of the questionnaire. Responses to questions about research variables were measured using a 5-point Likert scale.

The following sections explain the theoretical background from which all constructs under each dimension were derived. A table which shows the measuring constructs, along with their corresponding question(s) is provided for each dimension in the questionnaire instrument (Appendix C in English; Appendix E in Arabic).

4.2 Stakeholder participation

4.2.1 Selecting the stakeholders

Depending on their level of involvement, stakeholders in construction industries participate in order to make a valuable contribution to a project in greater or lesser ways (Newcombe 2003; Smith, J & Love 2004). At some point, each of the stakeholders has an influence on its development (Chinyio & Olomolaiye 2009). While Evan, W.M. and Freeman (1993) classify stakeholders as belonging in a wide or a narrow category in terms of their level of interaction and effect on an organisation's policies and strategies, Chinyio and Olomolaiye (2009) grouped stakeholders into two categories, depending on their influence on a construction project.

As discussed in Chapter 2, using a broad concept to define stakeholders in the current study was not considered to be a useful means of analysis since it would be impossible to examine all the stakeholders during any single study. Therefore, it was necessary to systematically narrow down the potential stakeholders in order to operationalise the model.

In the previous review of the literature, it was established that stakeholders may be divided into two groups: (1) ***primary stakeholders*** who have a direct impact upon an organisation and have formal or contractual relationships with the organisation, such as the client/owner, project managers, and contractors; and (2) ***secondary stakeholders***: who are indirectly engaged in the organisation's activities, but are able to influence the organisation's decisions, such as government bodies, authorities and agencies (Savage *et al.* 1991), insurance companies, competitors, and media. Given the limitations inherent in quantitative analysis, it was decided for the purposes of this research to limit the number of stakeholders discussed to those who could exercise the strongest power, i.e., wielded the greatest influence over the construction companies.

Selection frameworks. In order to identify the stakeholders in the context of Saudi Arabia, Mitchell *et al.*'s (1997) framework, consisting of three stakeholder attributes – power, legitimacy and urgency – was employed, as discussed in Chapter 2. According to Neville *et al.* (2011) successful stakeholder management relies upon the accurate identification of the stakeholder. Therefore, this framework was chosen because of the frequency with which it is used as a framework for stakeholder identification, and its provision of relevant suggestions for the ways in which this research should address the different types of stakeholder.

For the current study, the Chinyio and Olomolaiye (2009) framework was used to divide the potential stakeholders into two groups – primary and secondary – along with the Mitchell *et al.* (1997) framework to identify their level of attributes. Schwartz and Carroll's (2003) model was used to identify activities related to corporate social responsibility, and Frooman and Murrell's (2005) description of how the types of stakeholders influence strategies for safety at construction projects.

Stakeholders in Saudi Arabian construction projects. To be able to determine which stakeholders matter most, an initial list of potential stakeholders was drawn up. According to Chinyio and Olomolaiye (2009), the primary stakeholders who can exercise direct and strong power on the construction process are usually the client/owner, project managers (such as architects, designers, and engineers) and contractors. The secondary stakeholders, who have indirect power, but can still exercise influence on the construction process are building inspectors, unions, regulatory and standards authorities, health and safety inspectors, and government bodies.

Mitchell *et al.* (1997) suggest that relevant stakeholders might be assessed according to the relative saliency of their claims. In the case of the current research, the stakeholder types were determined according to the context of Saudi Arabia's construction industry. Therefore, the client/owner, project leaders and contractors were considered to be primary stakeholders, whereas the government bodies and regulation agencies, insurance companies, competitors, and media were deemed to be secondary stakeholders. Unions, inspectors, and standards authorities were excluded from this research because they either do not exist in Saudi Arabia or do not deal with workplace safety.

4.2.2 Primary stakeholders

Client/owner. With regards to the current study, a client or an owner in construction projects is a truly salient stakeholder who possesses the power to influence project outcomes (Chinyio & Olomolaiye 2009), and can make an immediate impact on the project's success. A project's owner is responsible for controlling and managing all activities of a project, and ensuring compliance with regulations by all project members, including the contractors and subcontractors (Sallinen 2011). In addition, in regards to resource dependence (Pfeffer & Salancik 1978), the project's owner possesses the financial resources. Therefore, the client/owner is best positioned to determine safety processes and outcomes (Briscoe *et al.* 2004; Wild 2005). Furthermore, the majority of European Union member states believe that the client can influence the safety performance of a construction project by their 'financial specifications and contract negotiations', and supply the funds needed to implement a safety management system in a comprehensive manner (Bluff 2003).

Project managers. Project managers, as representatives of firms, exercise power over different stakeholders. They have the primary responsibility for organising the project team, interpreting the project plan, preparing cost and schedule estimates, determining and implementing the best practices, and managing all the design and construction work (Chinyio & Olomolaiye 2009). In regards to resource dependence (Pfeffer & Salancik 1978), whereas the project's owner possesses the financial resources, the project managers offer the technical know-how to execute the project.

In addition, project managers must act in the interests of the other stakeholders, along with the interests of the owner/client, in order to ensure the survival of the organisation, and safeguard its welfare (Fontaine *et al.* 2006). Therefore, the role of the project manager with respect to safety involves the development of strong management safety commitment, safety leadership, and hazard identification and control (Charles *et al.* 2007).

Contractors. Contractors typically manage all the project functions relating to cost estimation, scheduling, procurement, and supervision of their own staff members, in order to meet client requirements and finish the project successfully (Harris 2010). The technical aspects of contractor performance are the one of the most important criteria for project success (Zanjirchi & Moradi 2012). Therefore, project contractors basically need to improve the construction's health and safety records by planning, managing and monitoring their own works, checking the competence of their workers, training their workers, and providing safety information to their workers, while ensuring that there are adequate welfare facilities (HSE 2007).

4.2.3 Secondary stakeholders

Government bodies and regulatory agencies. A government, as stakeholder, affects organisations through fiscal and regulatory policies (Moloney 2006). Some stakeholders have the power and potential to cooperate or threaten organisational strategies because of the organisation's resource dependence; the greater the dependence, the greater is the willingness of the organisation to cooperate (Fontaine *et al.* 2006).

Government bodies and regulators have moral and ethical responsibilities in terms of projects. Their priority should be to place society's interests before those of any organisation (Sallinen 2011). According to Fassin (2009), government bodies are considered to be highly salient stakeholders because of their ability to enact laws and impose regulations, and their consequent power to order organisations to take on certain responsibilities for workers' well-being (Fassin 2009). Furthermore, they can limit the resources available (such as licenses and permits) to firms (Frooman 1999), or projects (Aaltonen *et al.* 2008) and demand changes to safety culture.

Workers' compensation insurance premiums. Insurance carriers as stakeholders are likely to assert influence (Savage *et al.* 1991) and have an impact on a project (Al-Khafaji *et al.* 2009). Basically, construction companies transfer the impact of accidents to insurance companies (Leung & Olomolaiye 2009). Workers compensation insurance bodies possess salient attributes because they create immediate impact on the organisation's finances (Loebbaka & Lewis 2009). According to Agarwal and Everett (1997) workers compensation insurance premiums are increasingly affecting organisations' ability to conduct business, and have made the costs of certain types of works very expensive. Therefore, in Saudi Arabia, employer stakeholders benefit by transferring all the expenses resulting from work injuries and occupational diseases to this social insurance (GOSI 2009-2010; Jannadi, M. 1996).

Competitors. Competitors in the construction industries have been classified as secondary stakeholders, who can affect, or are affected by, each other (Chinyio & Olomolaiye 2009). Safety practices in one organisation may confer a competitive advantage over another. Good safety practices have the potential to create a more productive workforce, leading Malca *et al.* (2006) to suggest that organisations with well-developed safety management lead the drive for improving safety in the workplace.

Media. The media has been classified as a non-traditional stakeholder for construction projects (Al-Khafaji *et al.* 2009; Freeman 2010; Friedman, AL & Miles 2006), while some authors argue that media is not a stakeholder at all as they have no stake in the projects (Moura & Teixeira 2010). However, media can have a significant influence on the success of a project (Leung & Olomolaiye 2009) because they wield considerable power and the capacity to influence other stakeholders in the project decision making process (Moura & Teixeira 2010), because of their ability to affect an organisation's reputation (Leung & Olomolaiye 2009). Therefore, reports and editorials in the media, both paper and digital, may force organisations to change (Freeman 2010) and improve their safety culture.

The enforcement and influence of stakeholders on the safety culture. The powers of these stakeholders are manifested in its enforcement and influence mechanisms. Prior studies provide evidence that the influences of stakeholders on improving safety are predicted to provide a positive safety culture and to reduce losses. The following questions were therefore developed:

- The question related to the primary stakeholder is: To what extent do the primary stakeholders influence their organisation to improve their safety culture?
- The question related to the secondary stakeholder is: To what extent do the secondary stakeholders enforce construction companies to improve their safety culture?

In order to determine stakeholder types according to their attributes and social responsibilities as defined by Mitchell *et al.* (1997), qualitative methods must be used to evaluate the stakeholder attributes of power, legitimacy, and urgency which it is not the case of this research.

As mentioned previously, earlier studies provide evidence that primary stakeholders can be both influenced and compelled to improve safety culture by secondary stakeholders (Walker *et al.* 2008), such as both local and central government agencies (Chinyio & Olomolaiye 2009). In the context of Saudi Arabia, the government bodies and agencies who deal with industrial safety are: government inspectors, the Ministry of Labour, the General Organization for Social Insurance, General Presidency of Meteorology and Environment Protection, and Civil Defence.

Furthermore, primary stakeholders may be *influenced* to shape plans and actions (Bourne & Walker 2005; Walker *et al.* 2008) by such factors as the rates for workers compensation insurance (Everett & Yang 1997), the safety practices of competitors (Sulaiman 2008), and by media attacks (Freeman 2010), which may lead to improvements in safety culture. Therefore, the following hypotheses were developed:

H1: ***The safety regulations and procedures of the government bodies and authorities agencies are positively enforcing the primary stakeholders to enhance safety culture.***

H2: ***The impact of the rates for workers' compensation insurance, safety practices of competitors, or social media are positively influencing the primary stakeholder to approach safety.***

The current research adopted these hypothesises related to enforcement and influence in order to answer the questions:

Q: To what extent are primary stakeholder efforts to enhance and improve safety culture the result of enforcement of safety regulations and procedures by the government bodies and authorities?

Q: To what extent are the primary stakeholders influenced by the rates for workers' compensation insurance, safety practices of competitors, and social media in their approach to safety and the improvement of safety culture?

Constructions of the stakeholder involvement dimension. Table 4.1 presents the various suggested constructions of the stakeholder involvement dimension, along with the corresponding questions, as in the questionnaire.

Questions were grouped to elicit answers on stakeholder participation, stakeholder influence and stakeholder enforcement, with participants responding using a 5-point Likert scale. Participation of the primary stakeholders was measured on a scale anchored at one end by 1 no involvement and at the other by 5 fully involved. The influence of secondary stakeholders on improving safety at the workplace was measured on a scale anchored at one end by 1 no influence and at the other by 5 very influential. The degree to which safety measures are enforced by secondary stakeholders was also measured using a 5-point Likert scale anchored at one end by 1 no enforcement and at the other by 5 extensive enforcement.

Table 4.1 Main constructs of 'stakeholder involvement' and corresponding questions (part of the questionnaire in Appendix C)

Construct		Positive perceptions	Question no.
Stakeholder participation			
Primary	Clients / owners	To what extent are these stakeholders involved in safety?	Question 12a
	Project leader, and designers/ architects		Question 12b
	Main contractor		Question 12c
2nd	Government		Question 12d
	Insurance company		Question 12e
Influence on stakeholders			
The rates for workers' compensation insurance		To what extent do these items influence the organisation's approach to improve safety?	Question 13a
Safety practices of competitors			Question 13b
Media attacks			Question 13c
Enforcement on stakeholders			
Safety regulations in workplaces		To what extent the following items enforce the organisation's approach to improve safety?	Question 14a
Government inspectors			Question 14b
Safety requirements from Ministry of Labour			Question 14c
Safety requirements from the General Organization for Social Insurance			Question 14d
Safety requirements from the General Presidency of Meteorology and Environment Protection			Question 14e
Safety requirements from Civil Defence			Question 14f

4.3 Organisational safety attitudes

As mentioned in Chapter 3, safety behaviour is based upon attitudes, beliefs, values, and assumptions, shared by members of an organisation. These shared attitudes and assumptions do not necessarily have to be positive. An organisation can be very negative in its beliefs about safety in the workplace, or see workplace safety as a competitive advantage and just the right thing to put in place. Whatever the organisation's outlook, it will pervade the way in which the organisation deals with safety (Guldenmund 2000).

Therefore, when seeking to understand an organisation's safety culture in order to meet an estimated benchmark, organisational safety attitudes can be seen as representative of the beliefs, assumptions, and shared values of that organisation's members (Edwards, JRD *et al.* 2013). Also, Teo and Feng (2009) found that these assumptions and attitudes are a snapshot of safety culture, and can be assessed by questionnaires in order to determine what should be done to improve safety performance and the safety culture itself.

Regarding the assessment and measurement of safety culture, such as basic assumptions and attitudes, Choudhry, R *et al.* (2007a) found that the assessment should be understood within a specific context, and attention should be paid to this when selecting a group or organisational level for study. Therefore, this study focussed on these organisational factors in order to distinguish one category from another (Hofstede, GH 2001).

Understanding the history and development of the questionnaire is particularly important in the safety culture research undertaken, because most of the instruments have varied development histories and therefore provide minimal information (Ferraro 2002). Therefore, validity and reliability of measurements are extremely important, as will be discussed in Chapter 5.

In the construction industry, organisational safety attitudes are regarded as the main construct in developing a positive safety culture (Mearns, K *et al.* 2003; Ostrom *et al.* 1993). There are a number of organisational safety attitudes necessary for developing a good safety culture, including:

- *the effectiveness of safety efforts* (Ostrom *et al.* 1993)
  Ostrom *et al.* (1993) point out that the effectiveness of an organisation's safety efforts are dependent on their safety activities, that is, the techniques in place for the gathering of safety related information, active encouragement of workers to work more safely, and the accurate measurement of safety performance, not only to solve immediate safety issues, but also to learn how to identify and address those issues as they apply to day-to-day activities. According to Ostrom *et al.* (1993) this type of safety effectiveness cannot measured by traditional criteria like safety inspection, review and audits, but it can be measured with surveys of employees' perceptions.
- *an atmosphere of trust between management and workers* (Gordon, R *et al.* 2007; Hansen 2007)
  Gordon, R *et al.* (2007) suggest that the character of the trust between management and workers is evidence that can be used to enhance the safety performance of an organisation. When workers are encouraged to become involved in how safety is managed in their organisation, honest participation from the workforce will help develop a good safety culture by ensuring workers feel free to contribute to developing a reporting culture.

Furthermore, workers who trust that management is committed to their welfare are likely to have different perceptions and attitudes to workers who do not perceive this safety commitment (Mearns, K & Flin 1996).

- *management attitude toward safety* (Ferraro 2002; Flin, R *et al.* 2000; Mearns, K & Flin 1996)
  According to Flin, R *et al.* (2000) management attitudes toward their safety responsibilities have been addressed in the majority of previous studies on safety assessment. Mearns and Flin (1996) point out that management's attitudes toward safety have an impact on worker's attitudes and behaviour. Usually, it is measured by employee's perceptions of their management's attitudes with respect to safety (Flin, R *et al.* 2000).

- *productivity versus safety* (Ferraro 2002; Filho *et al.* 2010; Mearns, K *et al.* 2003)
  refers to any situation where the management prioritises production and safety in the workplace equally, not only when serious accidents or work-related illnesses occur (Ferraro 2002; Filho *et al.* 2010; Mearns, K *et al.* 2003).

- *the clarity of the safety rules and regulations* (Chunlin *et al.* 1999; Hofstede, G & Hofstede 2004)
  refers to the clarity of these rules and regulations, and whether or not they are vague or ambiguous. Research by Hofstede, G and Hofstede (2004), which was carried out in more than 60 countries, suggests that, because their language comprehension may affect an organisation's safety culture, international workers need to have widespread and detailed safety rules and regulations in order to follow the organisation policy (Chunlin *et al.* 1999).

- *work pressures* (Chinda & Mohamed 2008; Flin, R *et al.* 2000; Glendon & Litherland 2001; MCA 1999; Mearns, K *et al.* 2003; Mohamed 2002)
  refers to management pressure to increase productivity; According to Mearns, K *et al.* (2003) this type of pressure leads workers to break and ignore the safety rules by taking risks and shortcuts to finish tasks, or get the job done.

- *reporting injures and accidents* (Filho *et al.* 2010; Ostrom *et al.* 1993)
  refers to those organisations which encourage their employees to report all unusual events and hazards, in order to analyse them and attempt to improve their safety performance (Filho *et al.* 2010; Ostrom *et al.* 1993).

- *workers' competence to understand safety warnings and posters* (Chunlin *et al.* 1999; Fang *et al.* 2006; Flin, R *et al.* 2000)

  refers to the ability of the construction workers to understand the verbal and nonverbal safety warnings, such as safety instructions and posters, because most of those workers are of different nationalities, with different languages, which may affect the culture of an organisation (Chunlin *et al.* 1999).

- *safety awareness* (Chinda & Mohamed 2008; Ostrom *et al.* 1993)

  The final item of organisational safety attitudes is safety awareness; according to Ostrom *et al.* (1993), an organisation can measure their efforts to improve safety culture by the level of safety awareness among their employees.

Table 4.2 presents the various suggested constructs of the organisation safety attitudes dimension, along with their corresponding questions (comprising nine questions) as placed in the questionnaire instrument. Research variables of the organisation safety attitudes dimension were measured on a 5-point Likert scale, anchored by 1 strongly disagree at one end and 5 strongly agree at the other.

Table 4.2 Main constructs of 'safety attitudes' and corresponding questions (part of the questionnaire in Appendix C)

Construct	Positive perceptions	Question no.
Safety effectiveness	*Daily routines show that safety is important*	Question 9a
Trust	*Achieving regulatory compliance is not the only objective of organisation*	Question 9b
Attitude	*Management understands that they are responsible for safety*	Question 9c
Productivity vs safety	*There is pressure to put safety before production*	Question 9d
Rules and regulation	*The written safety rules are easy for people to follow*	Question 9a
Work pressure	*If there is work pressure, workers don't break safety rules*	Question 9e
Reporting	*Workers don't hesitate to report minor injuries and incidents*	Question 9f
Competence	*Workers understand all the safety warnings and posters*	Question 9g
Awareness	*In general, workers are aware of safety rules and instructions*	Question 9h

4.3.2 Management safety practices

As discussed in Chapter 3, management safety practices are based strongly upon practice theory, which views culture in terms of the shared safety practices of organisational managers and practitioners (Edwards, JRD *et al.* 2013). This approach has been discussed in the safety literature and labelled as management safety practice, a subset of safety culture (Cheng *et al.* 2012; Mearns, K *et al.* 2003; Zacharatos *et al.* 2005).

Along the same lines, the negative impact of accidents in the workplace necessitates repositioning the roles of management in safety practice, in order to safeguard workers from hazards in the workplace by encouraging positive employee behaviour (Cheng *et al.* 2012). Another study by Al-Refaie (2013) found that management safety practices should be implemented to enhance self-efficacy by senior management. The author found that management safety practices, such as commitment from senior management, significantly affect workers' self-efficacy through safety activities.

Mearns, K *et al.* (2003) point out that the present studies view management safety practices as an indicator of safety culture within upper management, including policy compliance, governance of safety implementation and the linking of health and safety into the operation of the business. Management commitment to safety encourages good attitudes and proactive safety performance among employees because it increases trust in senior management (Zacharatos *et al.* 2005) and a sense of a shared responsibility and goals for the workplace.

The elements of senior management safety practices are slightly different from one study to another. For instance, Kheni *et al.* (2010) found that implementation of safety roles by management, management involvement in improving safety at the workplace, and the provision of proper safety resources helps to prevent accidents. On the other hand, Mearns, K *et al.* (2003) found that satisfaction with management safety activities (such as safety meetings, emergency response), involvement in safety, communication about safety, competence, and commitment are also components of management safety practices. Leadership in terms of safety is often reflective of a manager with a strong interpersonal style, and strong safety knowledge (Chinda & Mohamed 2008; Cipolla *et al.* 2005). Wu, T-C (2005) defines safety leadership as:

> *...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, T-C 2005, p.28)*

Various studies have suggested a number of management safety practices. Those relevant to the context of the Saudi Arabian construction industry, and which may be deemed necessary for the development of a positive safety culture, include:

- *senior management commitment to safety* (MCA 1999)
  refers to the safety commitment of senior management toward safety campaigns and promotions in order to encourage a positive safety culture (Aksorn & Hadikusumo 2008). According to the Minerals Council of Australia (1999), employees are most positive about perceived safety commitment when a commitment to safety is clearly shown by their management.
- *management involvement with day-to-day safety activities* (Choudhry, R *et al.* 2007a; Ferraro 2002)
  is about the degree to which the senior management of an organisation is involved, and participates in, safety issues, in reviewing rules and procedures, and in accident analysis; being proactive rather than reactive (Choudhry, R *et al.* 2007a).
- *two-way communication* (Fang *et al.* 2006; Ferraro 2002)
  refers to the effectiveness of both formal and informal communication between management and frontline workers, in order to improve safety culture. Passing down safety information from senior management to frontline employees helps to enhance safety performance (Fang *et al.* 2006).
- *resource availability for safety* (Aksorn & Hadikusumo 2008; Ferraro 2002)
  is about allocating financial resources and sufficient staff to provide tools, equipment, and safety information to the staff in order to implement safety practices safely. Aksorn and Hadikusumo (2008) point out that the effectiveness of safety activities depends largely on the level of the resource allocation.
- *safety meetings* (Ostrom *et al.* 1993)
  refers to the degree to which safety matters are prioritised during meetings by the senior management of an organisation. According to Ostrom *et al.* (1993) when safety meetings are held to discuss and analyse accidents and near misses, then safety outcomes will be improved.

- *sharing safety matters with contractors* (Carder & Ragan 2003; Sawacha *et al.* 1999)
  refers to the need for an organisation to discuss all safety procedures and rules with all contractors in tender documents, in order to establish a better safety culture before commencing a project. As part of an organisation's actions, Sawacha *et al.* (1999) point out that the responsibilities of health and safety on a project should be clearly defined, and reflected in a contractual arrangement, in order to enhance safety performance.

- *management's safety leadership* (coaching, caring, and controlling) (Wu, T-C 2005)
  refers to senior management's positive safety practices, strong interpersonal style, and strong safety knowledge (Cipolla *et al.* 2005). According to Wu, T-C *et al.* (2011) safety leadership mainly includes three dimensions: safety coaching, safety caring, and safety controlling.

  – Safety coaching refers to the extent to which senior management can be a role model to their workers; can engage their intellect; can share opinions; and can include employees in decision making.

  – Safety caring refers to the extent to which senior management treat their workers in a friendly way; achieves harmony in everyday management issues; respects and trusts employees; cares about employees' needs and understands their problems.

  – Safety controlling refers to the extent to which senior management creates a system to set standards of behaviour for employees; uses authority to correct infractions; uses technology to monitor safety performance (Wu, T *et al.* 2007).

Table 4.3 presents these constructs along with their corresponding question(s) (comprising 9 questions) as placed in the questionnaire instrument. Research constructs of management safety practices dimension were measured a 5-point Likert scale, anchored by <u>1 never</u> at one end and <u>5 always</u> at the other.

Table 4.3 Main constructs of 'safety practices' and corresponding questions (part of the questionnaire in Appendix C)

Construct	Positive perceptions	Question no.
Commitment	*In this organisation safety has been taken seriously*	Question 8a
Involvement	*Management is involved with day-to-day safety activities*	Question 8b
Communication	*Safety concerns are effectively communicated to workers*	Question 8c
Resources	*Sufficient resources are available for safety*	Question 8d
Meeting	*In meetings, safety issues are given high priority*	Question 8e
Contractor management	*Safety provisions in tender documents are clear for promoting better safety on site*	Question 8f
Controlling	*Management use their authority to require subordinates to reach safety targets*	Question 7a
Coaching	*Management make clear that safety is more important than productivity*	Question 7b
Caring	*Management participate in regular safety activities*	Question 7c

4.3.3 Safety management system

The safety management system should be an integrated element of the organisation's design, and available for use as a tool for improving or maintaining safety outcomes (Frazier *et al.* 2013; Antonsen 2009b; Fernández-Muñiz *et al.* 2007). According to Fernandez-Muniz *et al.* (2009):

> *Safety management systems are integrated mechanisms in organisations designed to control the risks that can affect workers' health and safety, and at the same time to ensure the firm can easily comply with the relevant legislation. (Fernández-Muñiz* et al. *2009, p. 981)*

However, little consensus has been reached about the key dimensions of the system (Fernández-Muñiz *et al.* 2007). Fang and Wu (2013) note that the system represents safety rules and management approaches, whereas Frazier *et al.* (2013) states that it includes actions to use to manage safety, such as assigning safety officials, creating safety committees, creating and performing polices, and developing prevention strategies.

Echoing these findings, Fernandez-Muniz *et al.* (2009) identified key aspects of safety management systems, which include policy, incentives, competences development, communication and safety information transfer, planning, control and review. In a description of the relationship between safety management systems and safety culture, McDonald *et al.* (2000) observed that the main elements of the safety management system include policy, standards, planning and organisation, operation, monitoring, feedback and change.

In addition, safety management standards also have common components. The AS/NZS 4801:2001 and OHSAS 18001 standards comprise OHS policy, planning, implementation and operation, checking and corrective action, and management review, whereas the HSE HSG65 standard includes policy, organising, planning and implementing measurement and performance reviews, and auditing.

However, because of the special case of Saudi construction industry (see Chapter 2), experts in this field suggested a number of the safety management system aspects, which are relevant and necessary for developing a good safety culture, including:

- *safety policy* (MCA 1999)
  means that an organisation needs to emphasis their safety commitment by stating that safety is important in its policy statements (MCA 1999).
- *safety goals* (MCA 1999)
  means that organisations have to state safety goals and targets to achieve, such as 'zero accidents'. It helps workers to concentrate toward those targets and goals and improve safety outcomes (MCA 1999).
- *safety planning* (Filho *et al.* 2010)
  means that the safety planning is integrated with the other aspects of an organisation in order to implement the safety policy and achieve the safety goals (Filho *et al.* 2010).
- *safety program* (Ferraro 2002)
  is related to perceptions of the safety system such as the status of safety officials and permits the system to function correctly within the organisation (Ferraro 2002).
- *hazard identification* (Ferraro 2002)
  related to the effectiveness of identifying risks and hazards which could affect workers by the implementation of safety inspections at the workplace (Ferraro 2002).
- *safety rules and procedures* (Mohamed 2002)
  means that the safety rules and procedures of an organisation are made available not only for government safety regulation, but also to protect workers from risks and hazards (Mohamed 2002).
- *safety review* (Filho *et al.* 2010)
  means that organisations have safety rules and procedures in place which are constantly reviewed for better outcomes (Filho *et al.* 2010).

- *safety auditing* (Parker *et al.* 2006)
  means that the organisation has an auditing program in all its sectors for safety at work (Parker *et al.* 2006).

Table 4.4 presents the various suggested constructs of the safety management system along with the eight corresponding questions from the questionnaire. Research constructs of the safety management system were measured using a 5-point Likert scale, anchored by 1 strongly disagree at one end and 5 strongly agree at the other.

Table 4.4 Main constructs of 'safety management system' and corresponding questions (part of the questionnaire in Appendix C)

Construct	Positive Perceptions	Question No.
Policy	*This organisation clearly states that safety is important in its policy*	Question 10a
Goals	*This organisation has clear goals and targets for safety*	Question 10b
Safety planning	*Safety planning is integrated with the other areas of the organisation*	Question 10c
Safety program	*This organisation has a useful safety system*	Question 10d
Hazard	*Safety inspections are effective at identifying hazards and risks*	Question 10e
Rules/procedures	*Current safety rules and procedures are made available to protect workers from accidents*	Question 10f
Review	*Current safety rules and procedures are constantly reviewed for better outcomes*	Question 10g
Auditing	*The organisation has an auditing program in all its sectors for safety at work*	Question 10h

4.3.4 Safety performance (safety outcomes)

The final element of the model of safety culture is safety performance. Safety performance relates to how well the organisation manages its hazards (Reason, JT 1997). An organisation can increase its resistance and lower the risk of accidents by a positive safety performance, or decrease its resistance and increase the risk of accidents by a negative safety performance (Nevhage & Lindahl 2008). Edwards, JRD *et al.* (2013) view safety outcomes as representative of safety culture's interpretation within the organisation and a subset of organisational performance.

Safety performance is difficult to measure (Wadsworth & Smith 2009). Self-reporting, accident rate, compensation costs, and officially recorded accident dates are poor measures of safety performance, because accidents can be rare events, may not be recorded accurately, and the inherent risk may not be taken into account (Choudhry, R *et al.* 2007a; Wadsworth & Smith 2009). Choudhry, R *et al.* (2007a) found that many studies advocate for the use of proactive measures that focus on safety activities to attain system success rather than system failure, which means that organisations can identify problem areas before a system failure occurs (Wadsworth & Smith 2009).

As Choudhry, R *et al.* (2007a) point out, the measurement of safety performance can be categorised into two approaches: lagging indicators and leading indicators. Lagging indicators basically measure an historical event of safety reactively, by assessing downstream consequences such as compensation costs and accident rates, as measures of the level of safety failure. Leading indicators are proactive measures taken upstream, which measure safety culture, through hazard identification, safe behaviour, and safety activities that ensure the success of a safety management system.

There is no common definition for safety performance (Wadsworth & Smith 2009). In the current research, safety performance defines the quality of the outcome resulting from safety culture activities (Nevhage & Lindahl 2008; Wu, T-C *et al.* 2009).

Regarding the dimensions of safety performance, Wu, T-C *et al.* (2009) found that many authors (Downs 2003; Schneid 1999; Swartz 2002; Wu, T 2005) have recommended safety performance dimensions at the organisational level, such as: safety training and education, hazard control, communications, safety motivation, safety planning and administration, and accident investigations and statistics. At the group level, the safety performance of senior management could be measured by the following:

- *inspections*
  refers to the inspection of employee behaviour and attitudes toward safety and safety equipment in the workplace, which involves observation, evaluations and strict oversight (Wu, T-C *et al.* 2009).

- *safety training*
  refers to a continuing safety education program for all employees at an organisation, and includes necessary knowledge, such as prevention techniques, and the development of a positive attitude, in order to improve safety behaviour (Wu, T-C *et al.* 2009).

- *accident investigation*
  refers to the identification by safety professionals of the causes of accidents in the workplace, and their assessment of the best means of avoiding accidents in the future (Wu, T-C *et al.* 2009).
- *motivation* (Wu, T-C *et al.* 2009; Petersen 2005)
  refers to stimulating an employee's attitude to make an effort to attain organisational safety objectives, by incentive or reward value (Wu, T-C *et al.* 2009).

By doing an exploratory factor analysis for the scale validity and an internal consistency analysis (Cronbach's α) for reliability, Wu, T-C *et al.* (2009) found that these four dimensions have good construct validity and internal consistency, and can serve as the basis for future research.

Table 4.5 presents the suggested constructs of safety performance, along with four corresponding questions from the questionnaire. Research constructs of the safety performance dimension were measured using a 5-point Likert scale, anchored by 1 strongly disagree at one end and 5 strongly agree at the other.

Table 4.5 Main constructs of 'safety performance' and corresponding questions (part of the questionnaire in Appendix C)

Construct	Positive Perceptions	Question No.
Inspection	*The safety environment of the workplace is always inspected*	Question 11a
Investigation	*The causes of accidents are carefully analysed*	Question 11b
Training	*Workers received adequate safety training related to their job*	Question 11c
Motivation	*The organisation implements safety incentive programs*	Question 11d

4.4 Interrelations between the five dimensions

4.4.1 Stakeholder involvement and safety culture

As discussed above, stakeholders of construction projects have an influence on improving safety outcomes. This section explores the interrelation between stakeholder involvement and safety culture.

Zou (2011) investigated five cases to find the fundamental elements that enhance safety culture in construction projects. He found that a strong construction safety culture needs to engage every project stakeholder, each of whom has an interest in, and influence over construction safety. This strong safety culture is achievable when all members of the construction projects have the right beliefs, attitudes, values, and adopt appropriate behaviour toward not only regulations, policies, and site conditions, but also the human factors (Zou 2011). Moreover, a strong degree of cooperation among stakeholders in the distribution of safety knowledge will cultivate safety culture and create a higher level of safety outcomes (Huang, X & Hinze, J 2006a; Loebbaka & Lewis 2009). According to Fang and Wu (2013) the interaction of the major players in a construction project as owners and contractors, represents the evolutionary process of safety culture; as a result, the changing of their contribution to construction projects' safety culture, and the consequences of their influence can be measured and studied.

Therefore, the effect of primary stakeholder involvement on safety culture in the literature led to the following hypotheses:

H3: ***Primary stakeholder involvement is positively associated with organisational safety attitudes.***

H4: ***Primary stakeholder involvement is positively associated with management safety practices.***

H5: ***Primary stakeholder involvement is positively associated with the effectiveness of the safety management system.***

4.4.2 Interrelations between the safety culture's dimensions

As discussed above, safety culture has four dimensions, namely: organisational safety attitudes, management safety practises, safety management system, and safety performance. This section explores the interrelation between these dimensions

Interrelations between organisational safety attitudes and safety performance. In construction project safety culture, Wadsworth and Smith (2009) found that there are positive associations with safety performance. Likewise, Wu, T-C *et al.* (2008) found that the safety climate is positively related to safety performance, which can affect both safety training and accident investigations. Another study by Sawacha *et al.* (1999) observes that senior management's attitudes toward safety represents a significant factor in enhancing safety performance, because workers will work more safely when they see their management regards safety as equally important as production.

Interrelations between organisational safety attitudes and safety practices. Fernández-Muñiz *et al.* (2007) point out that through its safety attitude, an organisation exerts a positive influence on improving safety practices such as safety commitment, and establishing regular, effective safety meetings. Sawacha *et al.* (1999) added that a positive safety attitude within the senior management will help to improve their safety practices, because when moral obligations towards employees are honoured, contractors will not be selected or placed on tender lists unless they can show competence in management in order to be more effective in preventing future hazards or risks.

Interrelations between organisational safety attitudes and safety management system. In order to more effectively implement a safety management system, Fernández-Muñiz *et al.* (2007) suggest that a positive safety attitude in an organisation is critical. For example, when Hsu *et al.* (2008) examined the relationship between senior management safety attitudes and safety management systems, with reference to Japanese companies, they found that, when dealing with hazards, Japanese senior managers take preventive measures, continuously reviewing safety procedures, and adjusting their safety goals accordingly. Similarly, Aksorn and Hadikusumo (2008) found that a safety control system required an appropriate attitude from upper level management in order to succeed.

Descriptions of the effects of organisational safety attitudes on safety management practices, safety management system, and safety performance in the literature led to the following three hypotheses:

H6: ***Organisational safety attitude is positively associated with safety performance.***

H7: ***Organisational safety attitude is positively associated with management safety practices.***

H8: ***Organisational safety attitude is positively associated with the effectiveness of the safety management system.***

Interrelation between safety management system and safety performance. According to Frazier *et al.* (2013) the safety management system could be used as a tool for an organisation to improve safety performance by monitoring and evaluating safety culture in general. To identify good practices in a safety management system, Fernandez-Muniz *et al.* (2009) analysed the effect of the safety management system on a set of indicators of organisational performance of Spanish firms. They found that the safety management system has a positive influence on the organisational performance, in particular, upon safety performance. Robson *et al.* (2007) had also found that these interventions indicated consistently positive effects on safety performance.

Therefore, the effect of safety management systems on safety performance presented in the literature led to the following hypothesis:

H9: Safety management system is positively associated with safety performance.

4.4.3 Interrelations between management safety practices and safety performance

Management safety practices were viewed as a part of safety culture in terms of the shared safety practices of managements and practitioners who provided safety leadership (Edwards, JRD *et al.* 2013; Cipolla *et al.* 2005). When Mearns, K *et al.* (2003) conducted surveys on management safety practices in separate years, they found that the management safety practices were positively associated with safety performance, and changed the level of management commitment from reactive to proactive.

Another study by Zacharatos *et al.* (2005) was conducted investigating the relationship between high performance work systems and safety performance. Their study showed that when management practices are applied to improve organisational performance, the effect is felt in safety performance too. Likewise, Al-Refaie (2013) examined the effectiveness of senior management safety activities and practices on safety self-efficacy and awareness. He found that the management safety practices significantly affect safety self-efficacy through safety activities, and also influence safety awareness. Although there is evidence that commitment by senior management to discuss safety may improve safety performance (Mearns, K *et al.* 2003), it is worth noting that Cheng *et al.* (2012) found that some management safety practices were positively, *but not significantly*, related to project performance (such as the safety management process).

The effect of management safety practices on safety performance presented in the literature overall led to the development of the following hypothesis:

H10: Management safety practices are positively associated with safety performance.

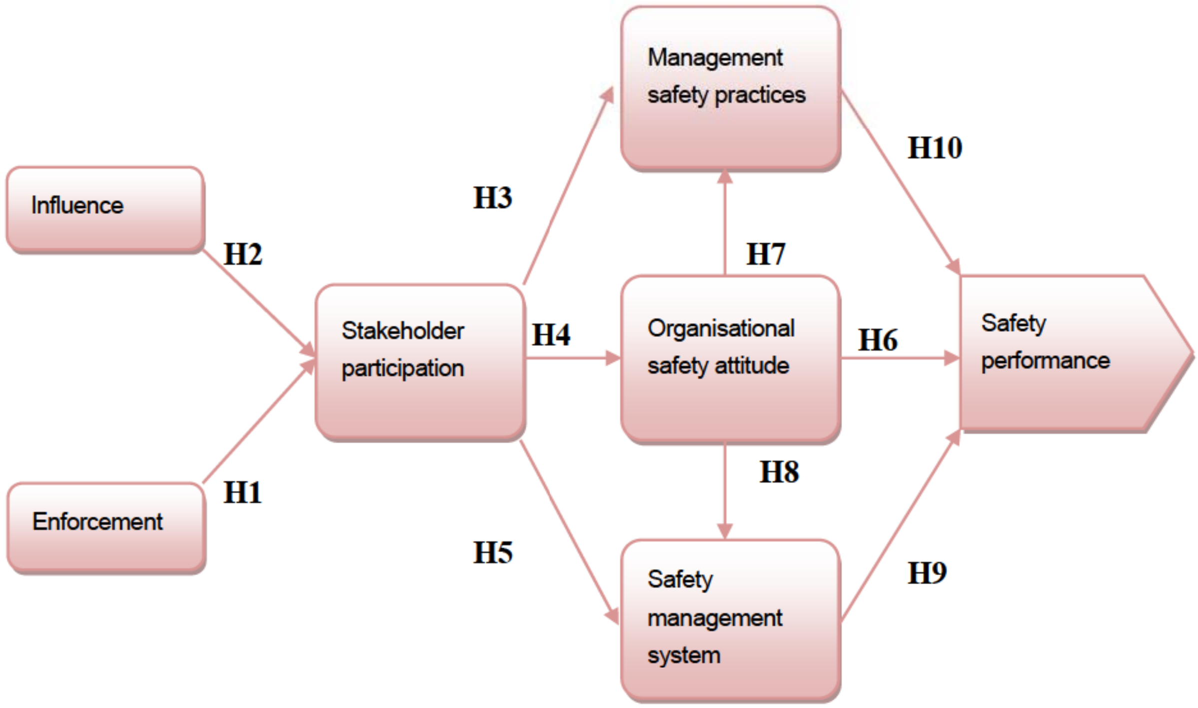


Figure 4.2 Mapping of hypotheses onto illustration of construct

4.5 Organisation size, stakeholder involvement and safety culture

The size of the organisation has been found to be associated with its safety performance in construction projects (Lin & Mills 2001). Existing studies indicate that the safety performance of small organisations is somewhat poor (Vickers *et al.* 2005), whereas large organisations tend to be more committed to improving safety (Lin & Mills 2001). Holmes *et al.* (2000) point out that small organisations often believe that controlling hazards is the responsibility of workers, while large organisations believe that safety systems must be part of their entire management system and across all projects. In regards to the current study, GOSI (2010) data show that the construction industry in Saudi Arabia consists of 94% small organisations, around 5% medium organisations, and around 0.6% large organisations. Therefore, in regards to stakeholder involvement and safety culture, the size of a construction firm may play a vital role in the proposed model and affect its variables. As result, the following hypothesis has been developed:

H11: Construction organisations with few employees are less likely to be influenced and enforced by stakeholders in their approach to safety matters. Those with a larger number of employees are more likely to be influenced and enforced by stakeholders in their approach to safety matters.

4.6 Summary

This chapter examined relationships between the dimensions of safety culture (organisational safety behaviour, management safety practices, safety management system, and safety performance) and stakeholder involvement by separately identifying constructs related to safety culture and stakeholder involvement. In addition, it examined the hypothesised relationships between stakeholder involvement and safety culture's dimensions that provide a positive safety performance for construction projects.

In an attempt to overcome the several shortcomings that exist in previous safety culture assessment models, a model encompassing all factors affecting safety outcome was developed. This model consists of the following dimensions: stakeholder involvement, management safety practices, management safety attitude, safety management system, and safety performance.

The conceptual model was developed based on the logical assumption, drawn from a comprehensive literature review into improving how an organisation operates. The conceptual model seeks to assess safety culture in general, and on construction sites in particular.

Chapter 5

Research methods

The conceptual model described in Chapter 4 formed the framework through which the research questions about stakeholder influence could be asked and answered. This chapter details the methods, including fieldwork, that were used to collect the requisite data for analysis.

The object of the research was to investigate how stakeholder involvement influences organisational safety culture and safety performance in the construction industry, with special reference to Saudi Arabia. The data were used at a macro level to provide the big picture about stakeholders' attitudes to safety, safety culture, and safety performance in the construction industry. At the micro level, the data revealed the associations between stakeholder involvement, safety culture, and safety performance.

This chapter details the specific methods employed during the research – questionnaire, semi-structured interviews, sampling procedures, and data analysis techniques.

5.1 Methodology and research design

It is important to understand the philosophical issues involved in the current study that guided the research approach and the types of data collected to investigate the problems, and to ensure satisfactory outcomes (Easterby-Smith *et al.* 2002). The nature of the current research was considered to be relevant to social science research, and in particular, to management research within the field of safety culture diffusion in the context of project management.

In the area of social science research, there are two prevailing and contrasting philosophical traditions that over many years have tended to join and support one another: the *positivist* approach (quantitative), and the *interpretive* approach (qualitative) (Easterby-Smith *et al.* 2002). Positivism is a deductive approach, which assumes that the source of our knowledge is information discovered through experience. It emphasises combining deductive logic with specific empirical observations to discover and confirm hypotheses which might be used to predict general patterns of human activity (Neuman 2006).

An interpretive approach, on the other hand, is inductive. Rather than studying behaviour by observation alone, people's experiences, perceptions and ideas are sought as data (Easterby-

Smith *et al.* 2002). The interpretive approach also analyses social activity through direct, detailed observation of people in a natural setting in order to establish general principles relating to human behaviour (Neuman 2006). Unlike positivism, the qualitative approach is not predictive.

The research began by studying related theories and literatures in the field of safety culture in construction projects and the influence of stakeholders. This was followed by the conceptualising of the discovered ideas into a model that contained identified variables and a set of hypotheses. *Qualitative* research was then conducted using semi-structured interviews. Besides being informative in itself, the data from the interviews were then used to inform the development of a questionnaire (survey).

Interview data also added depth and richness to the deductive conclusions developed from the survey data. To control bias, reduce error, and remove unwanted influence from the interview results, therefore, statistical techniques and measurements were used to validate the outcomes of the interviews. Using the interview data and survey data from the study participants, a picture of the influence of stakeholders on safety culture in Saudi Arabian construction projects was developed.

Figure 5.1 illustrates the procedure and methods used in the current research. In sum, these were:

- A comprehensive and critical review of relevant literature was conducted in order to develop the necessary research instruments.
- Formal interviews with safety experts were conducted to verify extracted variables.
- A pilot test was conducted to modify the questionnaire.
- Data were collected.
- Descriptive statistics were undertaken in this research by SPSS program.
- Confirmatory factor analysis was also undertaken by using AMOS.
- Group analyses were conducted using AMOS.
- The final results and model were validated by experts in construction projects conducted with experts after the data were analysed.

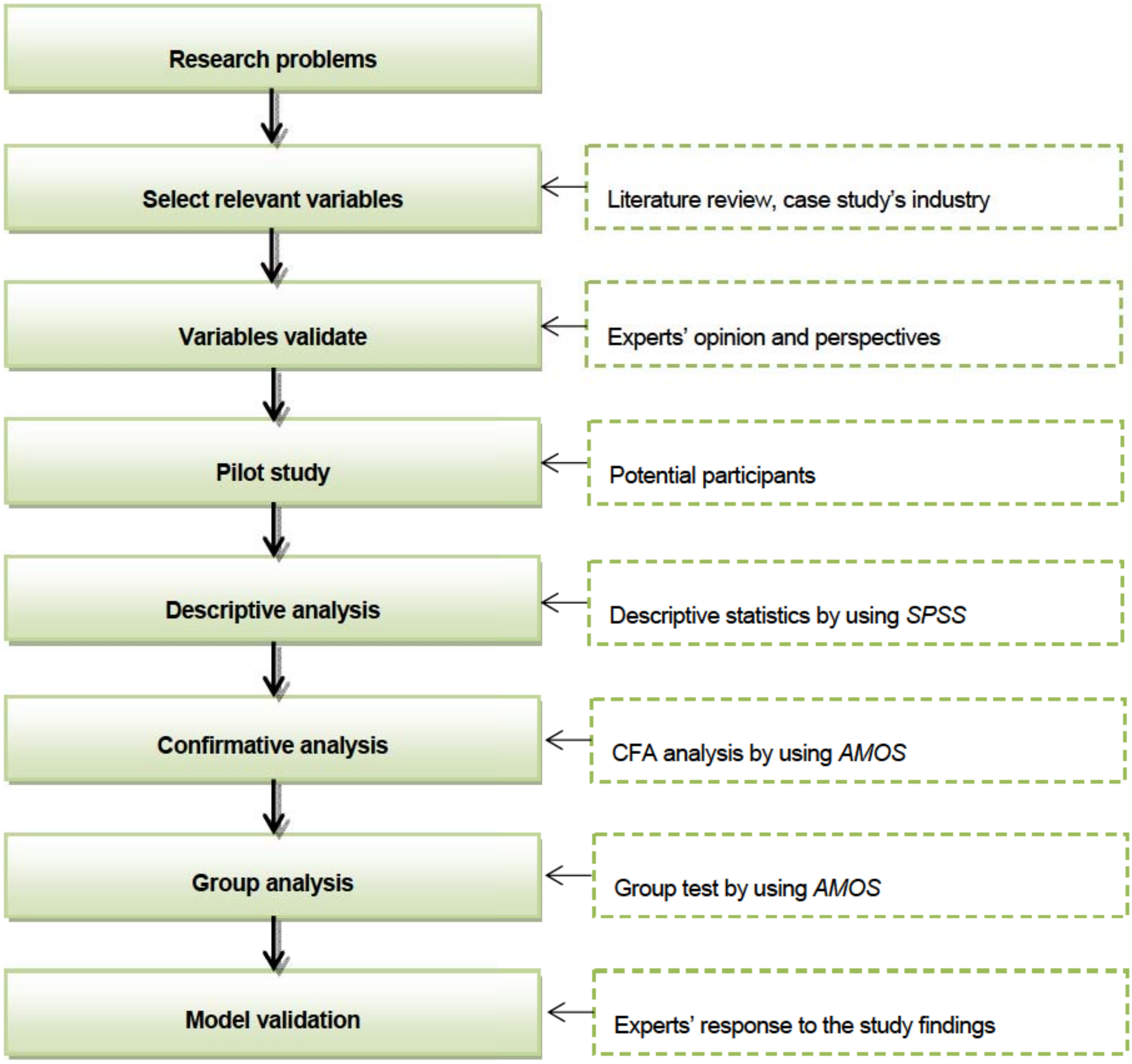


Figure 5.1 Research design for the current study

5.2 Research methods

5.2.1 Ethics

As part of the university research procedure, ethics requirements had to be completed in order to confirm that this research complied with the national guidelines. Project number H-2012-148 was approved on 12 November 2012 (Appendix A). Guarantees of privacy and confidentiality were presented in the covering letter to participants that explained the rules of the University of Adelaide, along with contact details for complaints if necessary. The letters were written in both English (Appendix B) and Arabic (Appendix D).

5.2.2 Literature review

The initial process of this research was to gather fundamental knowledge about safety culture and stakeholder involvement in construction projects. A comprehensive and critical review was conducted on international and Saudi Arabian literatures in order to develop a research rationale and survey instruments. Published literature on accident causation, safety culture, and stakeholder theory in the construction industry was thoroughly studied, with particular emphasis on current management safety practices, organisational safety attitudes, safety management systems, safety performance, and stakeholder involvement. Furthermore, a critical review of other developed countries was conducted to identify what has been done and achieved in terms of improving safety at workplaces in the construction industry in those countries.

This literature review provided comprehensive background knowledge on how safety culture is conceptualised and has been influenced by stakeholder participation. Safety culture's dimensions, particularly its safety attitude, safety practices, and safety management systems, are crucial to safety performance, and all are influenced and enforced by stakeholder involvement.

Findings from this critical review were proposed as a conceptual model of safety culture (see Chapter 4) and comprehensive constructs related to safety culture and stakeholder involvement. Theses outcomes helped fulfil some of the research objectives, which sought to understand safety culture in general (and more specifically, within the Saudi Arabian context) while emphasising the importance of stakeholder involvement in construction projects in order to improve safety performance.

5.2.3 Preparing for data collection

For a deductive approach, the research method of collecting data is an important stage. Research method is defined as 'a strategy of inquiry which moves from the underlying philosophical assumptions to research design and data collection' (Myers & Avison, 2002, p. 7).

With regard to this research, the type of sample and data collection methods used, and how the variables were measured have been discussed. Quantitative analyses – known as positivism (Gay *et al.* 2011) – has been employed to show how the context can be seen, measured, and understood. The deductive approach can be used to establish facts, make predictions, and test hypotheses; therefore, survey research method was considered appropriate for this research.

Survey research method enables generalisation from a large enough representative sample of the population. It refers to a set of questions that are carefully designed in a predefined order to be completed by participants (Payne & Payne 2004). The survey method was selected from two main reasons. First, there have been very few studies that have investigated the stakeholders' factors influencing and enforcing organisations to improve safety culture in Saudi Arabia. The second reason was that a major part of the study is concerned with the respondents' perceptions of stakeholder involvement and how these perceptions affect and improve safety culture in construction projects.

Research sampling: The participants. Research sampling is a very important aspect of the research process in order to ensure effective data collection before administering a questionnaire (Trochim & Donnelly 2008). Sampling is about choosing a number of people – the *sample frame* – representative of a larger group of people – the *population* – to survey (Patton 1990). The labour force of the construction companies in Saudi Arabia was selected in this research as the population.

According to the Ministry of Municipalities and Rural Affairs of Saudi Arabia (MOMRA) (www.momra.gov.sa), there are 3,650 construction companies licensed to carry out different types of projects in the kingdom. The Ministry provided a set of data on their website of 1,800 companies' contact details (email, fax, or phone number), which is around 47% of the total number of companies listed on the site. The small percentage is possibly because many of the organisations did not want to declare to the public their contact details or because the database had not been updated.

In order to select the sample from the population, probability and simple random sampling techniques were used. Probability sampling is a technique that ensures that every member of the population has an equal probability of being chosen (Patton 1990). Simple random sampling is a method that eliminates bias by giving all members of the study population an equal chance to be selected (Moore *et al.* 2010).

The sample frame selected in this research presented some constraints. Because the survey was conducted online, only organisations that had registered an email address in their database were used. This issue could introduce some bias into the study, and to eliminate this bias, the researcher sent invitations to other organisations by way of their mail addresses or to their fax numbers. The questionnaire was sent eventually to 1,711 participants asking them to participate, along with an invitation letter which included a brief about the study, contact details, ethics committee approval and their contact details for any matters which might arise from the survey.

Generating data: The survey. Survey questions, such as those in the questionnaire, usually search for the beliefs, attitudes, attributes, and behaviour of people. These categories consequently impact on the structure of the questions, which can be: open-ended; close-ended with ordered choice; close-ended with unordered choice; or partially close-ended (Dillman 1978).

According to Jonker and Pennink (2010), a closed question gives a clear picture of which aspects are taken into account and which are not, and indicates the relationships between the elements of the model and the phenomenon being studied. These researchers suggest a process to translate a theoretical concept into measurable questions in three steps: 1) a definition of the concept, 2) a translation into indicators, and 3) a translation of each indicator into questions. Therefore, this research used these steps and roles to define and translate the conceptual model into a measurable questionnaire, while taking into consideration the level of concepts and the level of variables (see Chapter 4).

One of the most common close-ended survey methods is the *Likert scale response* in which an opinion question is asked and the response is measured on a scale with one of several traditional interval levels. One of the most common Likert scale intervals ranges from 1 to 5. This research obtained a set of data by distributing quantitative questionnaires using a 1 to 5 Likert scale to generate data.

The aim of this data was to measure the impact of stakeholder involvement on safety culture and safety performance in Saudi Arabian construction projects. As a result of the literature review described earlier and the conceptual model selected, safety culture indices were measured with special attention to the Saudi Arabian context by using different constructs. Some of the items in the questionnaire were already adopted from previous studies, where they have been tested and verified (Chunlin *et al.* 1999; Ferraro 2002; Gordon, R *et al.* 2007; Mearns, K *et al.* 2003; Ostrom *et al.* 1993). These items needed to be examined in a broader population to confirm the research's conceptual model of safety culture. The quantitative method of a close-ended questionnaire was selected to identify the critical culture that impacts on safety performance in Saudi Arabian construction projects, and to permit generalisation of the outcome.

The original constructs

It was in order to use this method effectively that the research conceptual model was proposed (Chapter 4). The aims of the model were to identify the roles of stakeholders and types of safety culture that impact on safety performance in Saudi Arabia by using seven constructs. The first four of these constructs were:

- management safety practices
- organisational safety behaviour
- safety management system
- safety performance.

Figure 5.2 Elements of the conceptual model (see also Chapter 4, Figure 4.1) These four dimensions are those highlighted in Edwards et al.'s study (2013), which augmented the model for this study.

Additional survey constructs

Since the questionnaire was conducted in Saudi Arabia using existing stakeholder and safety culture indices, some of those indices were therefore measured with special attention to the Saudi Arabian context by creating new constructs. These constructs were obtained after conducting formal interviews with safety experts. The new constructs generally fall into three categories: the first category is stakeholders' participation, the second concerns things which could influence stakeholders, and the third investigates matters which could compel stakeholders to improve safety at the workplace. The section below describes these constructs and their definitions.

Participation. according to the *Cambridge Online Dictionary* (www.dictionary.cambridge.org), participation is defined as 'the fact that [someone] take[s] part or become(s) involved in something'. Also, by the *Oxford Dictionaries* (www.oxforddictionaries.com) it is defined as 'the action of taking part in something'. In the context of Saudi Arabia, most of the stakeholders in a project are taking part in safety at the workplace for legal reasons. Therefore, participation has been created as an indicator derived from the country's legal requirements.

Influence. according to *Oxford Dictionaries*, influence is defined as 'the capacity to have an effect on the character, development, or behaviour of someone or something'. In Saudi Arabia, there are some conditions, such as the rates for workers' compensation insurance, and the safety practices of competitors, which could influence the primary stakeholders of a project to approach and improve safety. Therefore, this construct was created for the purposes of this research as an indicator to facilitate the measuring of these types of conditions.

Enforcement. according to Cambridge online dictionary, enforcement is defined as 'to make a particular situation happen or be accepted'. In the context of Saudi Arabia, there are laws, rules, and obligations toward the safety of secondary stakeholders which may be enforced against the primary stakeholders of a project, in order to compel compliance. Therefore, this construct has been created as an indicator, in order to determine which stakeholders are complying with these regulations. Table 5.1 details the three additional constructs and their indicators.

Table 5.1 **Stakeholder constructs and their indicators**

Construct	Indicators	Positive perceptions
Participation	clients / owners	*To what extent are these stakeholders involved in safety?*
	project managers	
	main contractor	
Influence	the rates for workers' compensation insurance	*To what extent do these items influence the organisation's approach to improve safety?*
	safety practices of competitors	
	media attacks	
Enforcement	safety regulations in workplaces	*To what extent the following items enforce the organisation's approach to improve safety?*
	government inspectors	
	safety requirements from ministry of labour	
	safety requirements from the general organization for social insurance	
	safety requirements from the general presidency of meteorology and environment protection	
	safety requirements from civil defence	

Combining the four initial constructs with the three new ones resulted in the study's conceptual model.

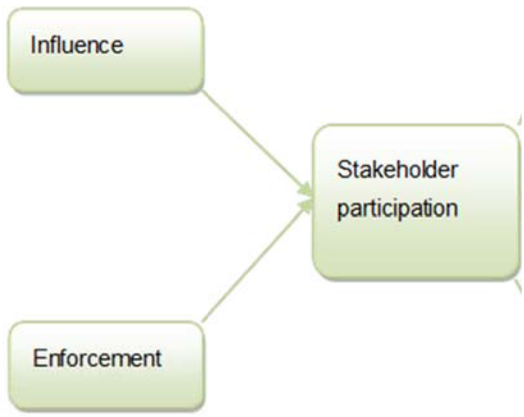


Figure 5.3 Elements of the conceptual model (see also Chapter 4, Figure 4.1)
These three dimensions were added for the current study.

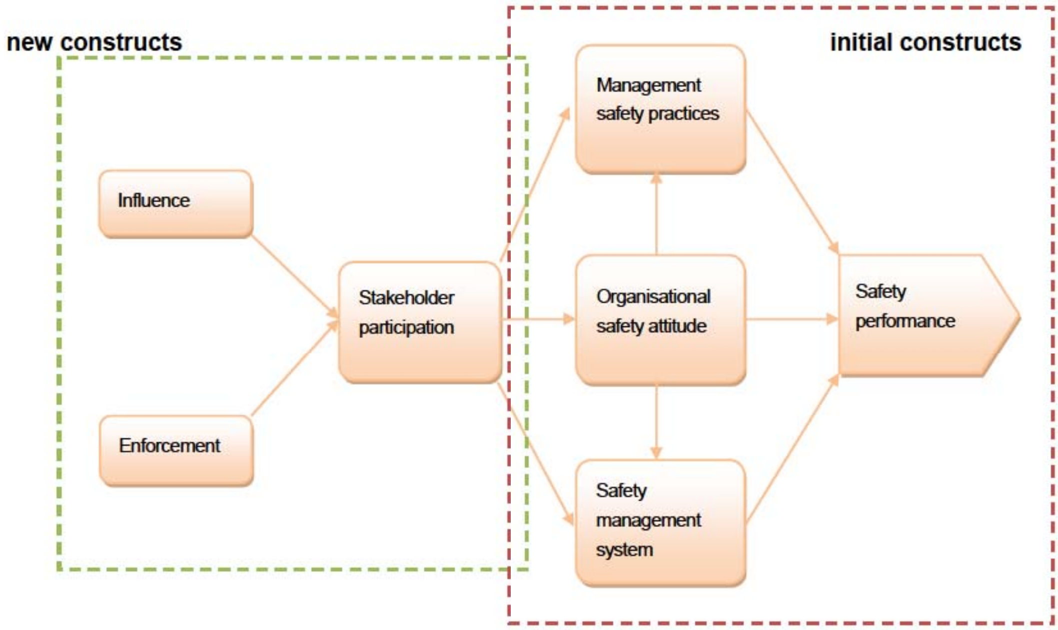


Figure 5.4 The conceptual model that emerged (see also Chapter 4, Figure 4.1)

All the latent constructs used in the instrument of this research with their indicators are listed in Table 5.2, along with the coding system used in the analysis for each indicator.

Table 5.2 All latent constructs and their indicators and codes

Latent Construct	Code	Indicators	Code
Stakeholder involvement	St	Participation	St_Part
		Influence	St_Influen
		Enforcement	St_Enforc
Management safety practices	MSP	Commitment	MSP1
		Involvement	MSP2
		Communication	MSP3
		Resources	MSP4
		Meeting	MSP5
		Contractor Management	MSP6
		Caring (Leadership)	MSPL1
		Coaching (Leadership)	MSPL2
		Controlling (Leadership)	MSPL3
Organisation safety attitudes	OSA	Effectiveness	OSA1
		Trust	OSA2
		Attitudes	OSA3
		Productivity vs. Safety	OSA4
		Rules and Regulations	OSA5
		Work Pressure	OSA6
		Reporting	OSA7
		Competence	OSA8
		Awareness	OSA9
Safety management system	SMS	Safety policy	SMS1

Latent Construct	Code	Indicators	Code
		Goals	SMS2
		Safety Planning	SMS3
		Safety Program	SMS4
		Hazard	SMS5
		Safety rules and Procedures	SMS6
		Review & Evaluate	SMS7
		Auditing	SMS8
Safety performance	SP	Inspection	SP1
		Investigation	SP2
		Training	SP3
		Motivation	SP4

Model measurement. To measure a model, it is essential to consider the model as reflective or formative in order to measure the relationship between constructs. Therefore, according to Coltman *et al.* (2008), three features should be considered when deciding whether the measurement of the model is reflective or formative:

- In a reflective model, the latent constructs exist independently, such as *attitudes*, which is measured by different indicators. In contrast, in the formative model, the latent constructs exist dependently, relying upon interpretation by researchers, such as the human development index, which it is a composite measure by health, income, and education (Coltman *et al.* 2008).
- The causal direction between latent constructs and indicators needs to be considered. Figure 5.6 illustrates that in the reflective model the direction flows start from the constructs to the indicators; whereas in the formative model, the flow is in the opposite direction, starting from the indicators and moving to the constructs (Baxter 2009; Coltman *et al.* 2008).

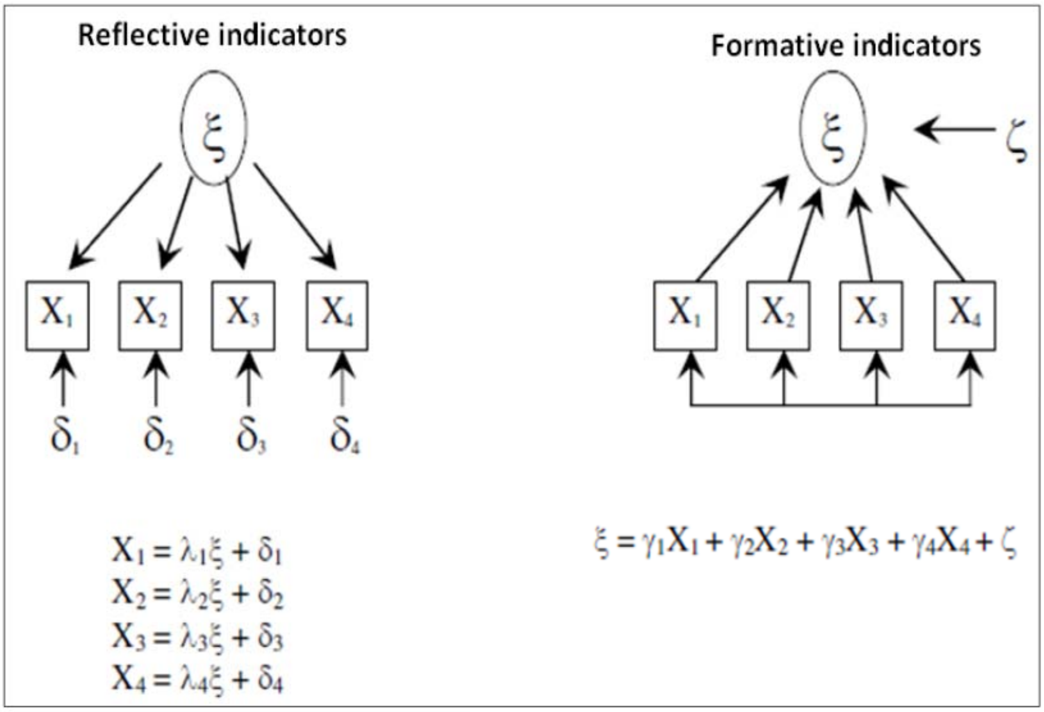


Figure 5.6 Reflective and formative measures (Coltman et al. 2008, p. 1253)

- In a reflective model, the indicators are interchangeable and share a common theme, and changes in latent constructs lead to variations in the indicators. This enables the measurement of constructs by sampling a few relevant indicators essential for the constructs; adding or removing more indicators does not change the content validity of the constructs. In a formative model, the types and numbers of indicators represent the latent constructs and adding or removing an indicator can change the validity of the latent constructs (Baxter 2009; Coltman *et al.* 2008).

The current research used a reflective model, because it measures and investigates latent constructs, such as attitudes and practices, and the inclusion or exclusion of one or more of its indicators does not change the validity of the latent constructs.

Constructing the questionnaire. This section explains the type of information needed from participants and the construction of the research questionnaire.

According to Taylor-Powell (1996) there are four different types of information that can be obtained from participants – knowledge, attitudes and opinion, behaviour, and attributes. One or any combination can be used in the questionnaire.

- *Knowledge* is about what participants know and how they understand something. This type of question asks what participants believe is factual or true.

- Questions about *attitudes*, opinions, or beliefs refers to psychological states, such as the participants' feelings, ideas, thoughts, ways of thinking, judgements, or their perceptions.
- Questions about *behaviour* are about what people have done in the past, do now, or will do in the future.
- Questions about *attributes* relates to what people are and what people have, such as age, education, or income (Taylor-Powell 1996).

According to Cooper, MD (2000) in terms of the psychological aspects, the most familiar tool to measure safety culture is the questionnaire, which comprise of a series of questions that measure people's beliefs, values, attitudes and perceptions in relation to various dimensions of safety thought.

Moreover, in constructing the questionnaire, this research considered the five major processes for questionnaire design before beginning the design process. According to Fraser and Lawley (2000) these processes are:

Step 1 Determine the information and data which is required to fulfil the research objectives.

Step 2 Administer the process of the questionnaire.

Step 3 Prepare a first draft of the questionnaire.

Step 4 Pre-test the questionnaire and revise it on order to avoid mistakes, inappropriate wording, or unclear questions.

Step 5 Assess the reliability and validity of the research's questionnaire.

The types of questions, and the administration processes were considered during the designing of the questionnaire, and the questions were carefully designed to fulfil the research objectives. The final version of the questionnaire consisted of seven major sections of grouped questions. The questionnaire was prepared in both English (Appendix C) and Arabic (Appendix E).

- *Section 1: Demographic questions,* which it is an attribute question type. This section includes the participant's position, organisation and project types, number of people employed in the organisation, and number of incidents. Also, participants were asked to state how long their organisation has been operating.

- *Section 2: The leadership style of top management,* a behavioural question type. Participants were required to state the current actions and practices of their senior management in regard to safety leadership, and their responses were measured using a 5-point Likert scale, anchored at one end with 1 never and at the other by 5 always.
- *Section 3: The organisational safety practices,* also a behavioural question type. It measures the safety practices of the participants' organisation by asking them what people had done in the past and what they were currently doing in regard to the safety actions of their management. Their responses were measured using a 5-point Likert scale, anchored at one end with 1 never and at the other by 5 always.
- *Section 4: Organisational safety attitude,* which it is an attitude and belief question type. Participants were required to state their current thoughts and judgements about the attitude of the organisation they work for in regard to safety. Their responses were measured using a 5-point Likert scale, anchored at one end by 1 strongly disagree and at the other by 5 strongly agree.
- *Section 5: Safety management system,* a belief and opinion question type. This section required participants to state their judgements and opinions on the effectiveness of the safety management system. Their responses were measured using a 5-point Likert scale, anchored at one end by 1 strongly disagree and at the other by 5 strongly agree.
- *Section 6: Safety performance,* a belief and opinion question type. The participants were required to state their perceptions and thoughts on the safety performance in their organisation. Their responses were measured using a 5-point Likert scale, anchored at one end by 1 strongly disagree and at the other by 5 strongly agree.
- *Section 7: Stakeholder involvement,* an attitude and opinion question type. As explained early, this section included stakeholder participation, and matters or events that influence and enforce stakeholder approach to safety. Participants were required to state their perceptions and judgements on the involvement of the project stakeholders. Their responses were measured in three different ways. Stakeholder participation was measured using a 5-point Likert scale, anchored at one end by 1 no involvement and at the other by 5 full involvement. The influence of stakeholders on improving safety in the workplace was measured using a 5-point Likert scale, anchored at one end by 1 no influence and at the other by 5 very influential. The enforcement of stakeholders to improve safety was measured using a 5-point Likert scale, anchored at one end by 1 no enforcement and at the other by 5 extensive enforcement.

Content validity. In order to verify the empirical indicators identified from the literature review, formal interviews with safety experts in the construction industry were conducted. According to Nunnally (1970) proactive stages may be taken to reduce bias and increase the validity of the research constructs by employing experts' opinions and perspectives. García-Valderrama and Mulero-Mendigorri (2005) suggest that an adequate result could be obtained with expert opinions, which will demonstrate that the empirical indicators are related and logical as shown in Figure 5.7.

The importance of the empirical indicators, the conceptual model, and the questionnaire used in this research have been validated by 10 safety experts. They have more than five years of experience in the construction industry, and they have adequate background knowledge of safety culture and safety management systems. Therefore, they were able to verify those items and provide some modification.

Contingent upon this process, some modification was achieved by grouping several indicators into one indicator, and deleting from the questionnaire items identified as unimportant by the experts. Also, additional indicators were added to the conceptual model, and to the questionnaire. However, expert opinions on the research items could not be accepted as the result, which still needed to be validated through a pilot study.

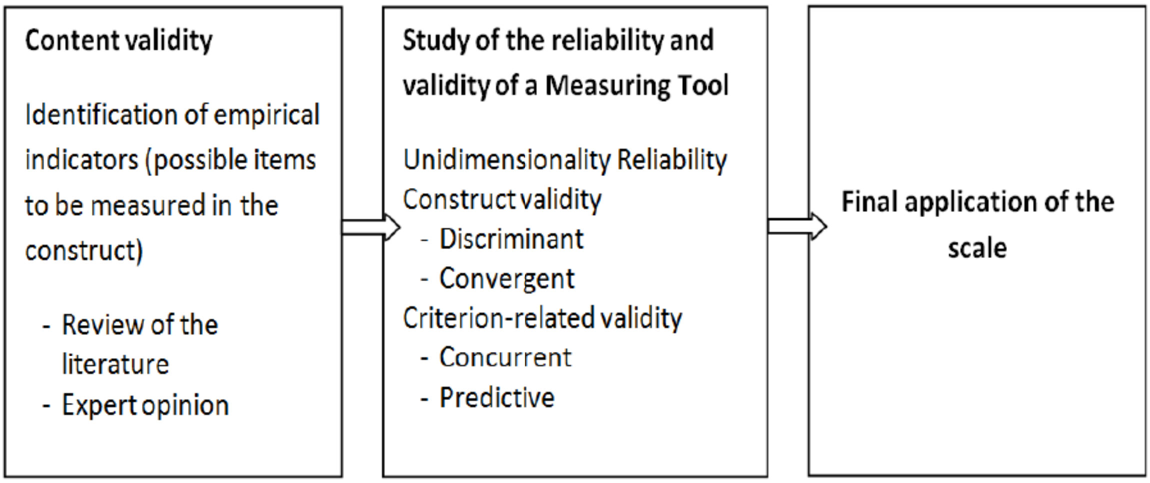


Figure 5.7 **Stages in the methodology for scale validation (García-Valderrama & Mulero-Mendigorri 2005, p. 315)**

The pilot study. Pilot studies differ from one study to another. Moore *et al.* (2010) suggest that in order to remove mistakes and problems, the final stage of questionnaire development is to test the questionnaire before inviting participants to start the survey. In this study a pilot test was applied.

Language differences were considered in this research. Firstly, the questionnaire was created in English, and then translated into Arabic by a certified translator in order to confirm its accuracy in terms of background context. Two versions of the questionnaire were created with minor differences to confirm its useability. To ensure clarity, and avoid ambiguities and misunderstandings, this research was administered in Arabic.

The pilot study in this research was conducted in two phases. Phase 1 had 12 participants, and Phase 2 had 20. The participants were drawn from the targeted population sample. The aims of this pilot study were to modify the questionnaire by rewording, re-categorising, and deleting some ambiguous questions. Some changes were undertaken in the main questionnaire and some suggestions were made to improve the survey. Finally, the last version of the questionnaire was modified to best capture the information specific to the research objectives.

5.2.4 Data collection

The aims of this research were to test the hypothetical relationship of the conceptual model's constructs. The study considered a cross-sectional design the most appropriate method by which to collect the data. The cross-sectional research was used to collect data on relevant variables at one and the same time, which provides a snapshot of the variables (Busk 2005). According to Busk (2005), the advantages of this method are that it fulfils multiple research requirements, such as collecting data on many variables, collecting data on behaviours and attitudes, and generating hypotheses for future study.

After conducting the pilot study, the final questionnaire was developed and refined into a hard copy and an online questionnaire. Of a total of 1711 invitations, 1253 invitations were sent to managers working in construction projects in Saudi Arabia by email and 458 were sent by mail fax managers working in construction projects in Saudi Arabia. Follow-up emails and a fax letter were sent two weeks after the questionnaire was sent in order to increase the response rate. One week before closing responses to the questionnaire, a letter was sent to thank those who had completed the questionnaire and remind those who had not.

Of the 413 responses received, 353 were by online survey, and 60 by mail. The response rates in this study were 28% for the email survey (353 responses received out of 1253 invitations sent by email) and 13% for the mail and fax survey (60 responses received out of 458 invitations sent by mail). Out of the 413 responses, 381 were complete and valid for analysis.

5.2.5 Data analysis

Multivariate statistics were used to analyse the data, because it deals with observations of many variables and how these variables are related (Tabachnick *et al.* 2001). Thus, it was considered an adequate technique to use, because the data had many dependent and independent variables. At the very first phase dealing with the collected data, the sample characteristics were studied. The statistical analysis began with some preliminary analyses, such as data screening, missing data handling, and assumption checking.

A variety of statistical analysis techniques were applied to examine the research hypotheses using the collected data, such as descriptive and inferential statistics. The first stage of data analysis was descriptive and involved recording and analysing the demographic data and finding the values of the research variables, such as, means and standard deviations. For this purpose, *SPSS* version 20.0 was used due to its powerful analytical capacity.

The second stage of data analysis requires analysis of the inferential data used to test the proposed conceptual model and its hypothesis. To do so, for the first and second stages, the following steps were followed in the preparation and analysis of the data:

- **Data entry** (data coding and entry by using *Excel* and *SPSS*)
- **Data preparation** (dealing with missing data *SPSS*)
- Data analysis

  Descriptive statistics (*SPSS*)

  Calculation of reliabilities (*SPSS*)

  Checking for outliers and non-normality (*AMOS*)

  Confirmatory Factor Analysis (*AMOS*)

  Convergent and construct validity (*AMOS*)

Discriminant validity (*AMOS*)

Developing composite scores (*AMOS*, *Excel*, and *SPSS*)

Analysis of the full structural model (*AMOS*)

Testing of group (*AMOS*)

Reliability. Reliability analysis was performed to test for internal consistencies within the main latent constructs. According to Zmud and Boynton (1991), the internal consistencies refer to the ability to test the interrelationship between items, these items being intended to measure the same construct, and expected to be positively correlated with each other. A reliability analysis using Cronbach's alpha (α) approved such computations.

Cronbach's alpha is a common measurement of internal consistencies, and provides many advantages over other reliability tools, including easy computations and no restriction on the types of indicators used (Zikmund *et al.* 2012). In a good solution, Cronbach's alpha ranges between 0 and 1 – the larger the value, the more stable the factors. A high value implies that the observed variables account for substantial variance in the factor scores, while a low value indicates that the factors are poorly defined by the observed variables.

Generally, the value of 0.70 is accepted as the minimum desired value of reliability (Pallant 2010). However, if the value of Cronbach's alpha was estimated to be between 0.60 and 0.70, it could be acceptable if other construct validity indicators are considered as having a good reliability (Hair & Anderson 2010). In this study, the estimated values for all corresponding constructs under each of the seven dimensions (stakeholder participation, stakeholder enforcement, stakeholder influence, management safety practices, organisational safety attitudes, safety management system, and safety performance) had values ranging from 0.71 to 0.95 for the seven latent constructs, all of which were considered acceptable.

Test of normality. The screening of continuous variables for normality is an important early step in almost every multivariate analysis (Tabachnick & Fidell 2012). Although the normality of the variables is not always required for an analysis in the strictest sense, the solution is usually more appropriate if the variables are all at least approximately normally distributed.

Furthermore, severe deviation from normality may severely harm the validity of interpretations from statistical analyses. In this research, the normality of the variables was assessed carefully, and necessary remedial steps were taken where necessary.

Two important components of normality are *skewness* and *kurtosis* (Tabachnick & Fidell 2012). Skewness relates to the symmetry of the distribution; a skewed variable is a variable whose mean is not in the centre of the distribution. Kurtosis, on the other hand, relates to the peak properties of a distribution; a distribution is either too peaked (with short, thick tails), or too flat (with long, thin tails). When a distribution is normal, the values of skewness and kurtosis are zero (Pallant 2010). If there is a positive skewness, there is a pileup of cases to the left, and the right tail is too long; with negative skewness, the result is reversed. Kurtosis values above zero indicate a distribution that is too peaked, while kurtosis values below zero are reversed. Non-normal kurtosis produces an underestimate of the variance of a variable.

There are several suggestions regarding the assessment of the normality of the variables in the literature. According to Morgan and Griego (1998), if the division of values of skewness (or kurtosis) and its standard error (named as *critical ratio*) are not above 5.5, then that skewness (or kurtosis) is not significantly different from normal. Curran *et al.* (1996a), however, recommend that the values of skewness < 2.0 and kurtosis < 7.0 are acceptable. Furthermore, Schumacker and Lomax (2012) suggest as a rule of thumb that data may be assumed to be normal if skewness and kurtosis are within the range of +/- 1.0. In this study, a number of attributes fail to meet the normality conditions suggested in the literature.

To deal with non-normal data, the Satorra-Bentler Chi-square was developed by Satorra and Bentler (1988) in order to correct the normal Chi-square when maximum likelihood is used. The Satorra-Bentler Chi-square is considered to be one of the best alternative test statistics when there a problem with non-normality (Chou *et al.* 1991; Curran *et al.* 1996b; Hu, L-t *et al.* 1992).

AMOS produces the Bollen-Stine bootstrap *P* to account for non-normality and to provide appropriate standard errors by generating multiple subsamples from an original database (Bollen & Stine 1992; Tomarken & Waller 2005; Yung & Bentler 1996) to calculate and adjusted Chi-square goodness-of-fit statistic (Byrne 2010). A model is typically accepted if the Bollen-Stine *P* is greater than 0.05.

Structural equation modelling (SEM). *Structural equation modelling* (SEM) is described as a useful technique when dependent variables convert into independent variables in the analysis, and explain the relationships among these multiple variables (Hair & Anderson 2010), which is the case of the model proposed in this study. According to the above authors, the SEM technique has three important characteristics:

- SEM is able to estimate multiple and interrelated dependence relationships.
- SEM is able to represent unobserved concepts in these relationships and account for measurement errors in the estimation process.
- SEM can define a model in order to explain the entire set of relationships (Hair & Anderson 2010).

For examining the research hypotheses, SEM technique was therefore used. Before proceeding to the estimation of a structural model, there are a number of steps to perform, as explained below.

Stages in the structural equation modelling process

As an example from Kline (2011) and Diamantopoulos and Siguaw (2000), there are a number of steps in the structural equation modelling process: model conceptualisation, path diagram construction and model specification, model identification, parameter estimation, assessment of model fit, and model re-specification.

- *Model conceptualisation:* Development of a set of latent variables and their observed indicators from a theory, including the inter-relationships between the latent variables. (Explained in Chapter 4.)
- *Path diagram construction and model specification:* Identifying the inter-relationships amongst the latent variables and their measurement, based on the theory, and on researcher opinion. (Explained in Chapter 4.)
- *Model identification:* Assessing the measurement of the parameters, which means that in order to be able to estimate all of the parameters that are specified by the hypotheses in the conceptual model, there must be enough information in the sample data. (See next Chapter 6.)

- *Parameter estimation:* This involves estimating the approximate value of each parameter which needs to converge on a set of parameter estimates. To do so, there needs to be enough information in the sample data. (See next Chapter 6.)
- *Assessment of model fit:* Examining the difference between the sample variances and covariances and the implied variances and covariances, which resulted from the parameter estimates. The model fit is accepted if the difference is small. (See next Chapter 7.)
- *Model re-specification:* Model mis-specification can occur, excluding and/or including parameters and variables that should/should not have been included. A model can be re-specified in order to improve model fit (Schumacker & Lomax 2012). *AMOS* provides a set of model fit indices that suggest how the model can be improved; however, any changes should only be done within a theoretical context. (See next Chapters 6 and 7.)

Confirmatory factor analysis of the measurement model

According to Anderson and Gerbing (1982) developing a full structural model needs to address the issues associated with the model's measurement based on its latent variables. To do so, this research used confirmatory factor analysis (CFA) in order to measure each construct of the model. CFA is performed when there is a strong theoretical expectation about the conceptual model and its variables' relationships before performing the analysis (Hair & Anderson 2010). In addition, CFA is a tool by which to assess whether the validity and acceptability of the construct fit the actual observation (Anderson & Gerbing 1982; Hair & Anderson 2010).

In a model consisting of multiple latent variables, it is important that the latent variables differ sufficiently from each other, and the observed variables are also reflective of the constructs. To address these matters, CFA is undertaken of the measurement models (Jöreskog 1993). Jöreskog (1993) suggests one of two approaches in the analysis of data – either a strictly confirmatory approach or a model-generating model approach. In the strictly confirmatory approach, a model needs to be formulated by the researcher, and it is either accepted or rejected.

In practice, such a test may not be practical, although it provides the strongest test of a measurement model. The model-generating model approach allows a tentative full model to be specified and developed around theory. However, a series of one-factor congeneric model tests should be undertaken for each construct that has at least four indicators, before the full model is tested. The constructs consisted of less than four indicator items. The variance of two residuals was set to equal in order to estimate the congeneric measurement models with three variables, based on pair-wise parameter comparisons provided by *AMOS* software (Plewa 2005), because there is an insufficient degree of freedom to perform the analysis on an individual construct that has less than four indicator items.

Once the measurement models have been satisfactorily tested for individual constructs, they are combined into a full measurement model and tested as a whole. This was the approach adopted in this research. The next section explains the congeneric models and the one factor congeneric model analysis.

One-factor congeneric measurement models

Parallel models assume that the measurement of each observed item is treated as an equally accurate indicator of the true latent variable, and the errors of measurement are assumed to have the same variance (Lord & Novick 1968). Whereas *congeneric models* assume that the measurement of indicator variables associated with any one factor reflect the same generic true score, it is assumed that the indicator variables may each contribute to the factor to varying degrees, and both the error variances differ, and factor loading differs. Congeneric measurement models have been applied in this research, because it is a common tool used to measure one factor and represent regression of a set of observed indicator variables on a single latent variable (Rowe 2002).

One-factor congeneric measurement is the simplest type of measurement model. It describes the regression of a set of observed indicator variables on a single latent variable. Using a SEM program, such as *AMOS*, factor variance, regression coefficients, and error variances of the measurement items can be estimated. For good fitting one-factor congeneric models, the indicator variables must represent the same generic true score.

In order to demonstrate one factor congeneric measurement modelling using structural equation modelling (SEM), a variety of goodness-of-fit indices must be utilised, which can confirm construct validity, i.e., that the hypothesised indicators measure the latent variable construct (Kline 2011). Convergent validity measures the direct relationship between observed variables and a latent variable (Holmes-Smith 2013). The next section explains those goodness-of-fit indices which are used to assess the model fit.

Assessment of model fit

The models used in this research required assessments of model fit. The program package *AMOS* has 25 indices of fit to assess a model. Only five indices were used and the rationale for these choices is explained below. These indices simply indicate whether the tested model should be accepted or rejected. They provide no indication of whether the paths within the model are significant or not. When the model is accepted, then it can be interpreted. The section below explains these indices in more detail:

The Chi-square. The Chi-square (χ_2) value is considered the most common absolute fit index, and the acceptable value for this index is $p > 0.05$ (Hair & Anderson 2010).

Bollen-Stine bootstrap P. The p value of the Bollen-Stine is a bootstrapped modification of the model made after adjusting the distributional misspecification of the model in order to test the model fit (Bollen & Stine 1992). In this research, the bootstrap was used with 2000 bootstrap samples in all CFA.

Absolute fit indices

The goodness-of-fit-index and adjusted goodness-of-fit index (GFI and AGFI). GFI measures the relative amount of variance and covariance in the sample size (Byrne 2010). The GFI value ranges from 0 to 1.00 (Hair & Anderson 2010), and when the value is greater than 0.90 a good fit is achieved (Kline 2011). AGFI takes into account the degrees of freedom available for testing the model, and addresses the issue of parsimony (Byrne 2010); when the value of the AGFI is greater than 0.90 it indicates a good fit (Kline 2011).

Goodness of fit indices. Comparative fit index (CFI) compares the predicted covariance matrix to the observed covariance matrix (Byrne 2010; Kline 2011). The value of the CFI ranges from 0 to 1.00 (Hair & Anderson 2010); a value between 0.90 and 1.00 indicates a good fit (Kline 2011).

Normal fit index (NFI). Normal fit index (NFI) compares the discrepancy covariance matrix to the observed covariance matrix (Byrne 2010; Kline 2011). The value of the NFI ranges from 0.00 to 1.00 (Hair & Anderson 2010); a value between 0.90 to 1.00 indicates a good fit (Kline 2011).

Incremental of fit index. The Tucker Lewis Index (TLI) is known as non normed fit index and indicates the relative improvement of the model's hypotheses over the independence model (Hu, Lt & Bentler 1999). The value of the TLI can fall below 0 or above 1 (Hair & Anderson 2010). Typically, a model with a good fit has a TLI value more than 0.95 (Hu, Lt & Bentler 1999).

Badness of fit indices. The root mean square of approximation (RMSEA) is less affected by sample size than other fit indices. According to Kline (2011), RMSEA is a 'badness-of-fit' index and considers the difference between the model hypothesis and the sample and population covariance matrixes. Conventionally, if the RMSEA is less than 0.05 there is a good fit; values between 0.05 and 0.08 suggest a reasonable fit; and the values around 0.06 represent an adequate fit (Byrne 2010; Hu, Lt & Bentler 1999; Kline 2011). Browne and Cudeck (1993) recommend a test of the hypothesis that RMSEA $\leq$ 0.05 (called PCLOSE). The PCLOSE statistic (p-value for a close fit) gives the probability that the RMSEA is not larger than 0.05. If this probability is less than 0.05 then the hypothesis that the RMSEA is larger than 0.06 is rejected.

Hair and Anderson (2010) suggest that multiple fit indices should be used to assess a model's goodness-of-fit, including the following:

- The value of the Chi-square fit index (X_2) should not be significant.
- One absolute fit index, such as GFI, should have a value greater than 0.9.
- One incremental fit index, such as TLI, should have a value greater than 0.95.
- One goodness-of-fit index, such as CFI, should have a value greater than 0.9.
- One badness-of-fit index, such as RMSEA, should have a value less than 0.06.

Validity types. Validity measures the internal consistency of the indicators. More reliable measurements provide more confidence that the indicators are consistent all together; it deals with measurement accuracy and concerns the extent to which the measured items reflect the hypothesised latent variable (Hair & Anderson 2010; Kline 2011). Structural equation modelling techniques were used to examine three types of validity – convergent, construct and discriminant validity as discussed below.

Convergent validity

Convergent validity measures the direct structural relationship between an observed variable and latent construct. In this study, the convergent validity was considered via factor loading, critical ratios, and construct reliability. Convergent validity is achieved when the *factor loading* is significantly different from zero and the estimated coefficient does not need to be greater than 0.70 to achieve convergent validity (Holmes-Smith 2013).

Convergent validity is assessed based on the factor loadings where high loadings on a factor would indicate that the observed variables converge on the latent construct (Hair & Anderson 2010). In this study, each observed variable to the construct is significant and substantial (standardised loading estimate > 0.7); therefore the convergent validity is achieved.

Furthermore, in order to achieve convergent validity, Schumacker and Lomax (2012) suggest that the *critical ratios* exceed +1.96. All the critical ratio values achieved the required +1.96, therefore convergent validity was achieved. In addition, *construct reliability* is a measure that reflects the internal consistency of the items of the latent variables. Construct reliability is calculated from the squared sum of factor loading for each construct and the sum of error variance terms for a construct (Hair & Anderson 2010). Therefore, the constructs should be highly correlated to show that they consistently represent the same latent construct.

According to Hair and Anderson (2010), a construct reliability estimate of 0.7 or higher suggests good reliability; and reliability between 0.6 and 0.7 may be acceptable, provided that other indicators of the model's construct validity are good. In this research, all constructs achieved the prescribed minimum required values, ranging from 0.745 to 0.889. Therefore, the constructs achieved a good level of convergent validity.

Construct validity

Construct validity measures whether there is a good representation of the variables being measured. For a one-factor congeneric measurement model to be acceptable, the indicator variables must all demonstrate valid measurements of the one latent construct. In this regard, the SEM 'goodness-of-fit' measures provide insight into construct validity and can be viewed as confirming construct validity. When they are within the relevant range, the construct validity can be confirmed (Holmes-Smith 2013). In this research, all one-factor congeneric measurement models have been accepted according to their 'goodness-of-fit' measures. Therefore, construct validity was achieved.

Discriminant validity

In order to assess the validity of the latent variables in this research, as suggested by Churchill (1979), the constructs were examined by not only convergent validity, but also discriminant validity parameters, which considers subtypes of construct validation. Discriminant validity is the extent to which constructs are actually distinct from one another (Hair & Anderson 2010). According to Holmes-Smith (2013) finding discriminant validity tests whether two constructs of interest are statistically different from each other; assessing discriminant validity is especially important where the constructs are interrelated. Large correlations between constructs (greater than 0.85) suggest a lack of discriminant validity (Kline 2011).

In this study, discriminant validity was established by using CFA and was performed based on the procedure suggested by Bagozzi *et al.* (1991), that is, the nested model method, because it is more rigorous and widely accepted (Holmes-Smith 2013). Models were constructed for all possible pairs of latent constructs and run on each selected pair by fixing the correlation between two constructs at 1.0. By using SEM, the first run of the model was unconstrained, and χ^2 was noted.

Secondly, constrain the correlation between constructs to 1.00 and again, note the χ^2. If a difference χ^2 test shows that constraining the correlation between the two constructs does not significantly worsen the model fit, then it can be concluded that the constructs differ (Holmes-Smith 2013).

For the seven constructs, a total of 20 different discriminant validity checks was conducted. It was found that constraining the correlation to 1.00 significantly worsened the model. As a result, it was concluded that the two constructs were different, a result that provides strong evidence of discriminant validity among the theoretical constructs.

Invariance testing (multi-group). Multi-group confirmatory factor analysis was used along with invariance testing to examine the measurement equivalence among the relations of latent variables and its observed variables to determine whether these were the same for different groups (e.g., small, medium, large, and giant organisations), or whether the groups varied in explicit ways across the groups on the constructs of interest (Byrne et al. 1989). In the case of different groups interpreting the meanings of the same constructs differently, it was important to establish measurement invariance between groups in order to make sure any construct comparison between them was valid (Cunningham, EG 2010). According to Widaman and Reise (1997), when making any group comparisons, the constructs and their indicators should be identical across the groups.

Therefore, in this research, invariance testing was undertaken because there were four groups. The approach of Vandenberg and Lance (2000) was adopted for the testing because they provide guidance on the invariance testing process. According to Cunningham, EG (2010), this approach involves testing more constrained models, which are nested using a Chi-square difference test in each case.

In *AMOS*, the *manage-group analysis* function was run to conduct the invariance tests.

When the means and intercepts were checked in *AMOS*, the default options in multiple-group analysis were tested for configural (i.e., unconstrained model), metric (measurement weights model) and scalar (measurement intercepts model) invariance, as well as invariant factor variances and covariances (structural co-variances model) and invariant uniqueness (measurement residuals). It is the tests of configural, metric and scalar invariance that must be satisfied prior to conducting any analyses involving comparisons of means across groups (Cunningham, E 2008).

In this research, to do invariance testing, three separate groups of analysis were conducted.

- developing an unconstrained model in which the parameter matrices of the models for the four groups are not constrained to be equal to each other
- developing a constrained model in which the factor loading and covariances between the factors are constrained to be equal to each other
- a Chi-square difference test between the four models.

It can be concluded that the invariance between groups and the models is the same for all groups, when the Chi-square difference test is not significant, and thus no further invariance testing is required.

In this research, the Chi-square difference test of invariant covariance was not significant and thus no further invariance testing was required, which indicated that the variance-covariance matrices were equivalent across both groups.

The measurement of composite variables. A limitation of full structural equation modelling is that where a large number of latent variables and observed indicators exist, the number of parameters to be estimated is also large. In such situations, creating a complex model is difficult because structural equation models are not robust, due to the confusing of measurement and structural parameter estimation problems. These are further complicated if the data being modelled are not multi-normally distributed (Holmes-Smith 2013) (which was the case of the research reported in this thesis).

For this reason, the Holmes-Smith and Rowe (1994) approach was adopted in this research to overcome this dilemma. Their approach to fitting complex models is a modification of more general two-step and four-step approaches to the structural equation model.

Two-step/four-step/multi-step approaches to SEM

A two-step approach was proposed by Anderson and Gerbing (1988, 1992) to overcome the problem of fitting complex models, but according to Holmes-Smith (2013) this approach has been strongly opposed by some researchers (such as Fornell & Yi 1992a; Fornell & Yi 1992b; and Hayduk 1996). A four-step approach was proposed by Mulaik (1990). In 2000, Mulaik and Millsap (2000) began a SEMNET debate around this approach in response to Hayduk and Glaser (2000) on their critique of the four-step procedure. As a result, the Holmes-Smith and Rowe (1994) approach seeks to redress some of the concerns expressed by Fornell and Yi, Hayduk and Hayduk and Glaser, yet build on Anderson and Gerbing's initial concept by incorporating some earlier work published by Munck (1979) (Holmes-Smith 2013).

In essence, according to Holmes-Smith (2013) the **Holmes-Smith and Rowe (1994) approach** incorporates the following steps:

1 Conduct a series of one factor congeneric measurement models in order to ensure that each construct is fitting well.

2 Conduct two multi-factor confirmatory factor analyses – one on all exogenous latent variables and one on all endogenous latent variables in order to ensure there are no cross-loadings across the constructs.

3 Use the factor score regression weights obtained from the one factor congeneric measurement models to create a single weighted composite measure for each case, on each construct. Furthermore, the variance and standard deviation of these composites can be computed and saved for use in Step 5 below.

4 Use either the Werts *et al.* (1978) maximised reliability approach or the Hancock and Mueller (2001) coefficient H formula to calculate the reliability of each composite measure.

5 Use the Munck (1979) approach to calculate the factor loadings in the regressions of each construct on its respective composite measure together with its associated error variance.

6 Specify the full structural equation model, but instead of using each of the multiple reflective indicator variables to measure each associated construct, use the single composite measure as a single reflective indicator of its associated construct. Furthermore, fix both the factor loading and error variance in this model to the values established in Step 5 above.

7 Run the model. Like the Anderson and Gerbing's two-step approach, the measurement parts of the model are fixed, so only the structural parts of the model are being estimated.

5.2.6 Further validation of the developed model

This research developed a conceptual model based on the literature review and survey data analysis. It is important and critical to validate the developed model in order to test its reliability and usefulness in assessing safety culture in the Saudi Arabian construction industry. This validation was necessary in order to clarify and improve the conceptual model, and also to identify its strengths and weaknesses. This section discusses the validation procedures adopted that sought experts' opinions towards the usefulness, completeness and appropriateness of the model elements.

Validation approach

Based on determining the level of model accuracy to practicality in the existing world, Sornette *et al.* (2007, p. 6562) defined the validation approach as 'the process of determining the degree to which a model is an accurate representation of the real world from the perspective of its intended uses'. Therefore, model validation was crucial in order to ensure that the developed model behaved as the real world under the same conditions (Miser 1993; Pidd 2009).

According to Pidd (2009), the social and historical perspectives suggest that a model can be considered valid when it is accepted by appropriate experts and the people who intend to use it. There are no common criteria for validation (Miser 1993), and a qualitative approach could be used to validate the developed model through interviews and survey techniques (Smith, JH 1993). The relationships identified through the quantitative analysis were presented to experienced participants in their fields to determine their opinions on the extent to which such relationships between stakeholder involvement, safety culture, and safety performance actually exist within the construction industry, based on their own experience.

This is an approach described in Silverman (2006) as *respondent validation*, which generates more confidence in the validity of the research finding. Adopted from Bloor (1978) and Silverman (2006), this approach involved providing participants with the research results and recording their responses. This kind of technique has been used in previous construction management studies (see Hari *et al.* (2005) as example).

In the current research, a validation workshop was held with six experts – people involved in the implementation of construction projects in Saudi Arabia. The workshop activities comprised a short presentation on the background of the research, an introduction to the proposed model, and an explanation of the outcomes from the study. This was followed by discussions on the applicability and practicality of the proposed model.

The workshop was undertaken in three stages as described below, and the participants were given a paper to read the questions and write their comments and views on and discuss the findings (see Appendix F).

Validation process

Validation was conducted in three stages, where six participants involved in the data collection phase were invited to attend a workshop. Table 5.3 shows the positions and years of experiences of each participant.

Table 5.3 The positions and years of experiences of each participant in the workshop

	Position	Years of Experience
1	Consultant and director of the Minister of Housing	35 Years
2	Project manager	25 Years
3	Project manager	14 Years
4	Site director	9 Years
5	Site manager	4 Years
6	Site supervisor	3 Years

During the first stage of the workshop, a 15 minute presentation was given, including an explanation of the background, aims, and objectives of the research, along with the research methodology to provide a clear picture of the process used to develop the conceptual model.

In the second stage of this workshop, the developed model was presented in order to provide a clear picture of the safety culture and stakeholder involvement in the context of Saudi Arabia's construction industry, and to capture participants' feedback on the strengths and weaknesses of its content and structure. This also permitted feedback on the level of correct identification of its elements, and was followed by two questions regarding the usefulness and applicability of the model. The workshop included an open discussion and debate with open-ended and close-ended questions being used, resulting in valuable feedback.

The participants were asked to indicate their level of agreement with the accuracy and clarity of the whole model, and the completeness and applicability of the model. This was asked with the aim of enabling them to assess the existing involvement of the stakeholders in improving safety at workplaces; it was followed by two open-ended questions regarding safety concerns and stakeholder groups who might have an impact on delivering a positive safety culture.

The results indicated that most of the participants believed that the developed model was adaptable and workable, and the involvement of stakeholders in improving safety culture was highly important. Further details of the workshop findings are presented and discussed in Chapter 7.

5.3 Summary

This chapter provided a detailed description of the methods applied in the current study, and justified the selection of the population sample and the research context. In addition, the development of the survey instrument was detailed, and all measurement scales adopted were outlined. The appropriateness of the quantitative approach was introduced; the structural equation modelling and confirmatory factor analysis for the investigation of the hypothesis was then discussed. This chapter concluded by presenting a description of the analytical strategies undertaken, which will be discussed in the next chapters.

Results, part 1

This chapter describes how the proposed model, hypotheses and theories discussed in the previous chapters were tested. This includes outlining the statistical analysis undertaken for this research. The results are presented in two sections based upon the following analyses:

- Initial data analyses involved a number of different procedures that primarily relied on using SPSS. This included statistical methods of the descriptive statistics, handling of missing data, the normality test, the outliers test, and the reliability test.
- Advanced data analyses were undertaken by using a structural equation modelling package, *AMOS* which included examining individual and full measurement models by using confirmatory factor analyses. In addition, discriminant analyses, and invariance testing of four groups were undertaken. The full structural model analysis results are presented in Chapter 7.

6.1 Descriptive statistics

Table 6.1 presents the descriptive statistics of the background variables of the sample population. Among the respondents, 124 (32.3%) noted their organisation as government; 36 (9.4%) were semi government; 182 (47.4%) were from private organisations; 31 (8.1%) worked in multinational organisations and the least 11 (2.9%) were from other types of organisations.

Among the respondents, 89 (23.2%) noted that their organisation was small, with fewer than 49 employees; 235 (61.2%) were working in medium size organisations with between 50 and 499 employees; and 60 (15.6%) were employed in large organisations with more than 500 employees.

In terms of what sort of work the participants did, 111 (28.9%) worked on industrial projects; 80 (20.8%) were working on residential projects; 121 (31.5%) were working on commercial products; 27 (7.0%) described their work as being on building projects; 38 (9.9%) were from highway construction, and heavy construction projects, and 80 (21.9%) marked their projects as being of ‘other kind’.

The data indicated that 46 (12%) of the organisations had been in operation for less than one year; 119 (31%) had been operation for one to five years; 80 (20.8%) had been in operation from five to ten years; 68 (17.7%) had been in operation ten years to less than 20; and 71 (18.5%) had been in operation for 20 years and more.

Table 6.1 The sample characteristics

Characteristics	Frequency	(%)
Type of organisation		
government	124	(32.3)
semi government	36	(9.4)
private organisation	182	(47.4)
multinational organisation	31	(8.1)
other	11	(2.9)
Size of organisation		
small	89	(23.2)
medium	235	(61.2)
large	60	(15.6)
Type of project		
industrial projects (such as manufacturing, power generation	111	(28.9)
residential projects (houses, apartments, etc.)	80	(20.8)
commercial (towers, hospitals, schools, shopping centres, warehouse, hotels, etc.)	121	(31.5)
building (small renovations such as addition of a room.)	27	(7.0)
highway construction (roads, highways, bridges, etc.)	38	(9.9)
heavy construction (water and sewer line projects, dams, etc.)	38	(9.9)
other	84	(21.9)
Period organisations in operations		
less than 1 year	46	(12)
1 year to less than 5 years	119	(31)
5 years to less than 10 years	80	(20.8)
10 years to less than 20 years	68	(17.7)
20 years and more	71	(18.5)

6.2 Data screening

After the data were collected, a number of data examination techniques, ranging from the simple process of visual inspection of graphical displays to statistical methods of the handling of missing data, the normality test, the outliers test, and the reliability test needed to be performed to increase confidence in the data. Each of these statistical methods is outlined below.

6.2.1 Data examination techniques

Handling missing data. Missing data is one of the most pervasive problems in data analysis. Its severity depends on the pattern of the missing data, how much is missing, and why it is missing. According to Tabachnick and Fidell (2012), the pattern of missing data is more important than the amount missing. Missing values that occur randomly through a data matrix create less severe problems than non-randomly missing values, which are severe, no matter how few they are, because they affect the general reliability of the results. There are a number of methods used to handle missing data, such as deleting cases, using mean substitution, using a missing data correlation matrix, and treating missing data as data.

Though the data collected for this research contain information from 490 individuals, only the data for 384 individuals was complete. The other individuals were eliminated from further analysis because of the serious extent of the missing data in their responses. This led to an ultimate sample size of 384 for this research work.

Test of normality. The screening of continuous variables for normality is an important early step in almost every multivariate analysis (Tabachnick & Fidell 2012). Although the normality of the variables is not always required for an analysis in the strictest sense, the solution is usually more appropriate if the variables are all at least approximately normally distributed. Furthermore, severe deviation from normality may seriously harm the validity of interpretations from statistical analyses. In this research, the normality of the variables was assessed carefully, and where necessary, remedial steps were taken.

Two important components of normality are *skewness* and *kurtosis* (Tabachnick & Fidell 2012). Skewness relates to the symmetry of the distribution; a skewed variable is a variable whose mean is not in the centre of the distribution. Kurtosis, on the other hand, relates to the peak properties of a distribution; a distribution is either too peaked (with short, thick tails), or too flat (with long, thin tails). When a distribution is normal, the values of skewness and kurtosis are zero (Pallant 2010). If there is a positive skewness, there is a pileup of cases to the left, and the right tail is too long; with negative skewness, the result is reversed. Kurtosis values above zero indicate a distribution that is too peaked, while kurtosis values below zero are reversed. Non-normal kurtosis produces an underestimate of the variance of a variable.

There are several suggestions in the literature regarding assessing the normality of variables. According to Morgan and Griego (1998), if the division of values of skewness (or kurtosis) and its standard error (named as critical ratio) are not above 5.5, then that skewness (or kurtosis) is not significantly different from normal. Curran *et al.* (1996a), however, recommend that the values of skewness < 2.0 and kurtosis < 7.0 are acceptable. Furthermore, Schumacker and Lomax (2012) suggest that as a rule of thumb, that data may be assumed to be normal if skewness and kurtosis are within the range of +/- 1.0.

Table 6.2 shows the skewness and kurtosis values of the 36 attributes, as well as their critical ratio values. The results demonstrate that a number of attributes (marked bold in Table 6.2) fail to meet normality conditions as suggested in the literature.

Table 6.2 Skewness, kurtosis and corresponding critical ratios of the attributes.

Variable	Minimum	Maximum	Skewness	Critical ratio	Kurtosis	Critical ratio
MSP_1	1.000	5.000	-.400	-3.211	-.782	-3.147
MSP_2	1.000	5.000	.117	.941	**-1.020**	-4.107
MSP_3	1.000	5.000	-.185	-1.486	**-1.068**	-4.301
MSP_4	1.000	5.000	-.335	-2.689	-.885	-3.563
MSP_5	1.000	5.000	.049	.394	-1.176	-4.735
MSP_6	1.000	5.000	-.475	-3.815	-.859	-3.456
MSPL_1	1.000	5.000	-.134	-1.075	-.881	-3.546
MSPL_2	1.000	5.000	-.011	-.091	**-1.256**	-5.058
MSPL_3	1.000	5.000	-.089	-.715	**-1.087**	-4.375
MSPL_4	1.000	5.000	-.490	-3.937	-.503	-2.026
OSA_1	1.000	5.000	-.704	**-5.651**	-.202	-0.813
OSA_2	1.000	5.000	-.427	-3.427	-.758	-3.054
OSA_3	1.000	5.000	-.800	**-6.424**	-.014	-0.056
OSA_4	1.000	5.000	-.200	-1.604	-.888	-3.575
OSA_5	1.000	5.000	-.436	-3.504	-.684	-2.756

Variable	Minimum	Maximum	Skewness	Critical ratio	Kurtosis	Critical ratio
OSA_6	1.000	5.000	-.093	-.744	**-1.082**	-4.358
OSA_7	1.000	5.000	-.640	-5.140	-.739	-2.976
OSA_8	1.000	5.000	-.469	-3.768	-.684	-2.754
OSA_9	1.000	5.000	-.551	-4.425	-.456	-1.836
SMS_1	1.000	5.000	-.738	**-5.927**	-.447	-1.798
SMS_2	1.000	5.000	-.510	-4.095	-.687	-2.766
SMS_3	1.000	5.000	-.475	-3.815	-.727	-2.928
SMS_4	1.000	5.000	-.245	-1.971	-.842	-3.391
SMS_5	1.000	5.000	-.354	-2.840	-.898	-3.614
SMS_6	1.000	5.000	-.586	-4.706	-.432	-1.741
SMS_7	1.000	5.000	-.389	-3.126	-.916	-3.687
SMS_8	1.000	5.000	-.275	-2.206	-.884	-3.560
SP_1	1.000	5.000	-.355	-2.848	-.884	-3.557
SP_2	1.000	5.000	-.340	-2.728	-.954	-3.840
SP_3	1.000	5.000	-.220	-1.763	**-1.041**	-4.190
SP_4	1.000	5.000	-.083	-.664	**-1.092**	-4.395
StEnfo_1	1.000	5.000	-.486	-3.905	**-1.046**	-4.209
StEnfo_2	1.000	5.000	-.251	-2.018	**-1.175**	-4.731
StEnfo_3	1.000	5.000	-.375	-3.015	-.879	-3.537
StEnfo_4	1.000	5.000	-.365	-2.934	-.828	-3.333
StEnfo_5	1.000	5.000	-.023	-.185	**-1.110**	-4.468
StEnfo_6	1.000	5.000	-.281	-2.253	**-1.015**	-4.087
StInflu_1	1.000	5.000	-.330	-2.652	-.913	-3.674
StInflu_2	1.000	5.000	-.478	-3.836	-.512	-2.062
StInflu_3	1.000	5.000	-.219	-1.762	-.889	-3.579
StP_1	1.000	5.000	.188	1.513	**-1.003**	-4.038
StP_2	1.000	5.000	-.202	-1.625	-.917	-3.690
StP_3	1.000	5.000	-.005	-.042	-.808	-3.253
StP_4	1.000	5.000	-.074	-.596	-.867	-3.489
StP_5	1.000	5.000	-.412	-3.311	-.846	-3.407

These violations of normality in data required taking remedial steps using further statistical analysis. This study used a range of fit indexes to avoid the potential effect of non-normality on the goodness-of-fit index, including the recommended comparative fit index (CFI) and normed fit index (NFI) (Lei & Lomax 2005), and integrating the Bollen-Stine bootstrapping technique with the data analysis (Bollen & Long 1993).

The Bollen-Stine bootstrapping technique was chosen for this research because it is one of the commonly accepted methods for handling non-normal data (Brown, TA 2006; Byrne 2010; Kline 2011). This method enables assessments of a conceptual model and its hypotheses by offering a modified bootstrap method for the Chi-square goodness-of-fit statistic (Byrne 2009), especially when skewness and kurtosis are lower than 2 and 7 respectively (Finney & DiStefano 2006). According to Byrne (2010, P. 331) it '…enables the researcher to create multiple subsamples from the original database'.

These violations of normality in the data required taking remedial steps by way of further statistical analysis. This study used a range of fit indices to avoid the potential effect of non-normality on the goodness-of-fit index, including the recommended comparative fit index (CFI) and normed fit index (NFI) (Lei & Lomax 2005), and integrating the Bollen-Stine bootstrapping technique with the data analysis (Bollen & Long 1993).

Outlier test. An outlier is a case with such an extreme value on one variable (a univariate outlier), or such a strange combination of scores on two or more variables (multivariate outlier), that it distorts the statistical results (Tabachnick & Fidell 2012). A number of ways of testing for outliers are available in the literature, such as the use of the 5% trimmed mean, the use of standardised scores (z-scores), and the use of box-plots (Pallant 2010; Tabachnick & Fidell 2012). In this study, however, the box-plots of the attributes were observed for the presence of outliers in the data; the conclusion was reached that the study data did not suffer from a significant outlier problem.

Reliability. In this study, the 43 attributes within the seven latent constructs were tested for internal consistency, using the data from the retained 384 individuals. The results, shown in Table 6.3, had values ranging from 0.73 to 0.95 for the seven latent constructs, all of which were considered acceptable. The obtained reliability measures thus increased confidence in the contribution of the 43 attributes to the measurement of their respective constructs.

Table 6.3 Internal consistency of the latent constructs

Construct	Cronbach's α
MSP (Management safety practices)	0.94
Attributes: MSPL_1; MSPL_2; MSPL_3; MSP_1; MSP_2; MSP_3; MSP_4; MSP_5; MSP_6	
OSB (Organisational safety attitude)	0.89
Attributes: OSA_1; OSA_2; OSA_3; OSA_4; OSA_5; OSA_6; OSA_7; OSA_8; OSA_9	
SMS (safety management system)	0.95
Attributes: SMS_1; SMS_2; SMS_3; SMS_4; SMS_5; SMS_6; SMS_7; SMS_8	
SP (Safety performance)	0.91
Attributes: SP_1; SP_2; SP_3; SP_4	
St_Part (Participation)	0.77
Attributes: StP_1; StP_2; StP_3; StP_4; StP_5 (0.75) secondary stakeholders	
St_Influen (Influence)	0.76
Attributes: StInflu_1; StInflu_2; StInflu_3	
St_Enforc (Enforcement)	0.92
Attributes: StEnfo_1; StEnfo_2; StEnfo_3; StEnfo_4; StEnfo_5; StEnfo_6	

6.3 Graphical displays of descriptive statistics

This section presents graphical displays of descriptive statistics. According to Larson (2006) graphs and figures are better suited than tables for identifying patterns in the data. Below is a discussion of how each dimension of the proposed model was described and analysed by calculating the mean score of the sample data.

6.3.1 Stakeholders' participation

The contribution of stakeholder participation in improving safety in the workplace demonstrated wide discrepancies (see Figure 6.1). While *insurance companies* at (3.33 out of 5) appeared to be almost fully involved in all areas of occupational safety, no other stakeholder demonstrated a similar involvement. The project *leader* was nearest the insurance companies in influence (3.18 out of 5). Both *government* and *main contractor* involvement lagged well behind the other stakeholders at 3.11 and 2.96, with the exception of *owners*, who demonstrated a much lower level of involvement within all aspects of safety (2.82 out of 5).

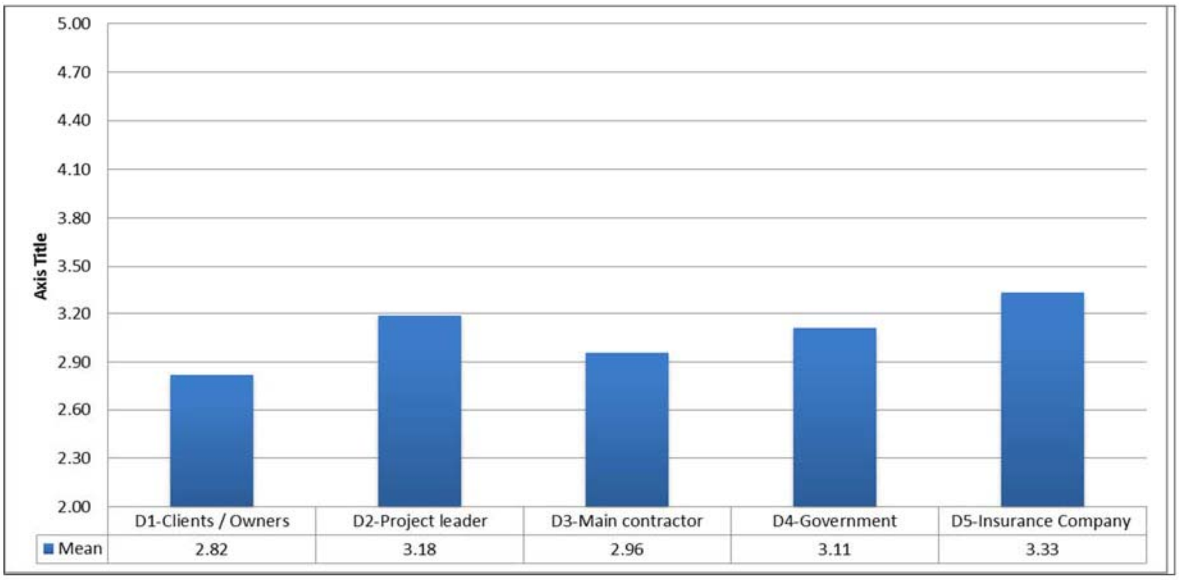


Figure 6.1 **The mean score of stakeholder participation**

6.3.2 The influence of enforcement on stakeholder behaviour

The enforcement of safety regulations was variable, depending upon the responsibility of the enforcing agency. Figure 6.2 shows that the greatest enforcement exerted on stakeholders derived from the *safety regulations*, and from the Ministry of Labour at 3.51 and 3.38 out of 5, While the lowest level of effective enforcement was that geared towards the *General Presidency of Meteorology and Environment Protection* at 3.05. Thus, safety requirements from *Civil Defence* registered 3.36; safety requirements from the *General Organization for Social Insurance* registered 3.32 and *government inspectors* registered 3.29 out of 5.

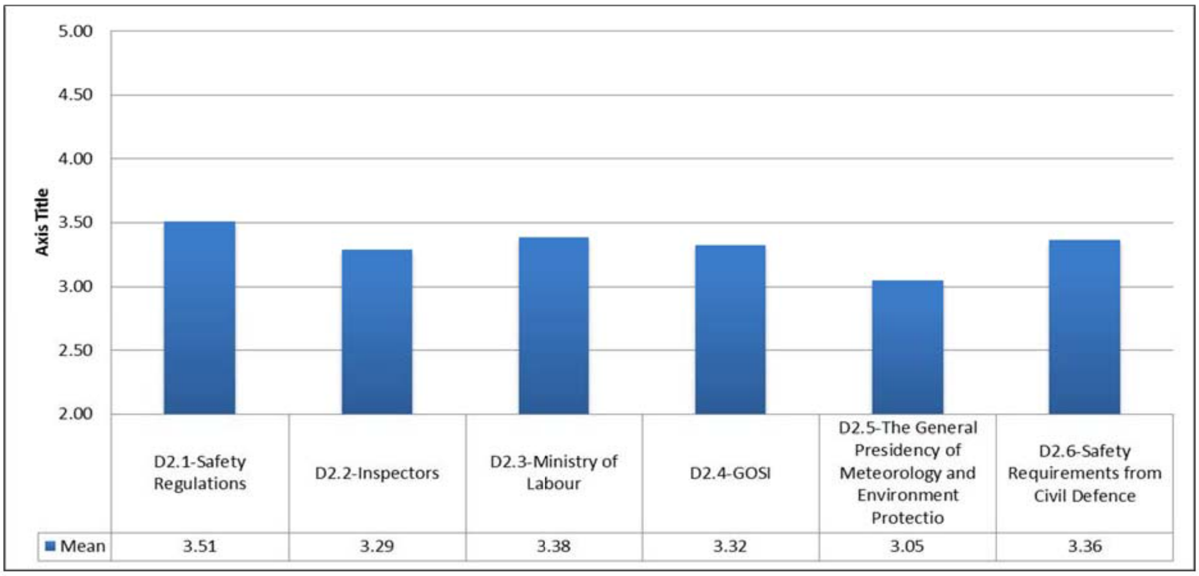


Figure 6.2 **The mean score of enforcement on stakeholders**

6.3.3 Greatest influence on stakeholders

Influence on primary stakeholders' approach to safety and their interest in improving safety conditions varied. Figure 6.3 shows that the greatest influence exerted on stakeholders was derived from the *safety practices of competitors*, and from the rates for workers' *compensation* insurance at 3.57 and 3.38 out of 5, while the lowest level of effective influence was that geared towards *media* attacks on organisations for their negligence in protecting their workers at 3.24 out of 5.

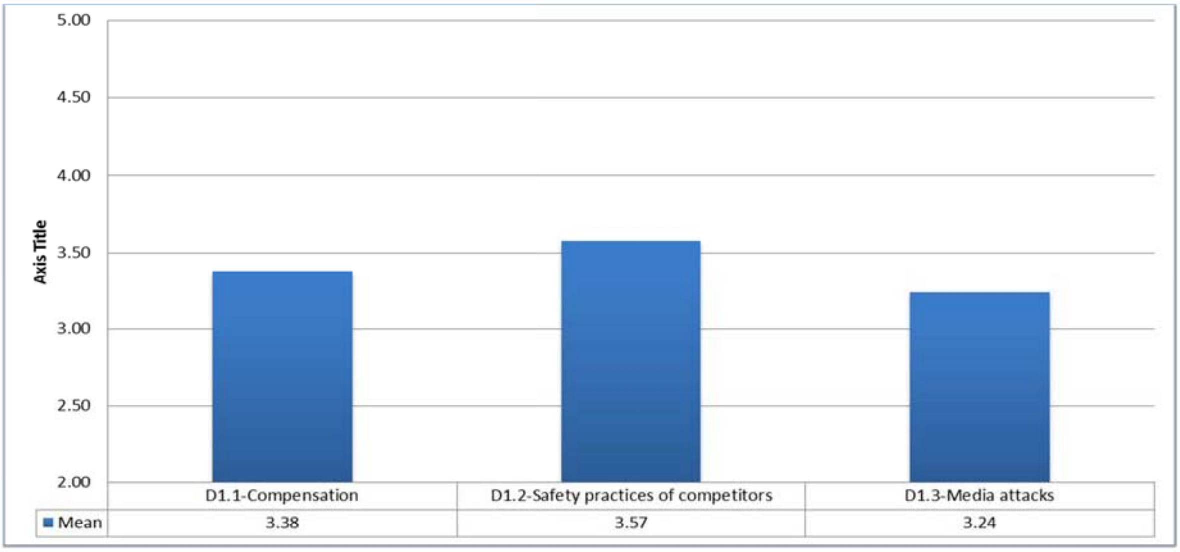


Figure 6.3 The mean score of influence on stakeholders

6.3.4 Management safety practices

Feedback from the survey indicated that management safety practices, while aspiring to a level of excellence, fell far below the proactive optimum of 5 as shown in Figure 6.4. The attitude of management to overall safety practices appeared to be extremely variable, with actual management *involvement* in day-to-day activities very low at 2.88 out of 5; safety priority in *meetings* was only a little higher at 3.01; while *contractor management* and *controlling* appeared to be moderately high at 3.54 and 3.59 out of 5, this being roughly level with management *participation* in regular safety activities. Allocation of *resources* for safety was only moderate at 3.38, as was *coaching* at 3.17. Management *commitment* appeared to be disproportionately high when compared to the foregoing at 3.5.

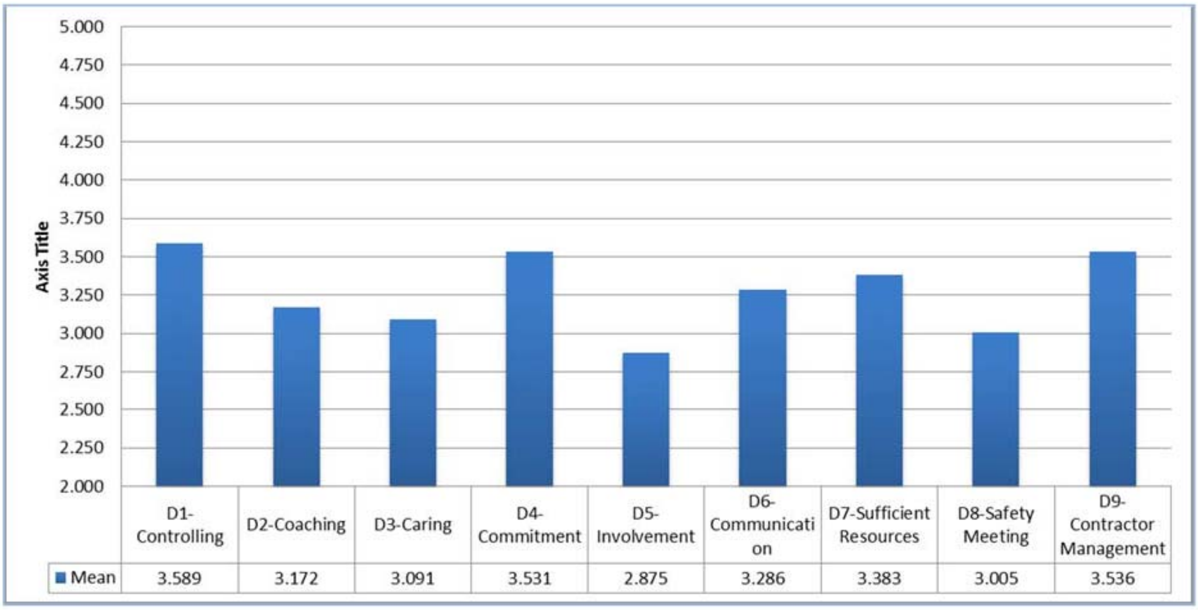


Figure 6.4 **The mean score of management safety practices**

6.3.5 Organisational safety attitudes

Organisational safety attitudes confirmed a high level of management recognition that they are responsible for safety, with low to moderate attitudes in other areas. Figure 6.5 shows that safety *effectiveness* is moderately high, as are following the written *rules and regulation*s, but this is offset by the lower scores of work pressure and *productivity vs safety*, with management placing a higher priority on productivity than safety (3.22 out of 5). Thus, *reporting* minor injuries and incidents registered 3.64 out of 5; *awareness* of safety rules and instructions registered 3.49 out of 5; *understanding* of all safety warnings and posters registered 3.44 out of 5; and *trust* of management by workers registered 3.29 out of 5.

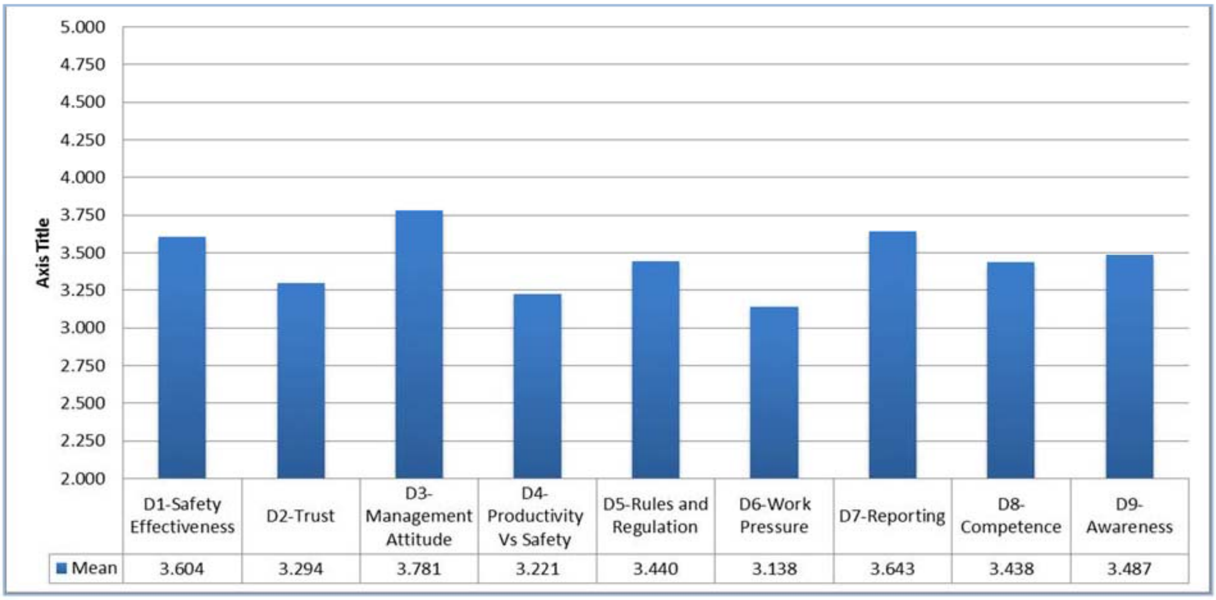


Figure 6.5 **The mean score of organisational safety attitudes**

6.3.6 Safety management system

Figure 6.6 shows that in all areas, safety management systems demonstrated a very low level of commitment towards achieving the proactive optimum of 5. While the theoretical objective represented by safety rules and procedures was relatively high (3.63 out of 5), actual efforts to implement them were low to very low. Thus, *safety policy* and *goals* registered 3.68 and 3.52 out of 5.0; *safety planning*, *safety program*, and *hazard identification* registered 3.4 , 3.32 and 3.39 out of 5.0; while both *safety review* and *auditing* registered 3.35 out of 5.

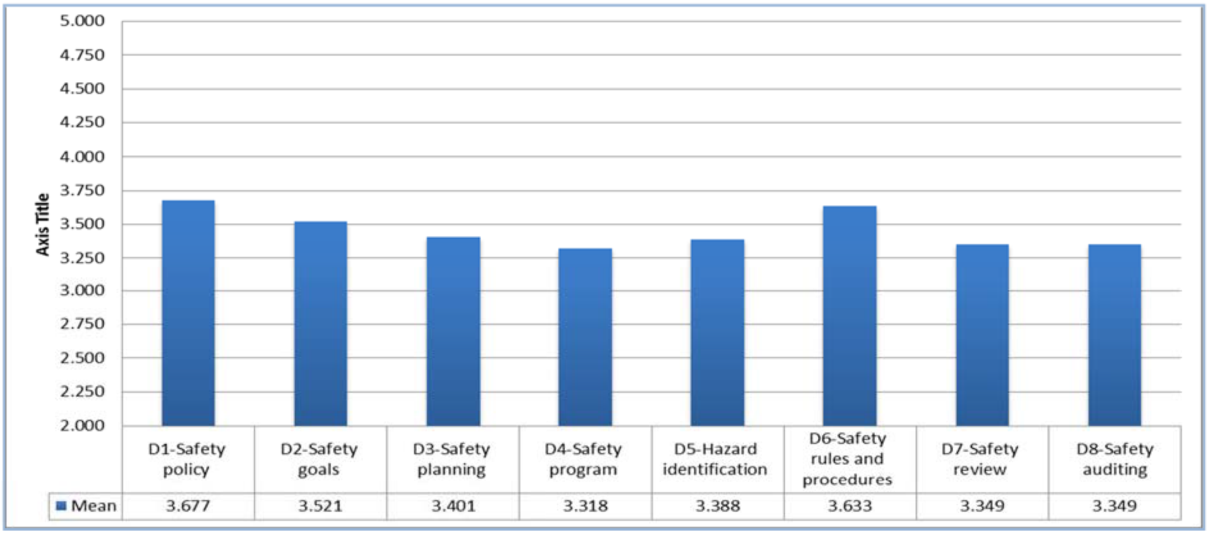


Figure 6.6 The mean score of safety management system

6.3.7 Safety performance

All areas of safety performance demonstrated only a moderate to very low level of compliance/performance. While *training* and *inspection* appeared to be at a moderate level, accident *investigations* and *motivation* scored at low, to very low levels (see Figure 6.7).

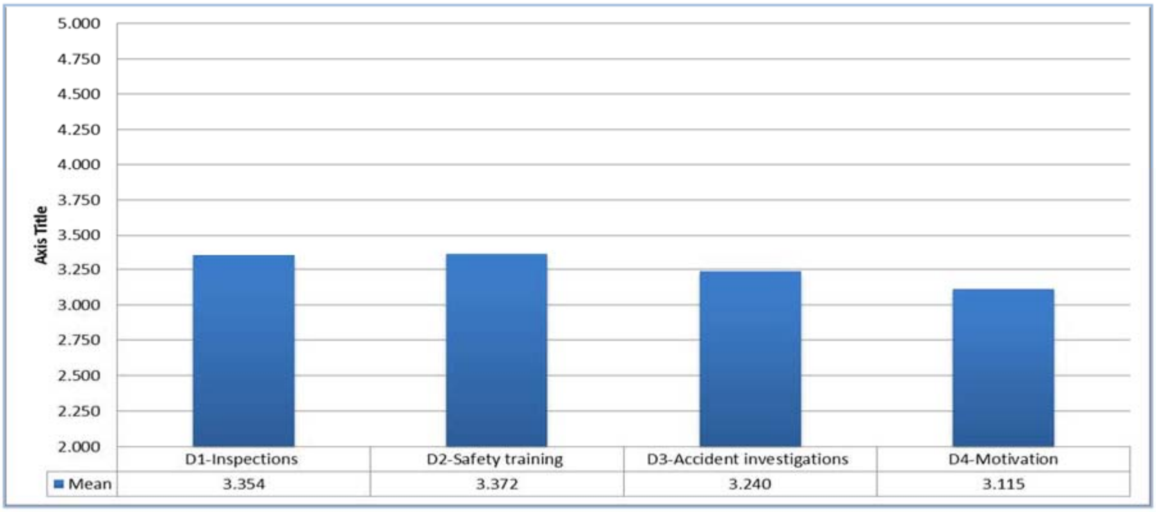


Figure 6.7 The mean score of safety performance

6.4 Development of the first part of the model: Stakeholder involvement

Following the analysis of the descriptive statistics, the latent variables were examined. The Latent variables are those that are unobserved. These are factors, or constructs, that can be measured by their respective indicators. These indicators contributed to the overall number of latent variables.

The stakeholder involvement section includes three latent variables, namely: safety enforcement, safety influence, and primary stakeholders, as explained below.

6.4.1 One factor model – Safety enforcement

Safety enforcement as a latent variable was measured by six observed variables: s*afety regulations, government inspectors*, and *safety requirements* from the Ministry of Labour, from GOSI, from the General Presidency of Meteorology and Environment Protection (PME), and from Civil Defence. Table 6.4 shows these variables with their codes as used in the analysis.

Table 6.4 Safety enforcement's variables with their codes

Latent Variable	Code	Variables	Code
Safety enforcement	StEnfo	safety regulations	StEnfo_1
		government inspectors	StEnfo_2
		Ministry of Labour	StEnfo_3
		GOSI	StEnfo_4
		PME	StEnfo_5
		Civil Defence	StEnfo_6

This latent variable relates to Question 14 of the survey, in which participants were asked to evaluate the level of safety enforcement in their organisations derived from the variables.

Specification of the one factor model – Safety enforcement. This one factor model included six indicator items. In order to analyse the significance of this factor, the variance of the latent variable was set to 1. In addition, a Bollen-Stine bootstrap procedure with 2000 bootstrap samples was performed and the respective p-value provided. The outputs requested for this model were:

- standardised estimates
- squared multiple correlations

- sample moments
- implied moments
- all implied moments
- residual moments
- modification indices (threshold value = 4).

Figure 6.8 presents the model which shows the latent variable of safety enforcement. The model is a function of the observed variables from StEnfo_1 to StEnfo_6.

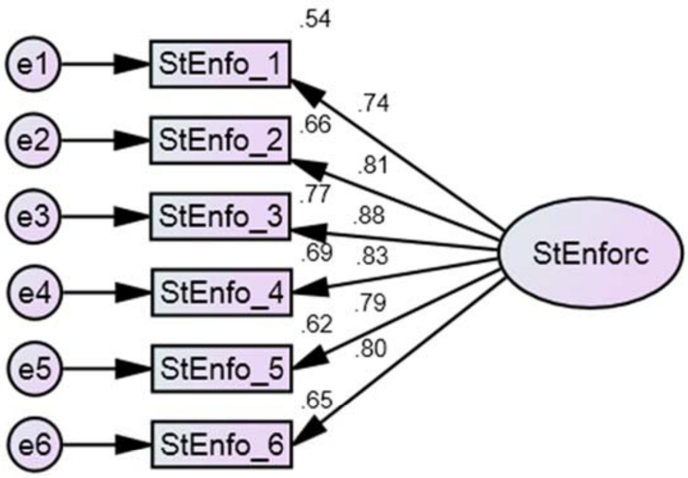


Figure 6.8 **Latent variables for safety enforcement**

Table 6.5 shows that the six observed variables were significant in the latent variable. The table displays unstandardised regression coefficients and factor loadings in the **estimates** column, standard errors in the **S.E.** column, *t-values* in the **C.R**. column (C.R. stands for critical ratio), and *p-values* in the **P** column for statistical significance. In the **P** column p=*** simply means that the *p-value* is close to zero.

Table 6.5 Regression weights

			Estimate	S.E.	C.R.	P	Label
StEnfo_6	<---	StEnforc	.994	.057	17.290	***	par_1
StEnfo_5	<---	StEnforc	1.000				
StEnfo_4	<---	StEnforc	1.010	.056	18.087	***	par_2
StEnfo_1	<---	StEnforc	.982	.063	15.466	***	par_3
StEnfo_2	<---	StEnforc	1.086	.062	17.526	***	par_4
StEnfo_3	<---	StEnforc	1.090	.056	19.371	***	par_5

Table 6.6 shows the regression weights. The standardised regression weights in the **estimates** column represent the standardised regression coefficients and factor loadings. The low loading is the safety regulations (StEnfo_1) with 0.736.

Table 6.6 Standardised regression weights

			Estimate
StEnfo_6	<---	StEnforc	.804
StEnfo_5	<---	StEnforc	.790
StEnfo_4	<---	StEnforc	.832
StEnfo_1	<---	StEnforc	.736
StEnfo_2	<---	StEnforc	.813
StEnfo_3	<---	StEnforc	.878

Model output of the one factor model – Safety enforcement. Table 6.7 shows the output of one factor model of safety enforcement. The original Model 1 with six items did not fit the data well, with most goodness-of-fit indices failing to meet acceptable levels. In Model 2, after removing three items (StEnfo_1), (StEnfo_5), and (StEnfo_6), the model achieved a good fit, satisfying all goodness-of-fit criteria (Model 2, Table 6.7). The Chi-square test shows that the p-value is equal to ($p = 0.385$), which means that the X^2 is not significant. The data fit well to the model GFI = 0.999, TLI = 1.001, CFI = 1.000, RMSEA = 0.000, and PCLOSE = 0.576.

Model re-specification. The scale of the latent variable was adopted from Chinyio and Olomolaiye (2009) and Walker *et al.* (2008). Model 2 (Table 6.7) has been fit after inspecting the standard residual covariance matrix and modification indices for regression weights, which revealed that the items (StEnfo_1), (StEnfo_5), and (StEnfo_6) were cross-loading with a number of other items in the model, and were also considerably lower compared with the others. Therefore this item was eliminated from the model. Table 6.7 shows that Model 2 with one-factor model of safety enforcement fits well.

Table 6.7 The goodness-of-fit statistics of the measurement models

Goodness-of-fit index	Recommended level	Measures	
		Model 1 (6 items)	*Model 2 (3 items)*
Chi-square fit index (X^2)	$p > 0.05$	p = 0.000	p = 0.385
Bollen-Stine bootstrap p	$p > 0.05$	p = 0.000	p = 0.339
Goodness-of-fit-index (GFI)	> 0.90	0.885	0.999
The Tucker-Lewis index (TLI)	> 0.95	0.866	1.001
Comparative fit index (CFI)	> 0.90	0.920	1.000
RMSEA	Close to 0 perfect fit <0.05 >0.05 and <.008	0.195	0.000
PCLOSE	>0.05	0.000	0.576

6.4.2 One factor model – Safety influence

Safety influence as a latent variable was measured by three observed variables – the rates for workers' compensation insurance, safety practices of competitors, and media attacks. (Table 6.8 shows these variables with their codes.)

Table 6.8 Safety influence's variables with their codes

Latent variable	Code	Variables	Code
Safety influence	StInfluen	The rates for workers' compensation insurance	StInflu_1
		Safety practices of competitors	StInflu_2
		Media attacks	StInflu_3

This latent variable relates to Question 13 of the survey in which participants were asked to evaluate the level of safety influence derived from the above items interacting with their organisations.

Specification of the one factor model – Safety influence. This one factor model included three indicator items. In order to analyse the significance of this factor, the variance of the latent variable was set to 1. Also, a Bollen-Stine bootstrap procedure with 2000 bootstrap samples was performed and the respective p-value provided. The outputs requested for this model were:

- standardised estimates
- squared multiple correlations

- sample moments
- implied moments
- all implied moments
- residual moments
- modification indices (threshold value = 4).

Figure 6.9 presents the model which shows the latent variable of safety influence. The model is a function of the observed variables from StInflu_1 to StInflu_3.

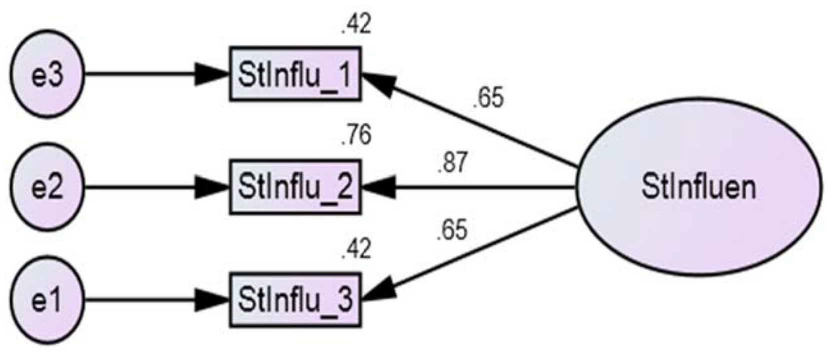


Figure 6.9 Latent variables for safety influence

Table 6.9 shows that the three observed variables were significant in the latent variable. The table displays unstandardised regression coefficients and factor loadings in the **estimates** column, standard errors in the **S.E.** column, *t-values* in the **C.R**. column (C.R. stands for critical ratio), and *p-values* in the **P** column for statistical significance. In the **P** column p=*** simply means that the *p-value* is close to zero.

Table 6.9 Regression weights

			Estimate	S.E.	C.R.	P	Label
StInflu_3	<---	StInfluen	.830	.075	11.103	***	a
StInflu_2	<---	StInfluen	1.000				
StInflu_1	<---	StInfluen	.830	.075	11.103	***	a

Table 6.10 shows the regression weights. The standardised regression weights in the **estimates** column represent the standardised regression coefficients and factor loadings. The low loading is the rates for workers' compensation insurance (StInflu_1) with 0.647.

Table 6.10 Standardised regression weights

			Estimate
StInflu_3	<---	StInfluen	.651
StInflu_2	<---	StInfluen	.872
StInflu_1	<---	StInfluen	.647

Model output of the one factor model – Safety influence. The safety influence measures were adopted from Bourne and Walker (2005), Everett and Yang (1997), Freeman (2010), Sulaiman (2008), Walker *et al.* (2008). Table 6.11 shows the output of one factor model of safety influence. The original Model 1 with three items fit the data well, with most goodness-of-fit indices meeting an acceptable level (see Model 1, Table 6.11). The Chi-square test shows a p-value equal to (p = 0.274), which means that the X^2 was not significant. The data fit well to the model GFI = 0.998, TLI = 0.998, CFI = 0.999, RMSEA = 0.023, and PCLOSE = 0.473.

Table 6.11 The goodness-of-fit statistics of the measurement models

Goodness-of fit-index	Recommended level	Measures
		Model 1 (3 items)
Chi-square fit index (X^2)	*p* > 0.05	p = 0.274
Bollen-Stine bootstrap p	*p* > 0.05	p = 0. 277
Goodness-of-fit-index (GFI)	> 0.90	0. 998
The Tucker-Lewis index (TLI)	> 0.95	0.998
Comparative fit index (CFI)	> 0.90	0.999
RMSEA	Close to 0 perfect fit <0.05 >0.05 and <.008	0.023
PCLOSE	>0.05	0.473

6.4.3 One factor model – Primary stakeholders

Primary stakeholder as a latent variable was measured by three observed variables, namely, the client/owner, project managers, and contractors. (Table 6.12 shows these variables with their codes.)

Table 6.12 Primary stakeholders' variables with their codes

Latent variable	Code	Variables	Code
Primary stakeholder	StPartici	client/owner	StP_1
		project managers	StP_2
		contractors	StP_3

This latent variable relates to Question 12 of the survey, in which participants were asked to estimate the involvement of their primary stakeholder to improve safety in their organisations.

Specification of the one factor model – Primary stakeholder. This one factor model included three indicator items. In order to analyse the significance of this factor, the variance of the latent variable was set to 1. Also, a Bollen-Stine bootstrap procedure with 2000 bootstrap samples was performed and the respective p-value provided. The outputs requested for this model were:

- standardised estimates
- squared multiple correlations
- sample moments
- implied moments
- all implied moments
- residual moments
- modification indices (threshold value = 4)

Figure 6.10 presents the model which shows the latent variable of the primary stakeholder. The model is a function of the observed variables from StP_1 to StP_3.

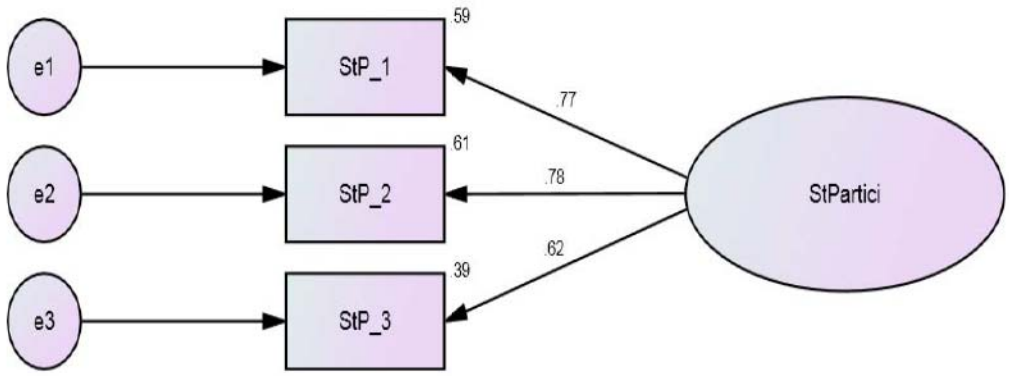


Figure 6.10 Latent variables for safety influence

Table 6.13 shows that the three observed variables were significant in the latent variable. The table displays unstandardised regression coefficients and factor loadings in the **estimates** column, standard errors in the **S.E.** column, *t-values* in the **C.R**. column (C.R. stands for critical ratio), and *p-values* in the **P** column for statistical significance. In the **P** column p=*** simply means that the *p-value* is close to zero.

Table 6.13 Regression weights

			Estimate	S.E.	C.R.	P	Label
StP_3	<---	StPartici	1.000				
StP_2	<---	StPartici	1.322	.116	11.442	***	a
StP_1	<---	StPartici	1.322	.116	11.442	***	a

Table 6.14 shows the regressions weights. The standardised regression weights in the **estimates** column represent the standardised regression coefficients and factor loadings. The low loading is the contractors (StP_3) with 0.621.

Table 6.14 Standardised regression weights

			Estimate
StP_3	<---	StPartici	.621
StP_2	<---	StPartici	.778
StP_1	<---	StPartici	.767

Model output of the one factor model – Primary stakeholders. The primary stakeholder scale was adopted from Chinyio and Olomolaiye (2009). Table 6.15 shows the output of the one factor model of primary stakeholders. The original Model 1 with three items fit the data well, with most goodness-of-fit indices meeting an acceptable level (see Model 1, Table 6.15). The Chi-square test shows that the p-value was equal to ($p = 0.097$), which means that the X^2 was not significant. The data fit well to the model GFI = 0.995, TLI = 0.982, CFI = 0.994, RMSEA = 0.068, and PCLOSE = 0.251.

Table 6.15 The goodness-of-fit statistics of the measurement models

Goodness-of-fit index	Recommended level	Measures
		Model 1 (3 items)
Chi-Square fit index (X^2)	$p > 0.05$	p = 0.097
Bollen-Stine bootstrap p	$p > 0.05$	p = 0.079
Goodness-of-fit-index (GFI)	> 0.90	0. 995
The Tucker-Lewis index (TLI)	> 0.95	0.982
Comparative fit index (CFI)	> 0.90	0.994
RMSEA	Close to 0 perfect fit <0.05 >0.05 and <.008	0.068
PCLOSE	>0.05	0.251

6.5 Development of the second part of the model – Safety culture

The safety culture section includes four latent variables, namely: management safety practices, organisational safety attitudes, safety management system, and safety performance, as explained below.

6.5.1 One factor model – Management safety practices

Management safety practices as a latent variable was measured by nine variables, namely, commitment, involvement, communication, resources, meeting, contractor management, and safety leadership. (Table 6.16 shows these variables with their codes).

Table 6.16 Management safety practices' variables with their codes

Latent variable	Code	Variables	Code
Management safety practices	MSP	commitment	MSP1
		involvement	MSP2
		communication	MSP3
		resources	MSP4
		meeting	MSP5
		contractor management	MSP6
		caring	MSPL1
		coaching	MSPL2
		controlling	MSPL3

This latent variable relates to Questions 7 and 8 of the survey which participants were asked to evaluate the management safety practices of their organisation.

Specification of the one factor model – Management safety practices. This one factor model included nine indicator items. In order to analyse the significance of this factor the variance of the latent variable was set to 1. Also, a Bollen-Stine bootstrap procedure with 2000 bootstrap samples was performed and the respective p-value provided. The outputs requested for this model were:

- standardised estimates
- squared multiple correlations
- sample moments
- implied moments
- all implied moments
- residual moments
- modification indices (threshold value = 4).

Figure 6.11 presents the model which shows the latent variable of management safety practices and leadership. The model is a function of the observed variables: from MSP_1 to MSPL_3.

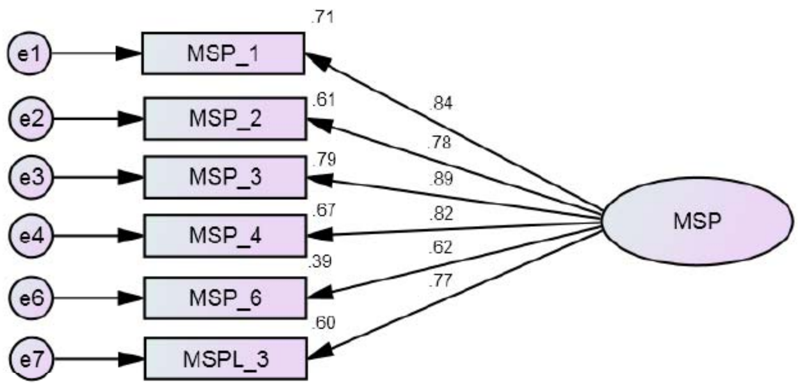


Figure 6.4 Latent variables for management safety practices & leadership

Table 6.17 shows that the observed variables were significant in the latent variable. The table displays unstandardised regression coefficients and factor loadings in the **estimates** column, standard errors in the **S.E.** column, *t-values* in the **C.R**. column (C.R. stands for Critical Ratio), and *p-values* in the **P** column for statistical significance. In the **P** column p=*** simply means that the *p-value* is close to zero.

Table 6.17 Regression weights

			Estimate	S.E.	C.R.	P	Label
MSP_3	<---	MSP	1.000				
MSP_2	<---	MSP	.879	.046	19.191	***	par_1
MSP_4	<---	MSP	.900	.043	21.147	***	par_2
MSP_6	<---	MSP	.700	.051	13.628	***	par_3
MSP_1	<---	MSP	.912	.042	21.937	***	par_4
MSPL_3	<---	MSP	.882	.047	18.815	***	par_5

Table 6.18 shows the regressions weights. The standardised regression weights in the **estimates** column represent the standardised regression coefficients and factor loadings. The lowest loading is MSP_6 (contractor management) with 0.621.

Table 6.18 Standardised regression weights

			Estimate
MSP_3	<---	MSP	.890
MSP_2	<---	MSP	.780
MSP_4	<---	MSP	.818
MSP_6	<---	MSP	.621
MSP_1	<---	MSP	.841
MSPL_3	<---	MSP	.773

Model output of the one factor model – Management safety practices. Table 6.19 shows the output of the one factor model of organisation safety attitude. The original Model 1 with eight items did not fit the data well, with most goodness-of-fit indices failing to meet an acceptable level. In Models 2 and 3, after removing two items – (MSPL_1) and (MSPL_2) – the model improved, apart from the p-value, GFI, TLI, CFI, RMSEA, and PCLOSE values. With the removal of the item (MSP_5), the model achieved a good fit, satisfying all goodness-of-fit criteria (see Model 4, Table 6.19). The Chi-square test shows that the p-value was equal to (p = 0.120), which means that the X^2 is not significant. The data fit well to the model GFI = 0.988, TLI = 0.994, CFI = 0.996, RMSEA = 0.038, and PCLOSE = 0.653.

Table 6.19 The goodness-of-fit statistics of the measurement models of OSA

Goodness-of-fit index	Recommended level	Measures			
		Model 1 (9 items)	***Model 2*** (8 items)	***Model 3*** (7 items)	***Model 4*** (6 items)
Chi-square fit index (X^2)	*p* > 0.05	p = 0.000	p = 0.001	p = 0.018	p = 0.120
Bollen-Stine bootstrap p	*p* > 0.05	p = 0.000	p = 0.018	p = 0.043	p = 0.339
Goodness-of-fit-index (GFI)	> 0.90	0.943	0.976	0.986	0.988
The Tucker-Lewis index (TLI)	> 0.95	0.946	0.980	0.985	0.994
Comparative fit index (CFI)	> 0.90	0.946	0.988	0.992	0.996
RMSEA	Close to 0 perfect fit <0.05 >0.05 and <.008	0.114	0.075	0.067	0.038
PCLOSE	>0.05	0.000	0.084	0.211	0.653

Model re-specification. The management safety practices measures were adopted from Aksorn and Hadikusumo (2008), Carder and Ragan (2003), Choudhry, R *et al.* (2007a), Fang *et al.* (2006), Ferraro (2002), MCA (1999), Sawacha *et al.* (1999), and Wu, T-C (2005). The original model of four items (Model 1, Table 6.19) did not meet all of the fit indices. Model 4 was fit after inspecting the standard residual covariance matrix and modification indices for regression weights, which revealed that the items (MSPL_2), (MSPL_3), and (MSP_5) were cross-loading with a number of other items in the model. Therefore, these items were eliminated from the model and not considered in the analysis. Table 6.19 shows that Model 4 with a one-factor model of safety management system fit well.

6.5.2 One factor model – Organisation safety attitude

Organisation safety attitude as a latent variable was measured by a nine variables, namely, effectiveness, trust, attitude, productivity vs safety, rules and regulations, work pressure, reporting, competence, and awareness. (Table 6.20 shows these variables with their codes).

Table 6.20 Organisational safety attitudes' variables with their codes

Latent Variable	Code	Variables	Code
Organisation safety attitudes	OSA	effectiveness	OSA1
		trust	OSA2
		attitudes	OSA3
		productivity vs. safety	OSA4
		rules and regulations	OSA5
		work pressure	OSA6
		reporting	OSA7
		competence	OSA8
		awareness	OSA9

This latent variable relates to Question 9 of the survey, in which participants were asked to evaluate the safety attitude of their organisation.

Specification of the one factor model – Organisation safety attitude. This one factor model included nine indicator items. In order to analyse the significance of this factor the variance of the latent variable was set to 1. Also, a Bollen-Stine bootstrap procedure with 2000 bootstrap samples was performed and the respective p-value provided. The outputs requested for this model were:

- standardised estimates
- squared multiple correlations
- sample moments
- implied moments
- all implied moments
- residual moments
- modification indices (threshold value = 4).

Figure 6.12 presents the model which shows the latent variable of organisation safety attitude. The model is a function of the observed variables: from OSA_1 to OSA_9.

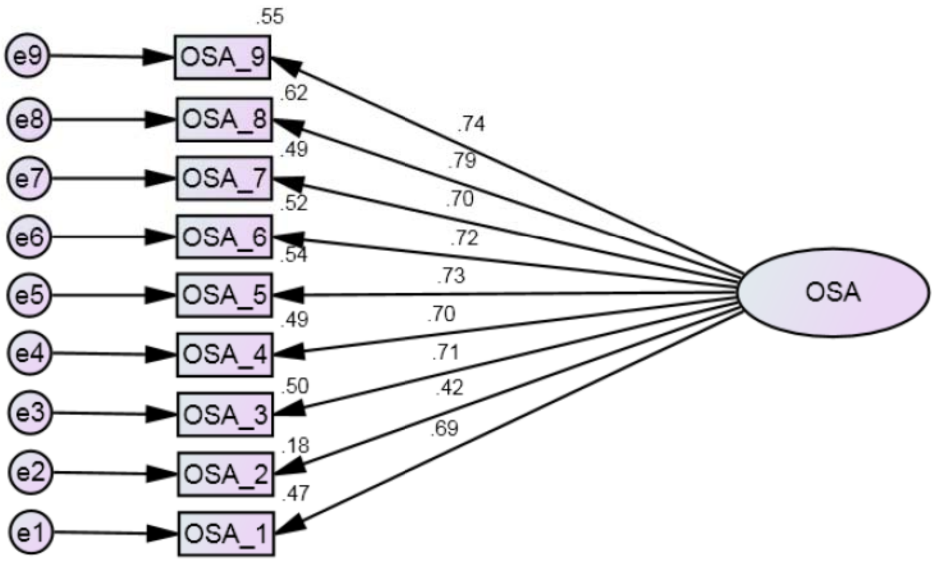


Figure 6.5 **Latent variables for organisation safety attitude (Model 1)**

Table 6.21 shows that the nine observed variables were significant in the latent variable. The table displays unstandardised regression coefficients and factor loadings in the **estimates** column, standard errors in the **S.E.** column, *t-values* in the **C.R**. column (C.R. stands for Critical Ratio), and *p-values* in the **P** column for statistical significance. In the **P** column p=*** simply means that the *p-value* is close to zero.

Table 6.21 Regression weights

			Estimate	S.E.	C.R.	P	Label
OSA_8	<---	OSA	1.000				
OSA_7	<---	OSA	.974	.068	14.251	***	par_1
OSA_6	<---	OSA	.986	.067	14.631	***	par_2
OSA_5	<---	OSA	.913	.061	14.978	***	par_3
OSA_9	<---	OSA	.897	.059	15.219	***	par_4
OSA_4	<---	OSA	.927	.065	14.167	***	par_5
OSA_3	<---	OSA	.847	.059	14.408	***	par_6
OSA_2	<---	OSA	.539	.067	8.012	***	par_7
OSA_1	<---	OSA	.840	.061	13.882	***	par_8

Table 6.22 shows the regressions weights. The standardised regression weights in the **estimates** column represent the standardised regression coefficients and factor loadings. The low loading is OSA_2 (trust) with 0.419.

Table 6.22 Standardised regression weights

			Estimate
OSA_8	<---	OSA	.787
OSA_7	<---	OSA	.703
OSA_6	<---	OSA	.719
OSA_5	<---	OSA	.733
OSA_9	<---	OSA	.743
OSA_4	<---	OSA	.700
OSA_3	<---	OSA	.710
OSA_2	<---	OSA	.419
OSA_1	<---	OSA	.688

Model output of the one factor model – Organisation safety attitude. Table 6.23 shows the output of the one factor model of organisation safety attitude. The original Model 1 with nine items did not fit the data well, with most goodness-of-fit indices failing to meet an acceptable level. In Models 2 and 3, after removing three items – (OSA_2), (OSA_4), and (OSA_8) – the model improved, apart from p-value, GFI, TLI, RMSEA, and PCLOSE values. With the removal of the item (OSA_3), the model achieved a good fit, satisfying all goodness-of-fit criteria (see Model 4, Table 6.23). The Chi-square test showed that the p-value was equal to (p = 0.677), which meant that the X^2 was not significant. The data fit well to the model GFI = 0.997, TLI = 1.006, CFI = 1.00, RMSEA = 0.00, and PCLOSE = 0.928.

Table 6.23 The goodness-of-fit statistics of the measurement models of OSA

Goodness-of-fit index	Recommended level	Measures			
		Model 1 (9 items)	*Model 2* (7 items)	*Model 3* (6 items)	*Model 4* (5 items)
Chi-square fit index (X^2)	$p > 0.05$	p = 0.000	p = 0.000	p = 0.000	p = 0.677
Bollen-Stine bootstrap p	$p > 0.05$	p = 0.000	p = 0.000	p = 0.007	p = 0.832
Goodness-of-fit-index (GFI)	> 0.90	0.896	0.937	0.963	0.997
The Tucker-Lewis index (TLI)	> 0.95	0.879	0.914	0.941	1.006
Comparative fit index (CFI)	> 0.90	0.909	0.943	0.964	1.000
RMSEA	Close to 0 perfect fit <0.05 >0.05 and <.008	0.119	0.116	0.096	0.000
PCLOSE	>0.05	0.000	0.000	0.005	0.928

Model re-specification. Organisation safety attitude scales were adopted from Chinda and Mohamed (2008), Chunlin *et al.* (1999), Fang *et al.* (2006), Ferraro (2002), Filho *et al.* (2010); Flin, R *et al.* (2000), Glendon and Litherland (2001), Gordon, R *et al.* (2007), Hansen (2007), Hofstede, G and Hofstede (2004), MCA (1999), Mearns, K and Flin (1996), Mearns, K *et al.* (2003), Mohamed (2002), Ostrom *et al.* (1993). The original model of nine items (See Model 1, Table 6.23) did not meet all of the fit indices.

Model 4 was fit after inspecting the standard residual covariance matrix and modification indices for regression weights, which revealed that the item (OSA_2) was the lowest value of loading, and the items (OSA_4) and (OSA_3) were cross-loading with a number of other items in the model. Therefore these items were eliminated from the model and not considered in the analysis. Table 6.23 shows that Model 4 with a one-factor model of organisation safety attitude fits well.

6.5.3 One factor model – Safety management system

Safety management system as a latent variable was measured by eight variables, namely, safety policy, goals, safety planning, safety program, hazard, safety rules and procedures, safety review and evaluation, and safety auditing. (Table 6.24 shows these variables with their codes).

Table6.24 Safety management system's variables with their codes

Latent Variable	Code	Variables	Code
Safety management system	SMS	safety policy	SMS1
		goals	SMS2
		safety planning	SMS3
		safety program	SMS4
		hazard	SMS5
		safety rules and procedures	SMS6
		review & evaluate	SMS7
		auditing	SMS8

This latent variable relates to Question 10 of the survey, in which participants were asked to evaluate the safety management system of their organisation.

Specification of the one factor model – Safety management system. This one factor model included eight indicator items. In order to analyse the significance of this factor the variance of the latent variable was set to 1. Also, a Bollen-Stine bootstrap procedure with 2000 bootstrap samples was performed and the respective p-value provided. The outputs requested for this model were:

- standardised estimates
- squared multiple correlations
- sample moments
- implied moments
- all implied moments
- residual moments
- modification indices (threshold value = 4).

Figure 6.13 presents the model which shows the latent variable of safety management system. The model is a function of the observed variables: from SMS_1 to SMS_8.

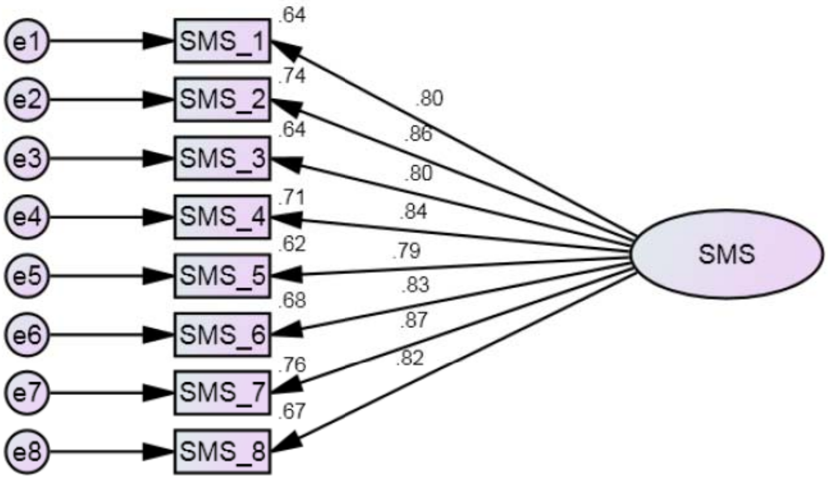


Figure 6.6 Latent variables for safety management system (Model 1)

Table 6.25 shows that the eight observed variables were significant in the latent variable. The table displays unstandardised regression coefficients and factor loadings in the **estimates** column, standard errors in the **S.E.** column, *t-values* in the **C.R**. column (C.R. stands for Critical Ratio), and *p-values* in the **P** column for statistical significance. In the **P** column p=*** simply means that the *p-value* is close to zero.

Table 6.25 Regression weights

			Estimate	S.E.	C.R.	P	Label
SMS_3	<---	SMS	1.000				
SMS_2	<---	SMS	1.038	.053	19.677	***	par_1
SMS_1	<---	SMS	1.010	.057	17.718	***	par_2
SMS_4	<---	SMS	1.023	.053	19.148	***	par_3
SMS_5	<---	SMS	.991	.057	17.473	***	par_4
SMS_6	<---	SMS	.965	.052	18.567	***	par_5
SMS_7	<---	SMS	1.125	.056	20.032	***	par_6
SMS_8	<---	SMS	1.015	.055	18.418	***	par_7

Table 6.26 shows the regression weights. The standardised regression weights in the **estimates** column represent the standardised regression coefficients and factor loadings. The low loading is SMS_5 (hazard identification) with 0.789.

Table 6.26 Standardised regression weights

			Estimate
SMS_3	<---	SMS	.799
SMS_2	<---	SMS	.860
SMS_1	<---	SMS	.797
SMS_4	<---	SMS	.843
SMS_5	<---	SMS	.789
SMS_6	<---	SMS	.825
SMS_7	<---	SMS	.871
SMS_8	<---	SMS	.820

Model output of the one factor model – Safety management system. Table 6.27 shows the output of the one-factor model of organisation safety attitude. The original Model 1 with eight items did not fit the data well, with most goodness-of-fit indices failing to meet an acceptable level. In Models 2 and 3, after removing three items – (SMS_1), (SMS_2), and (SMS_4) – the model improved, apart from p-value, GFI, TLI, CFI, RMSEA, and PCLOSE values. With the removal of the item (SMS_7) the model achieved a good fit, satisfying all goodness-of-fit criteria (see Model 4, Table 6.27). The Chi-square test shows that the p-value was equal to (p = 0.709), which means that the X^2 is not significant. The data fit well to the model GFI = 0.999, TLI = 1.005, CFI = 1.00, RMSEA = 0.00, and PCLOSE = 0.870.

Table 6.27 The goodness-of-fit statistics of the measurement models of OSA

Goodness-of-fit index	Recommended level	Measures			
		Model 1 (8 items)	***Model 2*** (6 items)	***Model 3*** (5 items)	***Model 4*** (4 items)
Chi-Square fit index (X^2)	$p > 0.05$	p = 0.000	p = 0.000	p = 0.002	p = 0.709
Bollen-Stine bootstrap p	$p > 0.05$	p = 0.000	p = 0.002	p = 0.087	p = 0.849
Goodness-of-fit-index (GFI)	> 0.90	0.906	0.950	0.981	0.999
The Tucker-Lewis index (TLI)	> 0.95	0.928	0.949	0.978	1.005
Comparative fit index (CFI)	> 0.90	0.949	0.969	0.989	1.000
RMSEA	Close to 0 perfect fit <0.05 >0.05 and <.008	0.131	0.124	0.087	0.000
PCLOSE	>0.05	0.000	0.000	0.055	0.870

Model re-specification. The safety management system scales were adopted from Ferraro (2002), Filho *et al.* (2010), MCA (1999), Mohamed (2002), and Parker *et al.* (2006). The original model of four items (see Model 1, Table 6.27) did not meet all of the fit indices. Model 4 was fit after inspecting the standard residual covariance matrix and modification indices for regression weights, which revealed that the items (SMS_1), (SMS_2), (SMS_4), and (SMS_7) were cross-loading with a number of other items in the model; therefore, these items were eliminated from the model and not considered in the analysis. Table 6.27 shows that Model 4 with the one-factor model of safety management system fit well.

6.5.4 One factor model – Safety performance

Safety performance as a latent variable was measured by a four variables, namely, inspection, investigation, training, and motivation. (Table 6.28 shows these variables with their codes).

Table 6.28 Safety performance's variables with their codes

Latent variable	Code	Variables	Code
Safety performance	SP	inspection	SP1
		investigation	SP2
		training	SP3
		motivation	SP4

This latent variable relates to Question 11 of the survey, in which participants were asked to evaluate the safety performance of their organisations.

Specification of the one factor model – Safety performance. This one factor model included four indicator items. In order to analyse the significance of this factor, the variance of the latent variable was set to 1. Also, a Bollen-Stine bootstrap procedure with 2000 bootstrap samples was performed and the respective p-value provided. The outputs requested for this model were:

- standardised estimates
- squared multiple correlations
- sample moments
- implied moments
- all implied moments
- residual moments
- modification indices (threshold value = 4).

Figure 6.14 presents the model which shows the latent variable of safety performance. The model is a function of the observed variables: SP_1 (inspection), SP_2 (investigation), SP_3 (training), and SP_4 (motivation).

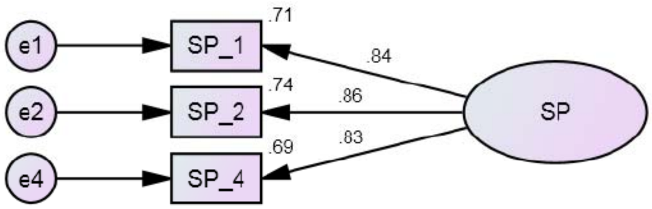


Figure 6.7 **Latent variables for safety performance (Model 2)**

Table 6.29 shows that the four observed variables were significant in the latent variable. The table displays unstandardised regression coefficients and factor loadings in the **estimates** column, standard errors in the **S.E.** column, *t-values* in the **C.R**. column (C.R. stands for Critical Ratio), and *p-values* in the **P** column for statistical significance. In the **P** column p=*** simply means that the *p-value* is close to zero.

Table 6.29 Regression weights

			Estimate	S.E.	C.R.	P	Label
SP_3	<---	SP	1.000				
SP_2	<---	SP	.930	.045	20.600	***	par_1
SP_1	<---	SP	.903	.045	20.087	***	par_2
SP_4	<---	SP	1.023	.044	23.424	***	par_3

Table 6.30 shows the regressions weights. The standardised regression weights in the **estimates** column represent the standardized regression coefficients and factor loadings. The low loading is SP_1 (inspection) with 0.81.

Table 6.30 Standardised regression weights

			Estimate
SP_3	<---	SP	.881
SP_2	<---	SP	.822
SP_1	<---	SP	.810
SP_4	<---	SP	.887

Model output of the one factor model – safety performance. Table 6.31 shows the output of the one-factor model of safety performance. The original Model 1 with four items did not fit the data well, with most goodness-of-fit indices failing to meet an acceptable level. In Model 2, after removing one item (SP_3), the model achieved a good fit and satisfied all goodness-of-fit criteria (Model 2, Table 6.31). The Bollen-Stine bootstrap test shows that the p-value was equal to (p = 0.562), which means that the *p* is not significant. The data fit well to the model GFI = 0.999, TLI = 1.003, CFI = 1.00, RMSEA = 0.00, and PCLOSE = 0.709.

Table 6.31 The goodness-of-fit statistics of the measurement models

Goodness-of-fit index	Recommended level	Measures	
		Model 1 (4 items)	*Model 2 (3 items)*
Bollen-Stine bootstrap p	*p* > 0.05	p = 0.001	p = 0.562
Goodness-of-fit-index (GFI)	> 0.90	0.965	0.999
The Tucker-Lewis index (TLI)	> 0.95	0.932	1.003
Comparative fit index (CFI)	> 0.90	0.977	1.000
RMSEA	Close to 0 perfect fit <0.05 >0.05 and <.008	0.178	0.000
PCLOSE	>0.05	0.000	0.709

Model re-specification. The safety performance measure was adapted from Wu, T-C *et al.* (2009). The original model of four items (see Model 1, Table 6.31) did not meet all of the fit indices. Model 2 has been fit after inspecting the standard residual covariance matrix and modification indices for regression weights, which revealed that the item SP_3 was cross-loading with a number of other items in the model; therefore, this item was eliminated from the model. Table 6.31 shows that Model 2 with a one-factor model of safety performance fit well.

6.6 Cross validation model for the seven latent variables

In the previous section of the chapter, the analysis of seven one-factor models was described for the constructs of safety performance, organisation safety attitudes, management safety practices, safety management system, stakeholder participants, safety enforcement, and safety influence. The purpose was to assess whether the items' indicators were significant in the creation of the latent variables.

In this part of the chapter the model cross validation is described. The cross validation was conducted after re-specifying the seven one-factor models previously explained. The safety performance one-factor model had three items; the organisation safety attitude one-factor model had four items; the safety management system one-factor model had three items, the management safety practices one-factor model had five items, the primary stakeholders one-factor model had three items, the safety influence one-factor model also had three items, and lastly, the safety enforcement one-factor model had two items.

6.6.1 Specification of the seven-factor model

This seven-factor model included 22 indicator items. In order to analyse the significance of this factor the Bollen-Stine bootstrap procedure with 2000 bootstrap samples was performed and the respective p-value provided. The outputs requested for this model were:

- standardised estimates
- squared multiple correlations
- sample moments
- implied moments
- all implied moments
- residual moments
- modification indices (threshold value = 4).

Figure 6.8 shows the correlation between exogenous constructs. This is a typical relationship that it is used in the SEM where some degree of association is expected between the exogenous constructs.

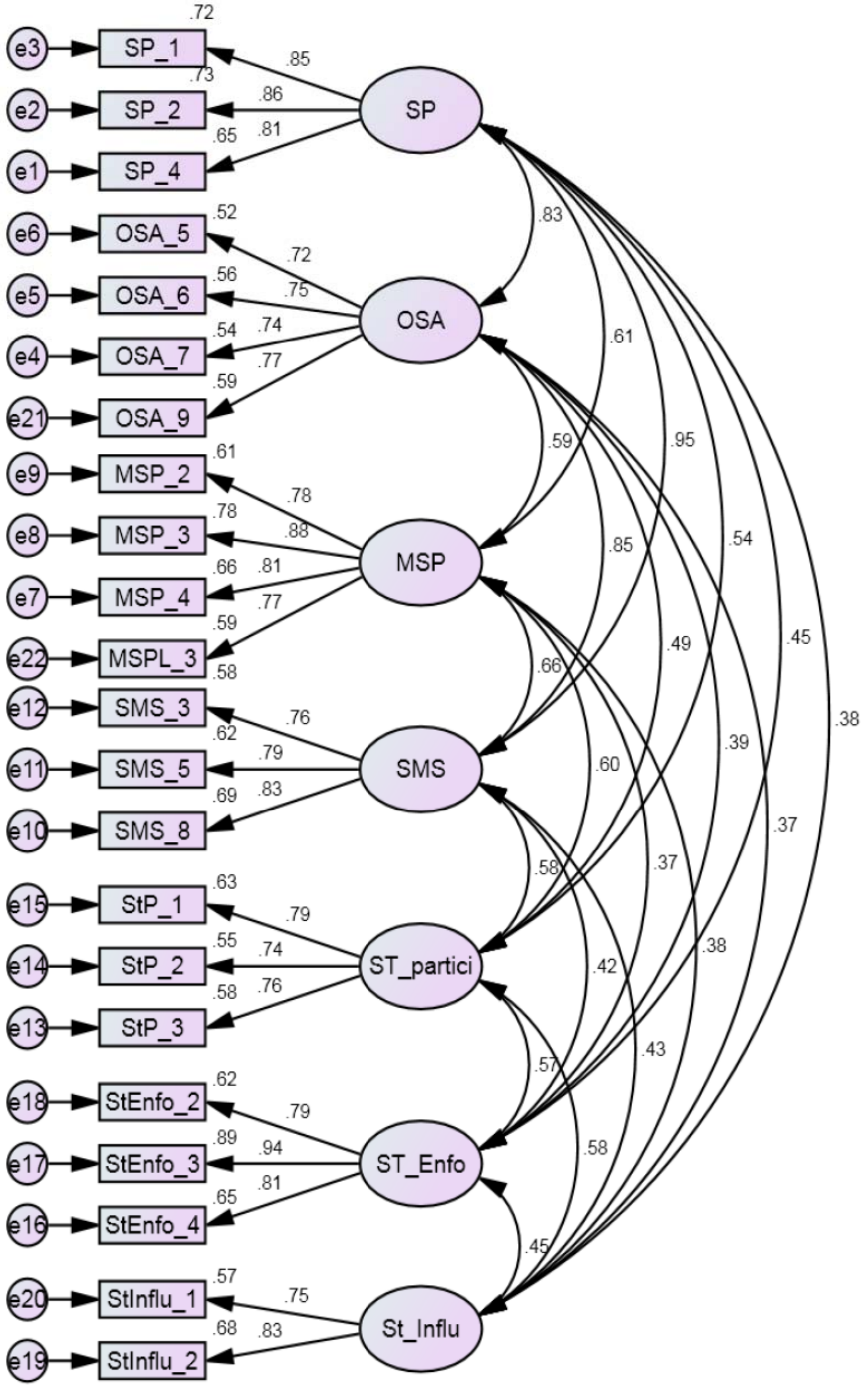


Figure 6.8 **Cross validation for the seven-factor model**

Table 6.32 presents the regression weights which refer to the unstandardized parameter estimates for the factor loadings, where not critical ratios (CR) or t-values are stated. All the factor loadings remaining were significant.

Table 6.32 Regression weights

			Estimate	S.E.	C.R.	P	Label
SP_4	<---	SP	1.000				
SP_2	<---	SP	1.075	.043	25.130	***	par_1
SP_1	<---	SP	1.047	.043	24.493	***	par_2
OSA_7	<---	OSA	1.000				
OSA_6	<---	OSA	.958	.054	17.777	***	par_3
OSA_5	<---	OSA	.842	.050	16.861	***	par_4
MSP_4	<---	MSP	1.000				
MSP_3	<---	MSP	1.128	.045	24.791	***	par_5
MSP_2	<---	MSP	1.007	.051	19.806	***	par_6
SMS_8	<---	SMS	1.000				
SMS_5	<---	SMS	.961	.046	21.034	***	par_7
SMS_3	<---	SMS	.927	.047	19.693	***	par_8
StP_3	<---	ST_partici	1.000				
StP_2	<---	ST_partici	.941	.056	16.800	***	par_9
StP_1	<---	ST_partici	1.061	.058	18.444	***	par_10
StEnfo_4	<---	ST_Enfo	1.000				
StEnfo_3	<---	ST_Enfo	1.210	.045	26.864	***	par_11
StEnfo_2	<---	ST_Enfo	1.083	.054	19.896	***	par_12
StInflu_2	<---	St_Influ	.949	.062	15.325	***	par_13
StInflu_1	<---	St_Influ	1.000				
OSA_9	<---	OSA	.872	.046	18.786	***	par_14
MSPL_3	<---	MSP	1.001	.052	19.147	***	par_15

Table 6.33 shows the standardised regression weights where the factor loadings range from a low of 0.722 for rules and regulations (OSA_5); and a higher of 0.941, for the Ministry of Labour (StEnfo_3).

Table 6.33 Standardised regression weights

			Estimate
SP_4	<---	SP	.808
SP_2	<---	SP	.856
SP_1	<---	SP	.847
OSA_7	<---	OSA	.735
OSA_6	<---	OSA	.746
OSA_5	<---	OSA	.722
MSP_4	<---	MSP	.814
MSP_3	<---	MSP	.881
MSP_2	<---	MSP	.784
SMS_8	<---	SMS	.833
SMS_5	<---	SMS	.787
SMS_3	<---	SMS	.761
StP_3	<---	ST_partici	.759
StP_2	<---	ST_partici	.744
StP_1	<---	ST_partici	.792
StEnfo_4	<---	ST_Enfo	.806
StEnfo_3	<---	ST_Enfo	.941
StEnfo_2	<---	ST_Enfo	.785
StInflu_2	<---	St_Influ	.826
StInflu_1	<---	St_Influ	.753
OSA_9	<---	OSA	.771
MSPL_3	<---	MSP	.769

Table 6.34 shows the correlations between the seven latent variables where the higher value is between the safety management system and safety performance.

Table 6.34 Correlations

			Estimate
SP	<-->	OSA	.826
SP	<-->	MSP	.609
SP	<-->	SMS	.950
SP	<-->	ST_partici	.536
SP	<-->	ST_Enfo	.451
SP	<-->	St_Influ	.384
OSA	<-->	MSP	.589
OSA	<-->	SMS	.846
OSA	<-->	ST_partici	.492
OSA	<-->	ST_Enfo	.394
OSA	<-->	St_Influ	.367
MSP	<-->	SMS	.658
MSP	<-->	ST_partici	.601
MSP	<-->	ST_Enfo	.371
MSP	<-->	St_Influ	.383
SMS	<-->	ST_partici	.583
SMS	<-->	ST_Enfo	.418
SMS	<-->	St_Influ	.425
ST_partici	<-->	ST_Enfo	.566
ST_partici	<-->	St_Influ	.584
ST_Enfo	<-->	St_Influ	.453

6.6.2 Model output of the five-factor model

Table 6.35 shows the output of the seven-factor model of the all latent variables. The model with 22 items fits correctly. The model achieved a good fit, satisfying all goodness-of-fit criteria (see Model 1, Table 6.35). The Chi-square test shows that X^2 is equal to 208.37 (p = 0.065 not significant). The data fit well to the model GFI = 0.945, TLI = 0.977, CFI = 0.982, RMSEA = 0.042, and PCLOSE = 0.916.

Table 6.35 The goodness-of-fit statistics of the measurement model

Goodness-of-fit index	Recommended level	Measures
		Model 1 (22 items)
Chi-Square fit index (X^2)	$p > 0.05$	p = 0.000
Bollen-Stine bootstrap p	$p > 0.05$	p = 0.080
Goodness-of-Fit-Index (GFI)	> 0.90	0.927
The Tucker-Lewis Index (TLI)	> 0.95	0.962
Comparative Fit Index (CFI)	> 0.90	0.968
RMSEA	Close to 0 perfect fit <0.05 >0.05 and <.008	0.045
PCLOSE	>0.05	0.829

6.6.3 Model re-specification

Table 6.35 shows that the Model 1 with the five-factor model of all constructs fit well. The model 1 has been improved after inspecting the standard residual covariance matrix and modification indices for regression weights, which revealed that the items (SMS-6) and (MSP-6), (MSP-1), (OSA-1), (OSA-8) and (StInflu_3) were cross-loading with a number of other items in the model, and also it was considerably lower when compared with the others. Therefore, this item was eliminated from the model.

6.7 Validation measure

As explained before, validity measures the internal consistency of the indicators; it deals with measurement accuracy and concerns the extent to which the measured the items reflect the hypothesised latent variable (Hair & Anderson 2010; Kline 2011). More reliable measurement could provide more confidence that the indicators are consistent all together.

6.7.1 Convergent validity

When observed variables are measuring hypothesised constructs which converge, or share a high proportion of variance in common, convergent validity is achieved (Hair & Anderson 2010). In this study, the convergent validity was considered via factor loading, critical ratios, and construct reliability as explained below:

Factor loading. According to Holmes-Smith (2013) when the factor loading is significantly different from zero, the estimated coefficient does not need to be greater than 0.70 to achieve convergent validity. Therefore, factor loadings are statistically significant because they achieve the minimum requirement. Table 6.36 Shows the factor loading for all latent variables, which range from 0.722 to 0.941.

Critical ratios. In order to achieve convergent validity, Schumacker and Lomax (2012) suggest that the critical ratios exceed +1.96. Along with CFA models the critical ratios (CR) were produced by AMOS. All the CR values achieved the requirements of +1.96, therefore convergent validity was achieved. (See the CR values in Table 6.36)

Construct reliability. Construct reliability, also known as composite reliability, is a measure that reflects the internal consistency of the latent variables. CR is calculated from the squared sum of factor loading for each construct and the sum of error variance terms for a construct (Hair & Anderson 2010). Therefore, the construct should be highly correlated to show that they consistently represent the same latent construct. According to Hair and Anderson (2010), a construct reliability estimate of 0.7 or higher suggests good reliability, and reliability between 0.6 and 0.7 may be acceptable, provided that other indicators of the model's construct validity are good.

Fornell and Larcker (1981) proposed the following formula to calculate construct reliability:

$$\rho_\eta = (\Sigma\lambda i)^2 / (\Sigma\lambda i)^2 + \Sigma\varepsilon i$$

ρ_η is the construct reliability value;

λ is the standardized factor loading

i is the number of items

ε is the error variance terms

The ρ_η values shown in Table 6.36 and all constructs achieved the prescribed minimum requirement, ranging from 0.745 to 0.889. Therefore, the constructs used in this research achieved a good level of convergent validity.

Table 6.36 Reliability checks for all constructs

Latent Variable	Items	Loading	t- Values	a	ρ_n
SP	SP_4	.808		0.91	0.882
	SP_2	.856	25.130		
	SP_1	.847	24.493		
OSA	OSA_7	.735		0.89	0.818
	OSA_6	.746	17.777		
	OSA_5	.722	16.861		
	OSA_9	.771	18.786		
SMS	SMS_8	.833		0.95	0.837
	SMS_5	.787	21.034		
	SMS_3	.761	19.693		
MSP	MSP_4	.814		0.91	0.889
	MSP_3	.881	24.791		
	MSP_2	.784	19.806		
	MSPL_3	.769	19.147		
ST_partici	StP_3	.759		0.77	0.770
	StP_2	.744	16.800		
	StP_1	.792	18.444		
ST_Enfo	StEnfo_4	.806		0.76	0.883
	StEnfo_3	.941	16.800		
	StEnfo_2	.785	18.444		
St_Influ	StInflu_1	.753		0.92	0.745
	StInflu_2	.826	15.325		

6.7.2 Construct validity

Construct validity measures whether there is a good representation of the variables that were intended to be measured. For a one-factor congeneric measurement model to be acceptable, the indicator variables must all be valid measures of the one latent construct. In this regard, the SEM 'goodness-of-fit' measures provide insight into construct validity and can be viewed as confirming the construct validity. When they are within the relevant range, the construct validity can be confirmed (Holmes-Smith 2013).

As shown in Tables 6.7 to 6.35, all one-factor congeneric measurement models were accepted according to their goodness-of-fit measures. Therefore, construct validity was achieved.

6.7.3 Discriminant validity

Discriminant validity is the extent to which constructs are actually distinct from one another (Hair & Anderson 2010). A discriminant validity test was performed. Based on the procedure suggested by Bagozzi *et al.* (1991), the nested model method was chosen, because it is more rigorous and widely accepted (Holmes-Smith 2013). Models were constructed for all possible pairs of latent constructs and run on each selected pair by fixing the correlation between two constructs at 1.0. For the seven constructs, a total of 20 different discriminant validity checks was conducted (Table 6.37). It was found that constraining the correlation to 1.00 significantly worsened the model. As result, it was concluded that the two constructs were different, and this result provided strong evidence of discriminant validity among the theoretical constructs.

Table 6.37 χ^2 Difference tests for assessing discriminant validity

Unobserved structural path constructs	Unconstrained		Constrained		χ^2
	χ^2	*df*	χ^2	*df*	Difference
SP →OSA	28.161	15	115.563	16	87.402
SP →MSP	22.237	15	415.112	16	392.875
SP →SMS	18.085	10	30.293	11	12.208
SP →ST_Practice	27.758	10	262.976	11	235.218
SP →ST_Enforcement	34.392	10	565.009	11	530.617
SP →ST_Influence	10.360	6	237.560	7	227.20
OSA→MSP	46.556	21	369.216	22	322.66
OSA→SMS	20.285	15	77.464	16	57.179
OSA→ST_Practice	32.223	15	262.941	16	230.718
OSA→ST_Enforcement	23.904	15	501.803	16	477.899
OSA→ST_Influence	12.151	10	215.31	11	203.159
MSP →SMS	29.93	15	277.674	16	247.744
MSP →ST_Practice	35.917	15	255.786	16	219.869
MSP →ST_Enforcement	8.987	15	644.717	16	635.73
SMS →ST_Practice	28.228	10	220.51	11	192.282
SMS →ST_Enforcement	19.236	10	451.63	11	432.394
SMS →ST_Influence	13.423	6	212.357	7	198.934
ST_Practice →ST_Enforcement	43.481	10	255.454	11	211.973
ST_Practice →ST_Influence	22.029	6	141.446	7	119.417
ST_Enforcement →ST_Influence	9.009	6	202.845	7	193.836

6.7.4 Invariance testing

Configural and invariance testing help to validate the factor structure and loadings, proving that they are sufficiently equivalent across groups. A Chi-square difference test allows for determining whether the values of model parameters vary across groups (Diamantopoulos & Siguaw 2000; Kline 2011). Invariance testing involves the estimation and comparison of three models (small, medium, and large organisations). To test, there must first be the development of a baseline model (as an unconstrained model) in order obtain a configural invariance test and find out whether the factor structure represented in the model achieves adequate fit when all three groups are tested together as an unconstrained model.

Secondly, structural regression weights are then constrained (as a constrained model) where the factor loadings and covariances between the factors are set equal across the groups. Finally, residuals are constrained and the model re-estimated.

Results related to the configural invariance testing revealed the $\chi 2$ value to be 1163.42 with 792 degrees of freedom fit (p= 0.268 [$p > 0.05$] insignificant). The CFI and RMSEA values, as expected, were 0.927 and 0.035, respectively. Therefore, according to Byrne (2010) the model achieved configural invariance across all groups.

Having established goodness-of-fit for the configural model, the researcher can proceed with testing for the invariance of factorial measurement and structure across groups (Byrne 2010). For metric invariance testing, a Chi-square difference test between the baseline model and the constrained models is performed in order to determine whether p-value is significant or not. If the p-value for the Chi-square difference test is not significant, then there is invariance between the three groups, and the models are the same for all groups.

Using a significance level of 0.05, Table 6.38 shows the non-significant p-value for both constrained models. Therefore, metric invariance was established across the three groups, and on this basis, it can be assumed that the model replicates well across the three groups.

Table 6.38 Invariance test results

Overall Model		Chi-square	df	Difference		p-Value	Invariant?
				Chi-square	df		
X^2	Baseline Model	1163.42	792				
X^2	Constrained Model	1203.093	837	39.673	45	0.696	YES
X^2	Structural Residuals	1240.639	867	77.219	75	0.408	YES
	Number of groups		4				

Conclusion: The X^2 *difference p value is non-significant; Therefore metric invariance is established.*

6.8 Summary

This chapter provides details of the research results for the analyses that are associated with the full structural model (see next chapter). The results were presented in two sections. Initial data analysis involved a number of different procedures, which included statistical methods of the handling of missing data, the normality test, the outliers test, and the reliability test. The second section included advanced data analyses undertaken by using a structural equation modelling package, *AMOS*, which included examining individual measurement models by using a confirmatory factor analysis for each of the constructs, along with the Chi-square and Bollen-Stine p statistics. In addition, discriminant analysis and invariance testing of four groups were undertaken. Given that these tests generally supported the measures used in this research, the structural model and hypothesis can now be examined.

Results, part 2

The chapter presents the results of the data analyses undertaken in this research that were associated with the full structural model. The *AMOS* program was primarily used to analyse the data by structural equation modelling. The full structural model is presented in this chapter, followed by a reduced model demonstrating how composites for the full structural model were developed by parcelling variable items. The reduced model formed the basis for undertaking tests of a group moderating variable that evaluated whether the relationships between variables differed for each group. Subsequently, the hypothesis is analysed, and the results are presented. Finally, although this research is mainly positivist, a qualitative approach has been used in a limited way in the finale as a form of validation of the main findings.

7.1 Full structural model

This section of the chapter combines the first part of the model (safety culture) with the second part of the model (stakeholder involvement).

7.1.1 Specification of the full structural model

This seven-factor model included 22 indicator items. In order to analyse the significance of this factor, the Bollen-Stine bootstrap procedure with 2000 bootstrap samples was performed and the respective p-value provided. The outputs requested for this model were:

- standardised estimates
- squared multiple correlations
- sample moments
- implied moments
- all implied moments
- residual moments
- modification indices (threshold value = 4)

7.1.2 Model output of the full structural model

Table 7.1 shows the output of the full structural model. The model with 20 items did not achieve a good fit (see Table 7.1). The Chi-square test shows that the X^2 equal to 348.758 and df 198 (p = 0.010 significant). But the other goodness-of-fit criteria were as expected: GFI = 0.927, TLI = 0.964, CFI = 0.969, RMSEA = 0.045, and PCLOSE = 0.875.

Table 7.1 The goodness-of-fit statistics of the measurement model

Goodness-of-fit index	Recommended level	Measures
		Full structural model (22 items)
Chi-square fit index (X^2)	$p > 0.05$	X^2 = 348.758 with 198 df and p = 0.0
Bollen-Stine bootstrap p	$p > 0.05$	p = 0.010
Goodness-of-fit-index (GFI)	> 0.90	0.927
The Tucker-Lewis index (TLI)	> 0.95	0.964
Comparative fit index (CFI)	> 0.90	0.969
RMSEA	Close to 0 perfect fit <0.05 >0.05 and <.008	0.045
PCLOSE	>0.05	0.875

Table 7.1 and Figure 7.1 show that the full structural model did not achieve good fit, which may be because of the large number of observed variables (Holmes-Smith 2013).

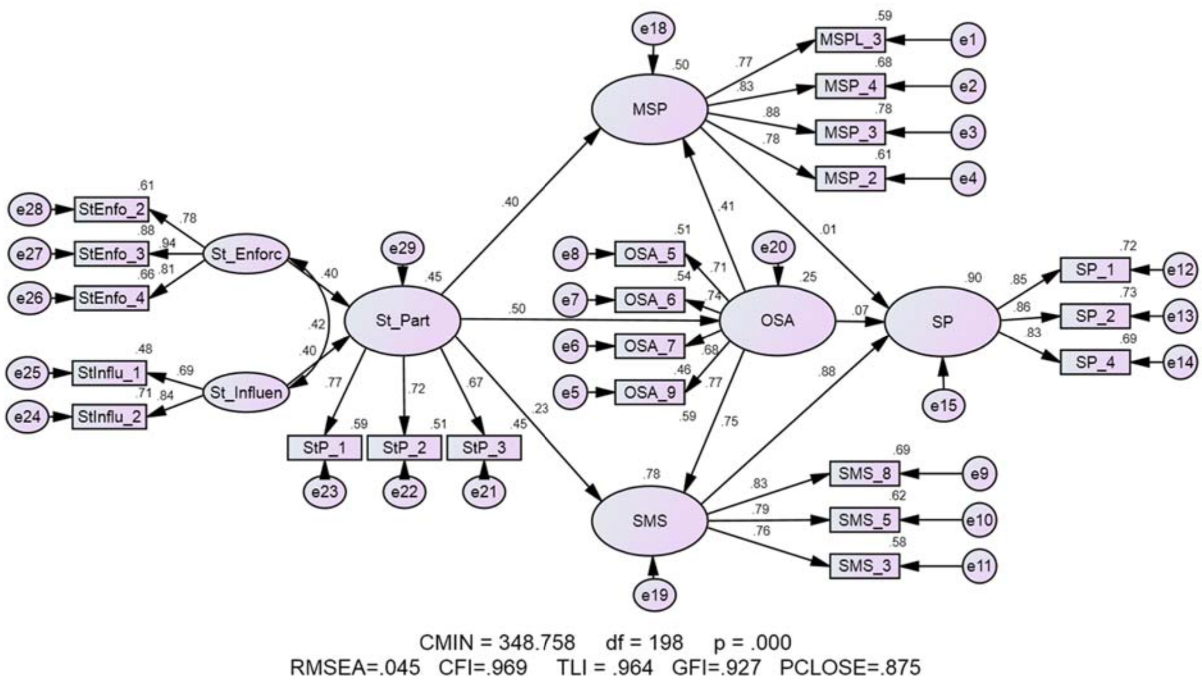


Figure 7.1 The full structural model

One approach to solving this problem is to apply a data reduction technique, such as developing a composite of the observed items of each latent construct. This method is useful when there are a large number of observed indicators and constructs. This makes it an appealing tool for dealing with similar issues (for example, see Bandalos 2002; Little *et al.* 2002). Therefore, the use of composite technique was considered. This involved refining the initial full structural model to include composites for each latent construct. The next section explains the development of the composites for the full structural model.

7.2 Developing composites for the full structural model

As explained in Chapter 5, on methodology, when there are a large number of latent variables and observed indicators, the number of parameters to be estimated is large, and fitting the resulting complex model is difficult (Holmes-Smith 2013). To overcome this dilemma, this research adopted the approach of Holmes-Smith and Rowe (1994). The following parameter estimates were required in the calculations for this approach of using the parameter estimates from one factor congeneric model analysis.

To ensure composite reliability, Hancock and Mueller's coefficient H should be used when the observed variables are weighted by the factor score regression coefficients, such as congeneric models (Holmes-Smith 2013). Coefficient H is given as follows:

$$H = \frac{1}{\left[1+\left[\dfrac{1}{\dfrac{\lambda_1^2}{1-\lambda_1^2}+\dfrac{\lambda_2^2}{1-\lambda_2^2}+\ldots+\dfrac{\lambda_n^2}{1-\lambda_n^2}}\right]\right]}$$

Where the λ's are the **standardised** factor loadings.

Calculate composite standard deviations by using the factor score regression coefficients.

After calculating coefficient H and composite standard deviations, they can be fed into the following formulae to create the composite factor loading and composite factor error variances for each construct.

Factor Loading: $\lambda = \sigma(\mathrm{x})\sqrt{\mathrm{r}}$

where **σ(x)** is the standard deviation of the composite variable, and **r** is the reliability of the composite variable.

Error Variance: $\theta = \sigma^2(x)(1\text{-}r)$

where **σ^2(x)** is the variance of the composite variable, and **r** is the reliability of the composite variable.

It is possible to build models by using these formulae, where each latent variable is measured by a single composite variable, and the composite scale variance, standard deviation and reliability are used to fix the composite variable factor loading and measurement error variance (Holmes-Smith 2013).

7.2.1 Safety culture composites

This section provides details of how the safety culture composites were calculated, which includes *safety performance, management safety practices, organisation safety attitude*, and *safety management system*.

Safety performance composites. Figure 7.2 represents the one-factor measurement model for the safety performance latent variable. The standardised regression weights from this model are used in the composite calculations.

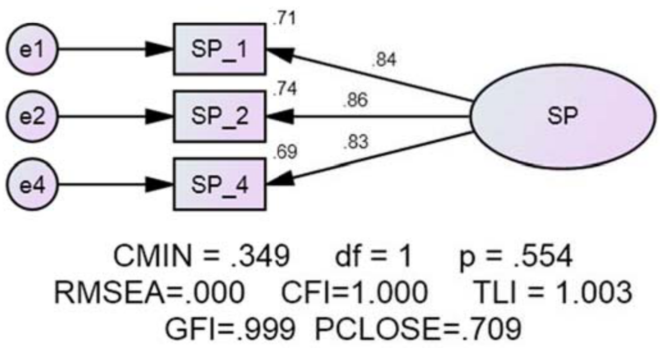


Figure 7.2 Safety performance one factor measurement model

Table 7.2 presents the worksheet used to calculate the coefficient H reliability used to calculate the composites for safety performance. Underneath this appears, for comparison purposes only, the Cronbach's alpha reliability which was not used in the calculations because the models were considered 'congeneric'. As can be seen, using coefficient H reliability is technically correct for a congeneric model; there is little difference between coefficient H (0.883) and Cronbach's alpha (0.882) reliabilities.

Table 7.2 Safety performance coefficient H and Cronbach's α calculations

Coefficient H using standardised regression weights		
Variables	λ	**Coefficient H**
SP_4	0.831	
SP_2	0.861	
SP_1	0.844	**0.883**

Cronbach's α using sample correlations				
	SP_1	**SP_2**	**SP_4**	**Cronbach's α**
SP_1	1			
SP_2	0.731	1		
SP_4	0.695	0.714	1	**0.882**

Using the factor score weights from the safety performance one-factor measurement model analysis, the 'rescaled' factor weights (that sum up) appear in Table 7.3 The factor score weights are rescaled so that the items that make up the composite are all measured on the same scale; thus, the composite will also have the same scale as its items.

Table 7.3 Rescaled factor score weightings for safety performance

	SP_1	**SP_2**	**SP_4**	**Total**
Factor score weights	0.290	0.324	0.254	0.868
Norm. factor weights	0.334	0.373	0.293	1.000

The rescaled factor score weights were then used to develop a weighted item composite in *SPSS*, so that the standard deviation of this composite can be calculated. This was then used in calculating the factor loading and error variance of the composite. The standard deviation for the safety performance latent variable composite is 1.14055.

Organisation safety attitude composites. Figure 7.3 represents the one-factor measurement model for the organisation safety attitude latent variable. The standardised regression weights from this model were used in the composite calculations.

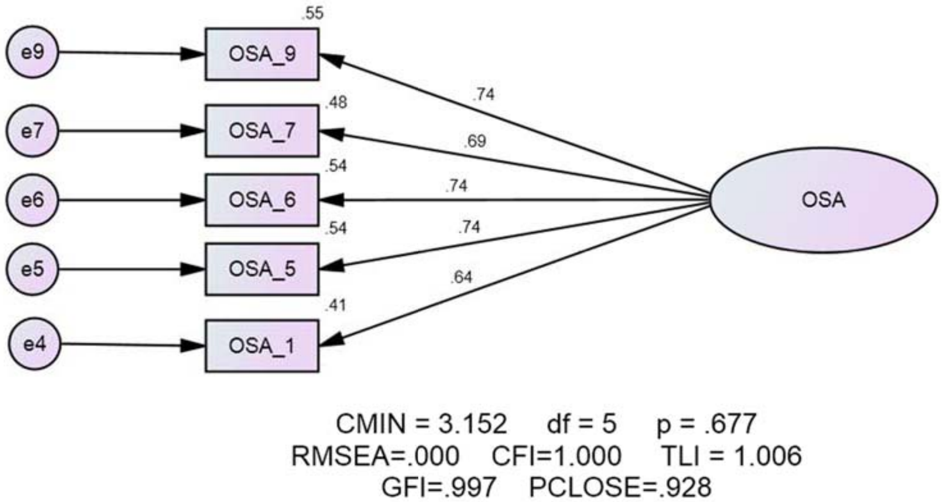


Figure 7.3 **Organisation safety attitude one factor measurement model**

Table 7.4 presents the worksheet used to calculate the coefficient H reliability used to calculate the composites for organisation safety attitude. Underneath this appears, for comparison purposes only, the Cronbach's alpha reliability, which was not used in the calculations because the models were considered 'congeneric'. As can be seen, using the coefficient H reliability is technically correct for a congeneric model; there is little difference between coefficient H (0.840) and Cronbach's alpha (0.835) reliabilities.

Table 7.4 **Organisation safety attitude coefficient H and Cronbach's α calculations**

Coefficient H using standardised regression weights		
Variables	**λ**	**Coefficient H**
OSA_7	0.695	
OSA_6	0.736	
OSA_5	0.738	
OSA_9	0.744	
OSA_1	0.638	**0.840**

Cronbach's α using sample correlations						
	OSA_1	**OSA_9**	**OSA_5**	**OSA_6**	**OSA_7**	**Cronbach's α**
OSA_1	1.000					
OSA_9	0.467	1.000				
OSA_5	0.453	0.557	1.000			
OSA_6	0.473	0.536	0.561	1.000		
OSA_7	0.469	0.526	0.495	0.502	1.000	**0.835**

Using the factor score weights from the organisation safety attitude one-factor measurement model analysis, the 'rescaled' factor weights (that sum up) appear in Table 7.5 The factor score weights were rescaled so that the items that make up the composite were all measured on the same scale; thus, the composite also had the same scale as its items.

Table 7.5 Rescaled factor score weightings for organisation safety attitude

	OSA_1	OSA_9	OSA_5	OSA_6	OSA_7	Total
Factor score weights	0.127	0.198	0.187	0.169	0.14	0.821
Norm. factor weights	0.155	0.240	0.228	0.206	0.171	1.000

The rescaled factor score weights were then used to develop a weighted item composite in *SPSS* so that the standard deviation of this composite could be calculated. This was then used in calculating the factor loading and error variance of the composite. The standard deviation for the organisation safety attitude latent variable composite is 0.9294.

Safety management system composites. Figure 7.4 represents the one-factor measurement model for the safety management system latent variable. The standardised regression weights from this model were used in the composite calculations.

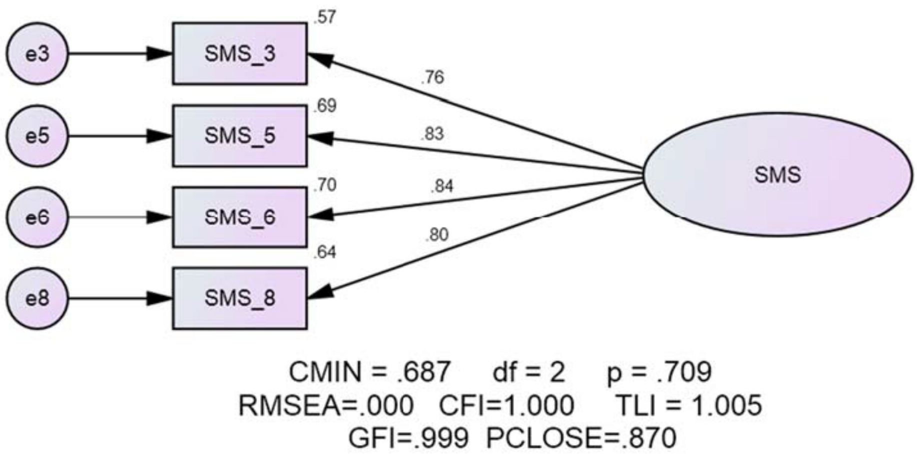


Figure 7.4 Safety management system one-factor measurement model

Table 7.6 presents the worksheet used to calculate the coefficient H reliability used to calculate the composites for the safety management system. Underneath this appears, for comparison purposes only, the Cronbach's alpha reliability which was not used in the calculations because the models were considered 'congeneric'. As can be seen, using coefficient H, reliability is technically correct for a congeneric model, that is, there is little difference between coefficient H (0.885) and Cronbach's alpha (0.881) reliabilities.

Table 7.6 Safety management system coefficient H and Cronbach's α calculations

Coefficient H using standardised regression weights		
Variables	**λ**	**Coefficient H**
SMS_3	0.755	
SMS_5	0.829	
SMS_6	0.838	
SMS_8	**0.801**	**0.885**

Cronbach's α using sample correlations					
	SMS_8	**SMS_6**	**SMS_5**	**SMS_3**	**Cronbach's α**
SMS_8	1.000				
SMS_6	0.665	1.000			
SMS_5	0.671	0.694	1.000		
SMS_3	0.604	0.641	0.618	1.000	0.881

Using the factor score weights from the safety management system one-factor measurement model analysis, the 'rescaled' factor weights (that sum up) appear in Table 7.7. The factor score weights were rescaled so that the items that made up the composite were all measured on the same scale; thus, the composite also had the same scale as its items.

Table 7.7 Rescaled factor score weightings for safety management system

	SMS_8	**SMS_6**	**SMS_5**	**SMS_3**	**Total**
Factor score weights	0.196	0.263	0.23	0.153	0.842
Norm. factor weights	0.233	0.312	0.273	0.182	1.000

The rescaled factor score weights were then used to develop a weighted item composite in *SPSS* so that the standard deviation of this composite could be calculated. This was then used in calculating the factor loading and error variance of the composite. The standard deviation for the safety management system latent variable composite is 1.0287.

Management safety practices composites. Figure 7.5 represents the one-factor measurement model for the management safety practice latent variable. The standardised regression weights from this model are used in the composite calculations.

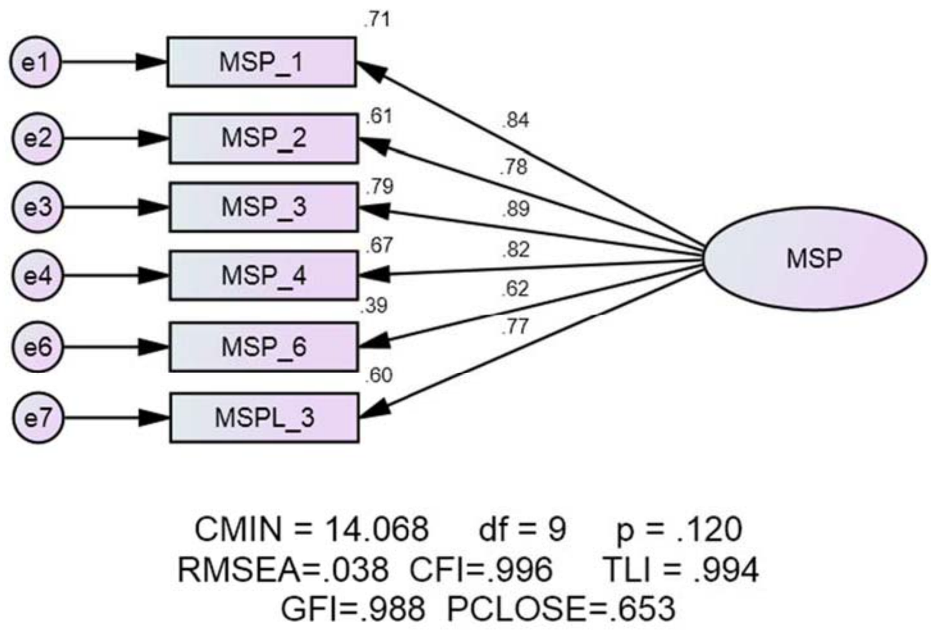


Figure 7.5 Management safety practice one-factor measurement model

Table 7.8 presents the worksheet used to calculate the coefficient H reliability that was used to calculate the composites for management safety practice. Underneath this appears, for comparison purposes only, the Cronbach's alpha reliability which was not used in the calculations because the models were considered 'congeneric'. As can be seen, using coefficient H reliability is technically correct for a congeneric model; there is little difference between coefficient H (0.923) and Cronbach's alpha (0.907) reliabilities.

Table 7.8 Management safety practice coefficient H and Cronbach's α calculations

Coefficient H using standardised regression weights		
Variables	λ	**Coefficient H**
MSP_3	0.890	
MSP_2	0.780	
MSP_4	0.818	
MSP_6	0.621	
MSP_1	0.841	
MSPL_3	0.773	**0.923**

Cronbach's α using sample correlations							
	MSPL_3	**MSP_1**	**MSP_6**	**MSP_4**	**MSP_2**	**MSP_3**	**Cronbach's α**
MSPL_3	1						
MSP_1	0.664	1					
MSP_6	0.486	0.526	1				
MSP_4	0.621	0.665	0.540	1			
MSP_2	0.626	0.675	0.441	0.626	1		
MSP_3	0.674	0.747	0.549	0.748	0.69	1	**0.907**

Using the factor score weights from the management safety practices one-factor measurement model analysis, the 'rescaled' factor weights (that sum up) appear in Table 7.9 The factor score weights were rescaled so that the items that made up the composite were all measured on the same scale; thus, the composite was also the same scale as its items.

Table 7.9 Rescaled factor score weightings for management safety practices

	MSPL_3	**MSP_1**	**MSP_6**	**MSP_4**	**MSP_2**	**MSP_3**	**Total**
Factor score weights	0.130	0.205	0.069	0.174	0.137	0.296	1.011
Norm. factor weights	0.129	0.203	0.068	0.172	0.136	0.292	1.000

The rescaled factor score weights were then used to develop a weighted item composite in *SPSS*, so that the standard deviation of this composite could be calculated. This was then used in calculating the factor loading and error variance of the composite. The standard deviation for the management safety practice latent variable composite is 1.0892.

7.2.2 Stakeholder involvement composites

This sub-section provides details of how the stakeholder involvement composites were calculated, which includes the primary stakeholder and safety enforcement latent variables. The safety influence latent variables are not included with this composite process, because they have less than three observed variables.

Stakeholder participant (primary stakeholders) composites. Figure 7.6 represents the one-factor measurement model for the primary stakeholder latent variable. The standardised regression weights from this model were used in the composite calculations.

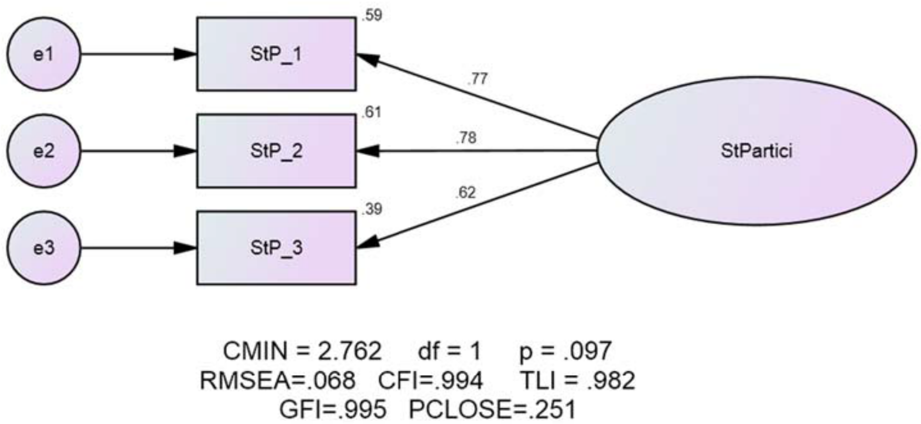


Figure 7.6 Primary stakeholder one-factor measurement model

Table 7.10 presents the worksheet used to calculate the coefficient H reliability that was used to calculate the composites for the primary stakeholders. Underneath this appears, for comparison purposes only, the Cronbach's alpha reliability which was not used in the calculations, because the models were considered 'congeneric'. As can be seen, using coefficient H reliability is technically correct for a congeneric model; there is little difference between the coefficient H (0.782) and Cronbach's alpha (0.764) reliabilities.

Table 7.10 The primary stakeholders coefficient H and Cronbach's α calculations

Coefficient H using standardised regression weights		
Variables	**λ**	**Coefficient H**
StP_3	0.621	
StP_2	0.778	
StP_1	0.767	**0.782**

Cronbach's α using sample correlations				
	StP_1	**StP_2**	**StP_3**	**Cronbach's α**
StP_1	1			
StP_2	0.598	1		
StP_3	0.506	0.454	1	**0.764**

Using the factor score weights from the primary stakeholders one-factor measurement model analysis, the 'rescaled' factor weights (that sum up) appear in Table 7.11 The factor score weights are rescaled so that the items that make up the composite are all measured on the same scale; thus, the composite will also have the same scale as its items.

Table 7.11 Rescaled factor score weightings for primary stakeholders

	StP_1	**StP_2**	**StP_3**	**Total**
Factor score weights	0.311	0.334	0.181	0.826
Norm. factor weights	0.377	0.404	0.219	1.000

The rescaled factor score weights were then used to develop a weighted item composite in *SPSS*, so that the standard deviation of this composite could be calculated. This was then used in calculating the factor loading and error variance of the composite. The standard deviation for the primary stakeholder latent variable composite is 1.0365.

Safety enforcement composites. Figure 7.7 represents the one-factor measurement model for the safety enforcement latent variable. The standardised regression weights from this model were used in the composite calculations.

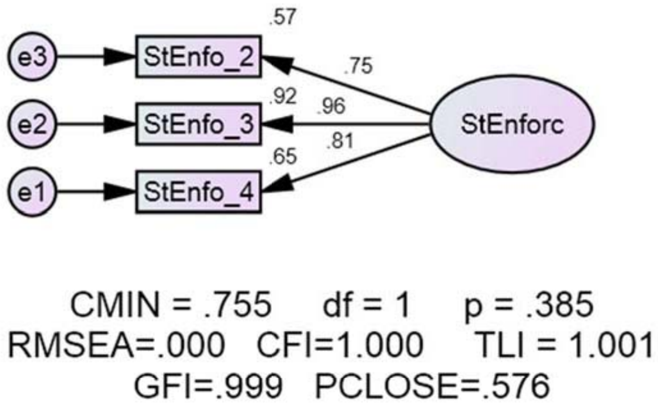


Figure 7.7 **Safety enforcement one-factor measurement model**

Table 7.12 presents the worksheet used to calculate the coefficient H reliability that was used to calculate the composites for the safety enforcement latent variable. Underneath this appears, for comparison purposes only, the Cronbach's alpha reliability, which was not used in the calculations, because the models were considered 'congeneric'. As can be seen, using coefficient H reliability was technically correct for a congeneric model; there was little difference between the coefficient H (0.782) and Cronbach's alpha (0.764) reliabilities.

Table 7.12 Safety enforcement coefficient H and Cronbach's α calculations

Coefficient H using standardised regression weights		
Variables	λ	**Coefficient H**
StEnfo_4	0.807	
StEnfo_3	0.960	
StEnfo_2	0.753	0.937

Cronbach's α using sample correlations				
	StEnfo_2	**StEnfo_3**	**StEnfo_4**	**Cronbach's α**
StEnfo_2	1			
StEnfo_3	0.734	1		
StEnfo_4	0.611	0.767	1	**0.877**

Using the factor score weights from the safety enforcement one-factor measurement model analysis, the 'rescaled' factor weights (that sum up) appear in Table 7.13 The factor score weights were rescaled so that the items that make up the composite were all measured on the same scale; thus, the composite also had the same scale as its items.

Table 7.13 Rescaled factor score weightings for safety enforcement

	StEnfo_2	StEnfo_3	StEnfo_4	Total
Factor score weights	0.100	0.736	0.142	0.978
Norm. factor weights	0.102	0.753	0.145	1.000

The rescaled factor score weights were then used to develop a weighted item composite in *SPSS*, so that the standard deviation of this composite can be calculated. This will then be used in calculating the factor loading and error variance of the composite. The standard deviation for the safety enforcement latent variable composite is 1.2135.

7.3 Full composite model

Based on the calculations above, the following sections present the refined full composite model for safety culture and stakeholder involvement. Table 7.14 presents the factor loadings and error variances that are used in the full composite model to form the latent variables. These were derived from the calculations reported in the previous section.

Table 7.14 Computing factor loadings and error variances for the composite variables

Name of Latent Variable	Stdev of Composite (s_x)	Reliability of Composite (r_x)	Factor Loading (λ) (s_x*$\sqrt{r_x}$)	Error Variance (θ) (s_x^2 [1-r_x])
primary stakeholder	1.0365	0.7820	0.9166	0.2342
safety enforcement	1.2135	0.9370	1.1747	0.0928
organisation safety attitude	0.9294	0.8400	0.8518	0.1382
management safety practices	1.0892	0.9230	1.0464	0.0913
safety management system	1.0287	0.8850	0.9677	0.1217
safety performance	1.1406	0.8830	1.0718	0.1522

These factor loading and error variances were manually inserted into the model of the composite variables and their error terms; Table 7.15 presents the model fit statistics for the composite model.

Table 7.15 The goodness-of-fit statistics of the measurement model

Goodness-of-fit index	*Recommended level*	*Measures*
		Model 1
Bollen-Stine bootstrap p	*p* > 0.05	p = 0.060
Goodness-of-fit-index (GFI)	> 0.90	0.982
The Tucker-Lewis index (TLI)	> 0.95	0.983
Comparative fit index (CFI)	> 0.90	0.991
RMSEA	Close to 0 perfect fit <0.05 >0.05 and <.008	0.047
PCLOSE	>0.05	0.525

Figure 7.8 presents the full structural model for safety culture and stakeholder involvement replaced with a composite for each latent variable. This model shows the extent to which the primary stakeholder (ST_PARTC) significantly and positively influences organisation safety attitudes (OSA), safety management system (SMS), and management safety practices (MSP). Although safety management system (SMS) and the factor organisation safety attitudes (OSA) had a significant positive influence on safety performance (SP), management safety practices (MSP) were found to have no significant effect on safety performance (SP).

The latent constructs – safety enforcement (ST_ENFO), influence (ST_ INFL) and primary stakeholder (ST_PARTC) – were found to exert significant indirect impact on safety performance (SP), and once again demonstrated evidence of mediating the relationship between stakeholders' involvement and safety performance (SP) by the other three factors, as hypothesised.

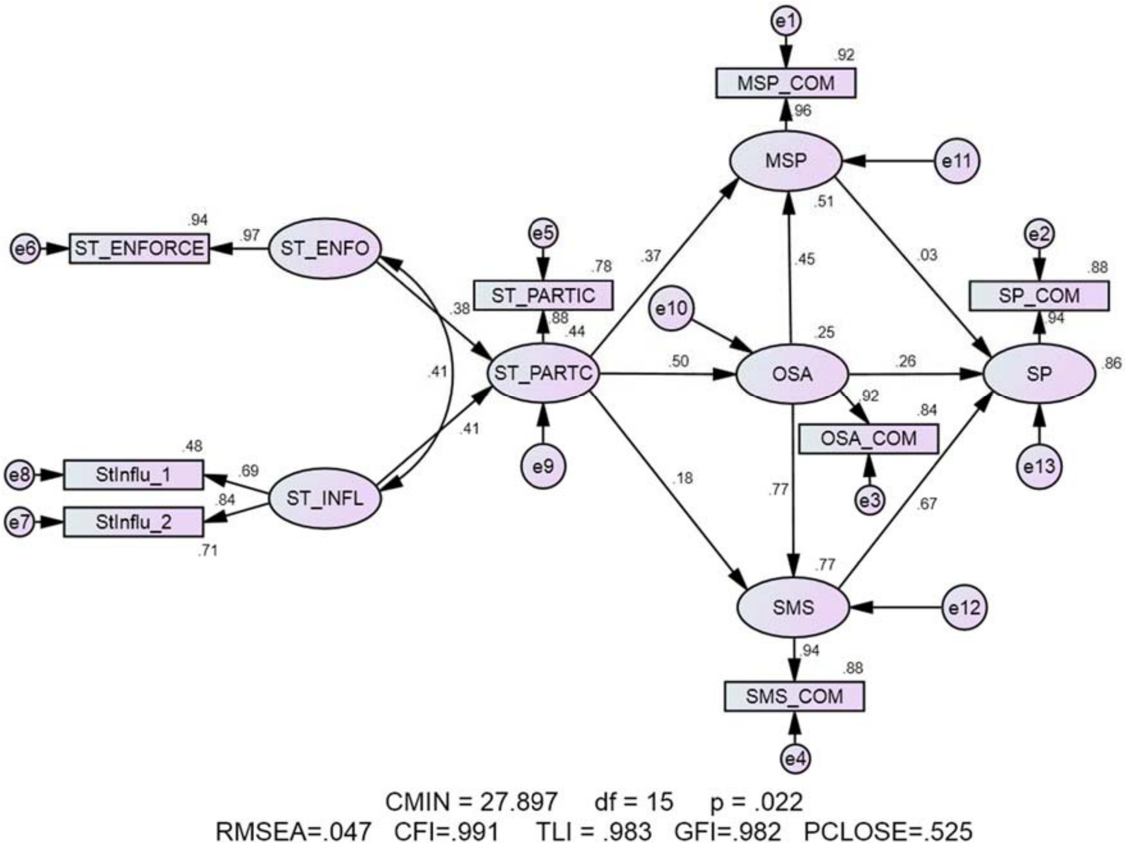


Figure 7.8 Full structural model using composites

Model output of the full composite structural model

Table 7.15 shows the output of the full structural model. The model with its items fits correctly. The model achieved a good fit, satisfying all goodness-of-fit criteria. The Chi-square test showed that the X^2 was equal to 27.897 (p = 0.060 not significant). The data fit well to the model GFI = 0.982, TLI = 0.983, CFI = 0.991, RMSEA = 0.047, and PCLOSE = 0.525.

Table 7.16 Regression weights

			Estimate	S.E.	C.R.	P	Label
ST_PARTC	<---	ST_ENFO	.379	.056	6.727	***	par_10
ST_PARTC	<---	ST_INFL	.429	.075	5.732	***	par_11
OSA	<---	ST_PARTC	.506	.058	8.776	***	par_3
MSP	<---	ST_PARTC	.375	.056	6.645	***	par_2
SMS	<---	ST_PARTC	.177	.049	3.641	***	par_4
MSP	<---	OSA	.455	.054	8.402	***	par_7
SMS	<---	OSA	.775	.048	16.022	***	par_8
SP	<---	OSA	.264	.090	2.925	.003	par_5
SP	<---	MSP	.029	.043	.674	.501	par_6
SP	<---	SMS	.675	.084	8.032	***	par_9

			Estimate	S.E.	C.R.	P	Label
MSP_COM	<---	MSP	1.046				
SP_COM	<---	SP	1.072				
OSA_COM	<---	OSA	.852				
SMS_COM	<---	SMS	.968				
ST_PARTIC	<---	ST_PARTC	.917				
ST_ENFORCE	<---	ST_ENFO	1.175				
StInflu_2	<---	ST_INFL	1.000				
StInflu_1	<---	ST_INFL	.937	.108	8.636	***	par_1

Table 7.16 presents the regression weights. It shows that there is only one relationship where the CR showed an insignificant result – management safety practices to safety performance.

Table 7.17 Standardised regression weights

			Estimate
ST_PARTC	<---	ST_ENFO	.381
ST_PARTC	<---	ST_INFL	.407
OSA	<---	ST_PARTC	.504
MSP	<---	ST_PARTC	.372
SMS	<---	ST_PARTC	.176
MSP	<---	OSA	.453
SMS	<---	OSA	.773
SP	<---	OSA	.263
SP	<---	MSP	.029
SP	<---	SMS	.675
MSP_COM	<---	MSP	.961
SP_COM	<---	SP	.939
OSA_COM	<---	OSA	.916
SMS_COM	<---	SMS	.941
ST_PARTIC	<---	ST_PARTC	.883
ST_ENFORCE	<---	ST_ENFO	.968
StInflu_2	<---	ST_INFL	.843
StInflu_1	<---	ST_INFL	.694

Table 7.18 shows the standardised regression weights where the factor loading ranges between a low of 0.029 (management safety practices – safety performance) and a higher number of 0.968 (safety enforcement).

Table 7.18 Squared multiple correlations

	Estimate
ST_PARTC	.439
OSA	.254
SMS	.766
MSP	.514
SP	.864
StInflu_1	.482
StInflu_2	.710
ST_ENFORCE	.937
ST_PARTIC	.779
SMS_COM	.885
OSA_COM	.839
SP_COM	.883
MSP_COM	.923

Table 7.18 shows that the model explains 76% of the variance in safety management systems and 86% of the variance in safety performance.

As can be seen from above, the variables had a good fit with the full structural model. The outputs showed that there was no problem during the iteration process, which converges to a minimum. The data fit well. There was no significant difference between the sample data's variance/covariance matrix and the model's implied variance/covariance matrix. Therefore, the composite full structural model was selected for interpretation in this research. This provided the basis for the discussion of the results in Chapter 8 and for the tests of a moderating hypothesis in the next section.

7.4 The estimated standardised total and direct effects from the overall and final structural equation model

The results of the estimated standardised total and direct effects from the overall and final structural equation model, along with the significance test, are presented in Table 7.19. A consideration of the standardised total effect shows that the secondary stakeholder enforcement (ST-ENFORCE) had a direct effect of 0.381 on primary stakeholder (ST_PARTC) and the stakeholder influence (ST_INFL) has a direct effect of 0.407 on primary stakeholder.

In comparison, the standardised total effect of primary stakeholder (ST_PARTIC) on management safety practices (MSP) was 0.601, with a standardised direct effect of 0.372. For organisation safety attitude (OSA), the standardised total effect was 0.504 with a standardised direct effect of 0.504. And for safety management system (SMS), the standardised total effect was 0.565, with a standardised direct effect of 0.176. Moreover, the standardised total effect shows that organisation safety attitude (OSA) has a direct effect of 0.453 on MSP; 0.773 on SMS; and 0.263 on SP. The standardised direct effect of SMS on SP was 0.675, whereas the standardised direct effect of MSP on SP was not significant (0.029).

Therefore, the above results demonstrate that stakeholder involvement (from both primary and secondary stakeholders), in particular, exercises a strong direct and indirect influence and enforcement on safety culture elements. However, management safety practice does not affect safety performance directly.

Table 7.19 Estimated standardised total and direct effects from the overall and final structural equation model

Hyp.	Independent variable	Dependent variable	Standardised effects		Critical ratio
			Direct	*Total*	
	ST_ENFORCE	ST_PARTIC	0.381	0.381	6.727 ***
	ST_INFL	ST_PARTIC	0.407	0.407	5.732***
	ST_PARTIC	MSP	0.372	0.601	6.645***
	ST_PARTIC	OSA	0.504	0.504	8.776***
	ST_PARTIC	SMS	0.176	0.565	3.641***
	OSA	MSP	0.453	0.453	8.402***
	OSA	SMS	0.773	0.773	16.02***
	OSA	SP	0.263	0.798	2.925**
	SMS	SP	0.675	0.675	8.032***
	MSP	SP	0.029	0.029	0.674 NS

*** p-value < 0.001; ** p-value < 0.01; * p-value < 0.05 ST_ENFORCE –(Enforcement by secondary stakeholder), ST_PARTIC- (Primary Stakeholder Participation), (ST_INFL : Influence on primary stakeholders), (MSP: Management Safety Practices), (OSA: Organisational Safety Attitude), (SMS: Safety Management System), (SP: Safety Performance)

7.5 Hypothesis testing

In the following section, each of the hypotheses is analysed and the results are presented.

H2 *The impact of the rates for workers' compensation insurance, safety practices of competitors, or social media are positively influencing the primary stakeholder to approach safety.*

The standardised regression coefficient for the ST_INFL variable was 0.407. Analysis of the standardised regression weights concluded that an increase of 1 SD in the rates for workers' compensation insurance, safety practices of competitors, or social media would predict an increase of 0.407 in primary stakeholder (ST_PARTC), which would have a moderately strong impact. Also the regression weight showed a significant result ($p < 0.001$).

This hypothesis is accepted. The rates for workers' compensation insurance, safety practices of competitors, or social media influence the primary stakeholders' approach to safety.

H3 *The safety regulations and procedures of the government agencies are positively enforcing the primary stakeholders to enhance safety culture.*

The standardised regression coefficient for the ST_ENFO variable was 0.381. Analysis of the standardised regression weights concluded that an increase of 1 SD in the safety regulations and procedures of government agencies would predict an increase of 0.381 in primary stakeholder (ST_PARTC), which would have a moderate impact. The regression weight also showed a significant result ($p < 0.001$).

This hypothesis is accepted. The safety regulations and procedures of the government agencies are positively enforcing the primary stakeholders to enhance safety culture.

H4 *Primary stakeholder involvement is positively associated with organisational safety attitudes.*

The standardised regression coefficient for the ST_PARTC variable was 0.504. Analysing the standardised regression weights led to the conclusion that an increase of 1 SD in the primary stakeholder involvement would predict an increase of 0.504 in organisational safety attitudes, which had a moderately strong and substantial impact. The regression weight also showed a significant result ($p < 0.001$).

This hypothesis is accepted. The primary stakeholders have a positive impact on organisation safety attitudes.

H5 *Primary stakeholder involvement is positively associated with management safety practices.*

The standardised regression coefficient for this path (ST_PARTC -> MSP) was 0.372. Analysis of the standardised regression weights concluded that an increase of 1 SD in the primary stakeholder involvement would predict an increase of 0.372 in management safety practices, which would have a moderate impact. Also, the regression weight shows a significant result ($p < 0.001$).

This hypothesis is accepted. The primary stakeholders have a positive impact on management safety practices.

H6 *Primary stakeholder involvement is positively associated with the effectiveness of the safety management system.*

The standardised regression coefficient for this path (ST_PARTC-> SMS) was 0.176. Analysis of the standardised regression weights concluded that an increase of 1 SD in the primary stakeholder involvement would predict an increase of 0.176 in safety management system, which would appear to have a negligible impact. However, the regression weight showed a significant result ($p < 0.001$).

This hypothesis is accepted. The primary stakeholders have a positive impact on safety management system.

H7 *Organisational safety attitude is positively associated with safety performance.*

The standardised regression coefficient for this path (OSA -> SP) is 0.263. Analysis of the standardised regression weights concluded that an increase of 1 SD in organisation safety attitudes would predict an increase of 0.263 in safety performance, which will have a mild impact. Also the regression weight shows a significant result ($p < 0.01$).

This hypothesis is accepted. Organisation safety attitudes have a positive impact on safety performance.

H8 *Organisation safety attitude is positively associated with the management safety practices.*

The standardised regression coefficient for this path (OSA -> MSP) was 0.453. Analysis of the standardised regression weights concluded that an increase of 1 SD in organisation safety attitudes would predict an increase of 0.453 in management safety practices, which would appear to have a moderate impact. The regression weight also showed a significant result ($p < 0.001$).

This hypothesis is accepted. Organisation safety attitudes influence management safety practices.

H9 *Organisation safety attitude is positively associated with the effectiveness of the safety management system.*

The standardised regression coefficient for this path (OSA -> SMS) was 0.773. Analysis of the standardised regression weights concluded that an increase of 1 SD in organisation safety attitudes would predict an increase of 0.773 in safety management system, which would appear to be a very strong impact. The regression weight also showed a significant result ($p < 0.001$).

This hypothesis is accepted. Organisation safety attitudes influence safety management system.

H10 *The effectiveness of the safety management system is positively associated with safety performance.*

The standardised regression coefficient for this path (SMS -> SP) was 0.675. Analysis of the standardised regression weights concluded that an increase of 1 SD in safety management systems would predict an increase of 0.675 in safety performance, which would appear to have a strong impact. The regression weight also showed a significant result ($p < 0.001$).

This hypothesis is accepted. Safety management system influences safety performance.

H11 *Management safety practices are positively associated with the safety performance.*

The standardised regression coefficient for this path (MSP -> SP) was 0.029. Analysis of the standardised regression weights concluded that an increase of 1 SD in organisation safety attitudes would predict an increase of 0.029 in safety performance, which would appear to have a tiny impact, and the regression weight showed no significant difference from zero at the 0.05 level (two-tailed) ($p = 0.632$).

This hypothesis is rejected. Management safety practices are not influence-leading indicators of safety performance.

7.6 Multi-group analysis of the moderating variables

The main purpose of the multi-group analysis was to investigate whether paths in a specified causal structure were significantly different between groups (Byrne 2009). Analysis of metric measurement invariance for the variables permitted the examination of the moderating hypotheses. In fact, metric invariance was established for all the model variables in this research (see Chapter 6). Therefore, tests for moderating hypotheses could proceed.

Invariance testing and tests for a moderating hypothesis are similar to a certain degree. However, whereas moderating hypothesis testing focuses on the variable relationships, invariance testing focuses on the variable itself. To test for a moderating effect in all groups, the following steps were undertaken in this research (Cunningham, EG 2010).

1 Using the manage groups function, three groups were established – small, medium, and large organisations.

2 On the structural model, each item factor loading was set to be the same for each group.

3 Using the manage models function, two models were established. One is an *unconstrained model* where all variable relationships are allowed to vary freely, and the other is the *constrained model* where the relationship between three variables is set to be the same.

4 The model is then run and a Chi-square difference test is performed between the two models. (This is reported in the *AMOS* output.)

5 The structural weights were tested by comparing the path coefficient between each model, and determining whether any differences were statistically significant. Significant differences were identified based on an examination of the *pairwise parameter comparisons matrix*. Each coefficient path was compared using a z-test (two-tail test) with an absolute value greater than |1.96| for the differences between paths; the results will be statistically significant at $p < 0.05$ (Holmes-Smith 2013).

The comparison models are shown in Figures 7.9 (Model 1), 7.10 (Model 2), and 7.11 (Model 3). All three models have different path labels to indicate clearly the significant differences when testing between three groups. Tables 7.20 to 7.22 show the results of the multi-group analysis of each moderating latent construct in the full composite model.

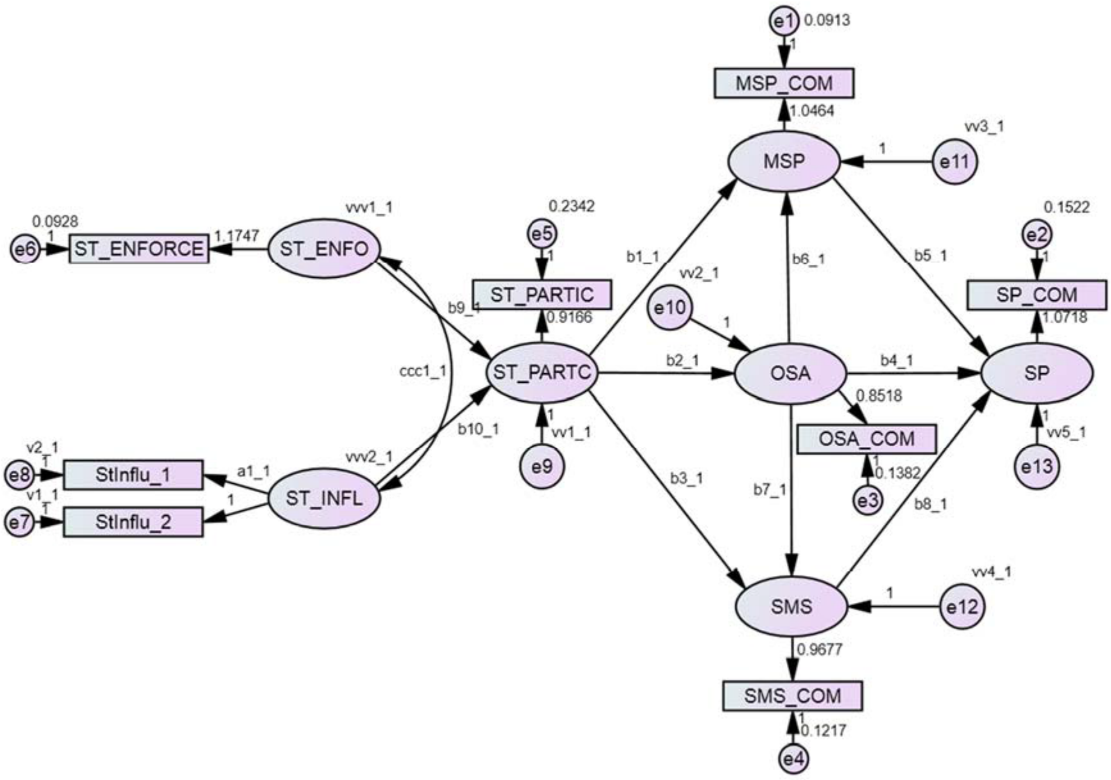


Figure 7.9 **Structural path diagram for multi-group analysis (Model 1)**

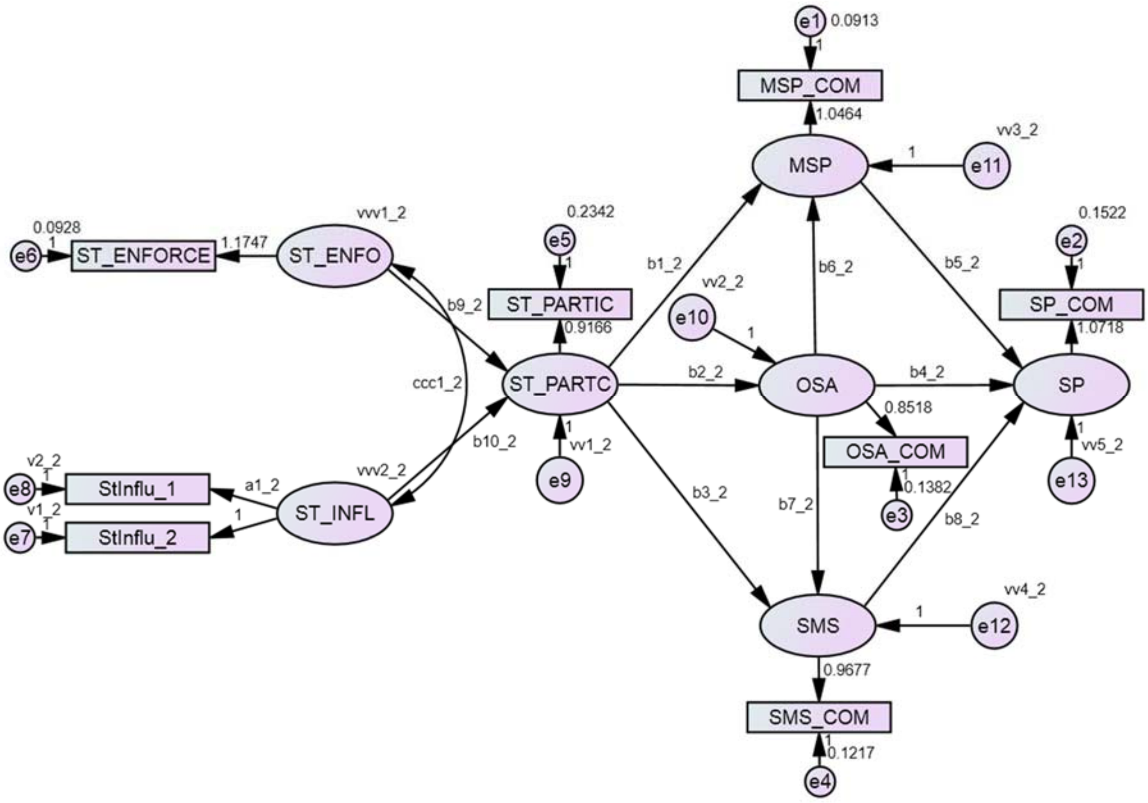


Figure 7.10 **Structural path diagram for multi-group analysis (Model 2)**

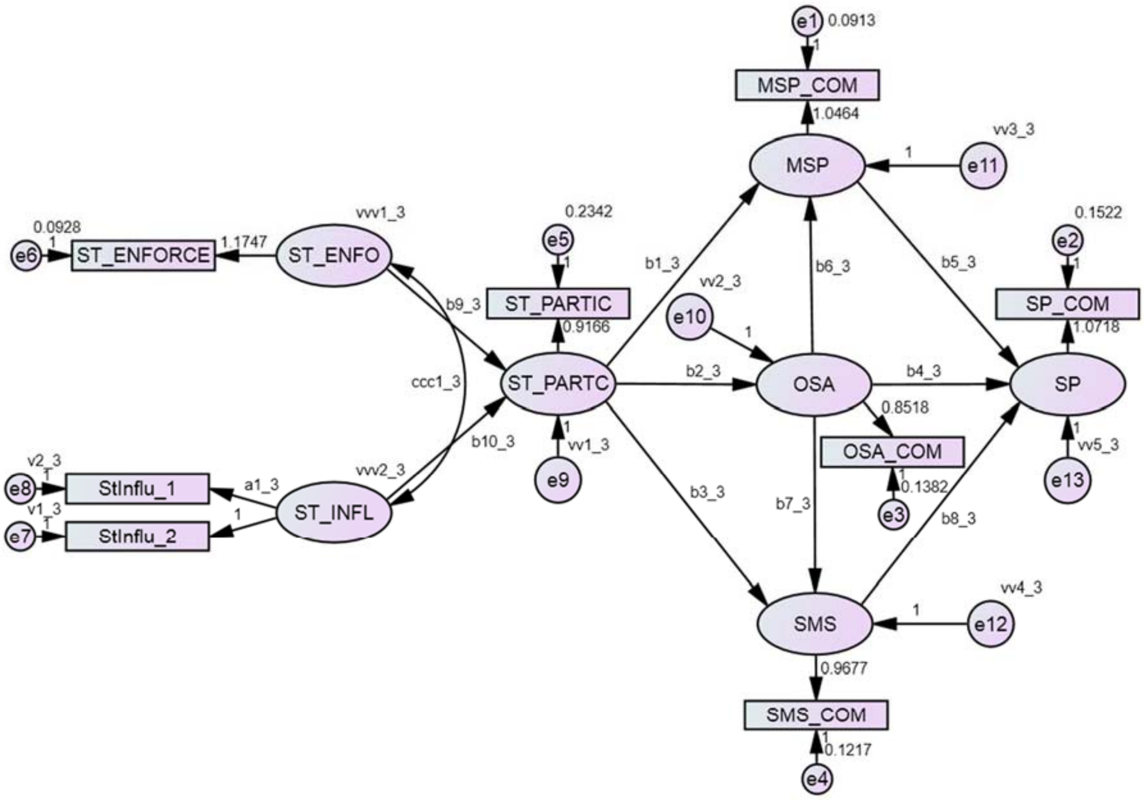


Figure 7.11 **Structural path diagram for multi-group analysis (Model 3)**

Tables 7.20 to 7.22 show the composite full structural models with the variables item factor loading set to be equal, in order to test the effect of a moderating group variable. In this research, for example, Table 7.20 shows the coefficient path (ST_PARTC->MSP) *primary stakeholder involvement* → *management safety practices* for Model 1 (the small size organisation) is b1_1. The coefficient path (ST_PARTC->MSP) *primary stakeholder involvement* → *management safety practices* for Model 2 (medium size organisation) is b1_2. A similar approach was undertaken with all the variable relationships to determine whether there were differences for the other groups.

A multi-group analysis of variance was performed between all three groups, small *vs* medium, small *vs* large, and medium *vs* large. The results indicated that there were five relationships that were significantly different, and 30 relationships which were not significant (see Tables 7.20 to 7.22). This implies that the moderating variable has a moderating effect on these five relationships. Results of the multi-group analysis for each moderating latent variable are presented in Tables 7.20 to 7.22.

7.6.1 Group analysis between small and medium size organisations

A multi-group analysis of variance was performed to compare the stakeholder involvement and safety culture model in small and medium size organisations. The analysis resulted in a significant difference on two paths.

Firstly, the impact of primary stakeholders on organisational safety attitudes was shown to differ between small organisations and medium organisations (small: b2_1, estimate= 0.21, p-value < 0.10; medium: b2_2, estimate=0.558, p-value < 0.01). Small organisations recorded a strong positive effect between primary stakeholders and organisational safety attitude, but for medium organisations the effect on the same path was more than double the strength (Table 7.20).

The second path indicated that the impact of the primary stakeholders on safety management system also differed between small and medium organisations (small: b3_1, estimate= 0.051, p-value not sig; medium: b3_2, estimate= 0.284, p-value < 0.01). Small organisations had a positive, but not significant, effect between primary stakeholders and safety management system, whereas medium organisations had a strong positive effect on the same path (Table 7.20). The result implies that the moderating variable had a moderating effect on these relationships.

Table 7.20 Structural invariance analysis between small and medium groups

PATH			Small			Medium			
			PATH	Estimate	P	PATH	Estimate	P	z-score
ST_PARTC	<-	ST_ENFO	b9_1	0.390	0.000	b9_2	0.336	0.000	-0.393
ST_PARTC	<-	ST_INFL	b10_1	0.357	0.012	b10_2	0.524	0.000	0.883
OSA	<-	ST_PARTC	b2_1	0.210	0.082	b2_2	0.558	0.000	2.47**
MSP	<-	ST_PARTC	b1_1	0.447	0.000	b1_2	0.311	0.000	-1.116
SMS	<-	ST_PARTC	b3_1	0.051	0.572	b3_2	0.248	0.000	1.743*
MSP	<-	OSA	b6_1	0.566	0.000	b6_2	0.423	0.000	-1.166
SMS	<-	OSA	b7_1	0.787	0.000	b7_2	0.728	0.000	-0.509
SP	<-	OSA	b4_1	0.250	0.156	b4_2	0.246	0.028	-0.022
SP	<-	MSP	b5_1	0.110	0.285	b5_2	0.004	0.939	-0.913
SP	<-	SMS	b8_1	0.630	0.000	b8_2	0.721	0.000	0.478
*Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10*									

7.6.2 Group analysis between small size of organisation and large size

A multi-group analysis comparing small and large organisations, demonstrated a significant difference on one path. The impact of the primary stakeholders on organisational safety attitude differed between small and large organisations (small: b2_1, estimate= 0.21, p-value < 0.10; large: b2_3, estimate=0.838, p-value < 0.01). Small organisations exhibited a strong positive effect between primary stakeholders and organisational safety attitude. However, the effect on the same path for large organisations was more than triple the strength at 399% as strong (Table 7.21). This implies that the moderating variable has a moderating effect on this relationship.

Table 7.21 Structural invariance analysis between small and large groups

PATH			Small			Large			
			PATH	Estimate	P	PATH	Estimate	P	z-score
ST_PARTC	<-	ST_ENFO	b9_1	0.390	0.000	b9_3	0.382	0.002	-0.046
ST_PARTC	<-	ST_INFL	b10_1	0.357	0.012	b10_3	0.476	0.000	0.633
OSA	<-	ST_PARTC	b2_1	0.210	0.082	b2_3	0.838	0.000	3.163***
MSP	<-	ST_PARTC	b1_1	0.447	0.000	b1_3	0.413	0.007	-0.192
SMS	<-	ST_PARTC	b3_1	0.051	0.572	b3_3	0.201	0.211	0.813
MSP	<-	OSA	b6_1	0.566	0.000	b6_3	0.554	0.000	-0.077
SMS	<-	OSA	b7_1	0.787	0.000	b7_3	0.831	0.000	0.269
SP	<-	OSA	b4_1	0.250	0.156	b4_3	0.405	0.232	0.405
SP	<-	MSP	b5_1	0.110	0.285	b5_3	-0.019	0.910	-0.650
SP	<-	SMS	b8_1	0.630	0.000	b8_3	0.561	0.073	-0.196
*Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10*									

7.6.3 Group analysis between medium and large organisations

When multi-group analysis was conducted between medium and large size organisations, the results demonstrated no significant difference. The results indicated that there was no difference between the two models. However, the results recorded in Table 7.22 show that the impact of the primary stakeholders on organisational safety attitude does appear to differ slightly between medium and large organisations (medium: b2_2, estimate= 0.524, p-value < 0.01; large: b2_3, estimate=0.763, p-value < 0.01). Medium organisations exhibited a strong positive effect between primary stakeholders and organisational safety attitude, whereas large organisations recorded the strongest positive affect among the three groups on the same path.

Table 7.22 Structural invariance analysis between medium and large groups

PATH			Medium			Large			
			PATH	Estimate	P	PATH	Estimate	P	z-score
ST_PARTC	<-	ST_ENFO	b9_2	0.336	0.000	b9_3	0.382	0.002	0.324
ST_PARTC	<-	ST_INFL	b10_2	0.524	0.000	b10_3	0.476	0.000	-0.298
OSA	<-	ST_PARTC	b2_2	0.558	0.000	b2_3	0.838	0.000	1.605
MSP	<-	ST_PARTC	b1_2	0.311	0.000	b1_3	0.413	0.007	0.583
SMS	<-	ST_PARTC	b3_2	0.248	0.000	b3_3	0.201	0.211	-0.265
MSP	<-	OSA	b6_2	0.423	0.000	b6_3	0.554	0.000	0.887
SMS	<-	OSA	b7_2	0.728	0.000	b7_3	0.831	0.000	0.698
SP	<-	OSA	b4_2	0.246	0.028	b4_3	0.405	0.232	0.447
SP	<-	MSP	b5_2	0.004	0.939	b5_3	-0.019	0.910	-0.131
SP	<-	SMS	b8_2	0.721	0.000	b8_3	0.561	0.073	-0.483
*Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10*									

7.7 The total effect of stakeholder involvement across the three groups

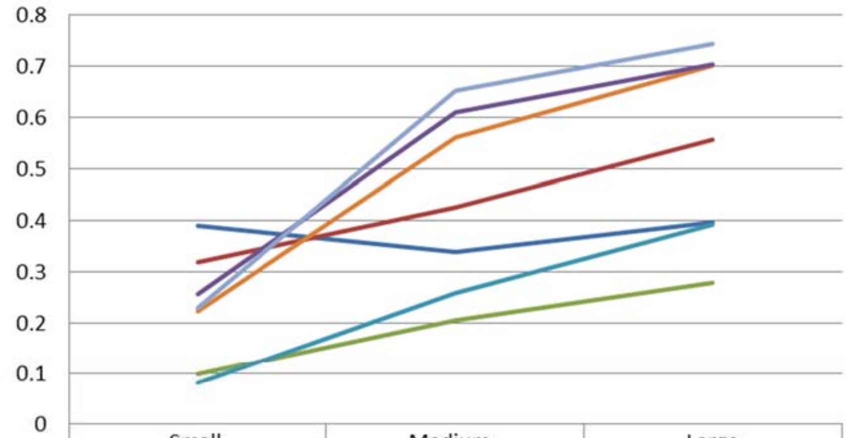
The standardised total effect of primary and secondary stakeholders on safety culture and performance have been reported in Table 7.23 and Figure 7.12.

Table 7.23 The estimated standardised total (direct and indirect) effect for stakeholder involvement

The size of the organisation	Independent variable	Dependent variable	The standardised total (direct and indirect) effect		Critical ratio
			Direct	Total	
Small	ST_ENFORCE	ST_PARTIC	0.391	0.391	3.418 ***
	ST_ENFORCE	SP	-	0.100	-
	ST_INFL	ST_PARTIC	0.319	0.320	2.495*
	ST_INFL	SP	-	0.082	-
	ST_PARTIC	OSA	0.223	0.223	1.737*
	ST_PARTIC	SMS	0.055	0.230	0.567 NS
	ST_PARTIC	SP	-	0.257	-
Medium	ST_ENFORCE	ST_PARTIC	0.338	0.338	4.44***
	ST_ENFORCE	SP	-	0.206	-
	ST_INFL	ST_PARTIC	0.426	0.426	4.498***
	ST_INFL	SP	-	0.260	-
	ST_PARTIC	OSA	0.561	0.561	7.583***
	ST_PARTIC	SMS	0.247	0.652	3.670***
	ST_PARTIC	SP	-	0.610	-
Large	ST_ENFORCE	ST_PARTIC	0.397	0.397	3.174**
	ST_ENFORCE	SP	-	0.279	-
	ST_INFL	ST_PARTIC	0.557	0.557	4.199***
	ST_INFL	SP	-	0.392	-
	ST_PARTIC	OSA	0.702	0.702	5.302***
	ST_PARTIC	SMS	0.167	0.744	1.250 NS
	ST_PARTIC	SP	-	0.704	-

*** p-value < 0.001; ** p-value < 0.01; * p-value < 0.05 ; Note: Dashes represent empty cells or no information because the paths are not direct. ST_ENFORCE –(Enforcement by secondary stakeholder), ST_PARTIC- (Primary Stakeholder Participation), (ST_INFL : Influence on primary stakeholders), (MSP: Management Safety Practices), (OSA: Organisational Safety Attitude), (SMS: Safety Management System), (SP: Safety Performance)

The results demonstrate that the standardised total effects differ across the three groups (small, medium, and large organisations). Table 7.23 and Figure 7.12 show the dramatic change across the three groups. In general, in small organisations stakeholder involvement had the lowest positive effect on safety culture and safety performance, whereas, in large organisations, stakeholder involvement had the highest positive effect on the same paths. However, enforcement by secondary stakeholders, specifically, remained steady across the small, medium, and large organisations (0.391; 0.338; and 0.397).



	Small	Medium	Large
ST_ENFORCE- ST_PARTIC	0.391	0.338	0.397
ST_INFL - ST_PARTIC	0.319	0.426	0.557
ST_PARTC-OSA	0.223	0.561	0.702
ST_ENFORCE- SP	0.1	0.206	0.279
ST_PARTIC - SP	0.257	0.61	0.704
ST_INFL - SP	0.082	0.26	0.392
ST_PARTC-SMS	0.23	0.652	0.744

ST_ENFORCE –(Enforcement by secondary stakeholder), ST_PARTIC- (Primary Stakeholder Participation), (ST_INFL : Influence on primary stakeholders), (SP: Safety Performance)

Figure 7.12 The standardised total (direct and indirect) effect for stakeholder involvement

The standardised direct effect shows that the secondary stakeholder enforcement (ST_ENFORCE) had almost the same effect across the three groups as primary stakeholder (ST_PARTC) at 0.39, 0.33, and 0.39; whereas stakeholder influence (ST_INFL) in terms of the primary stakeholder increased significantly from small, medium, to large organisations at 0.319, 0.426, and 0.557.

Demonstrating the same trend, the standardised total effect shows that from small to large organisations, the positive effect of stakeholder involvement on safety performance increased dramatically (Figure 7.12). As a result, hypothesis number 11, which states that *Construction organisations with few employees are less likely to be influenced and enforced by stakeholders to approach safety matters; those with a larger number of employees are more likely to be influenced and enforced by stakeholders to approach safety matter*s is accepted.

Table 7.24 provides a summary of the hypothesised relationships identified and the outcome of their testing by the research (also tabularised in another context in Chapter 6).

Table 7.24 Summary of hypothesis relationships identified

No	Hypothesis	Level of Support
H1	The impact of the rates for workers' compensation insurance, safety practices of competitors, or social media are positively influencing the primary stakeholder to approach safety.	Supported
H2	The safety regulations and procedures of the government agencies are positively enforcing the primary stakeholders to enhance safety culture.	Supported
H3	Primary stakeholder involvement is positively associated with organisational safety attitudes.	Supported
H4	Primary stakeholder involvement is positively associated with management safety practices.	Supported
H5	Primary stakeholder involvement is positively associated with the effectiveness of the safety management system.	Supported
H6	Organisational safety attitude is positively associated with safety performance.	Supported
H7	Organisational safety attitude is positively associated with management safety practices.	Supported
H8	Organisational safety attitude is positively associated with the effectiveness of the safety management system.	Supported
H9	Safety management system is positively associated with safety performance.	Supported
H10	Management safety practices are positively associated with safety performance.	Not Supported
H11	Construction organisations with few employees are less likely to get influenced and enforced by stakeholders to approach safety matters. Those with a larger number of employees are more likely to get influenced and enforced by stakeholders to approach safety matters	Supported

7.8 Further model validation

This section presents the outcomes from the validation procedures adopted in this study by seeking experts' opinions regarding the completeness, usefulness, and appropriateness of the model. A validation workshop was held with six experts, that is, people involved in the implementation of construction projects in Saudi Arabia. The workshop activities consisted of a short presentation on the background of the research and an introduction to the proposed model, while highlighting of the outcomes of the study. This was followed by discussions on the applicability and practicality of the proposed model.

Table 5.3 (Chapter 5) shows the details of six of the individuals who participated in the validation process. One participant currently holds a position as consultant and director, with 35 years' experience in the construction sector; two participants were project managers, with 25 and 14 years' experience respectively; and the remaining participants were a site director and site manager with nine and four years of experience respectively; and a site supervisor with three years of experience. This mixture of participants from the Saudi Arabian construction industry ensured an appropriate balance of expert opinions, as suggested by Fox *et al.* (2003). The feedback received from the validation workshop can thus be accepted as the opinion of the appropriate experts, and considered as sufficient for analysis and recommendations. For instance, the construction consultant stated that:

> *It is clear that the model was constructed on the basis of well thought of stakeholder and safety issues, and that the survey was produced carefully.*

The project manager also stated that:

> *I think that most of the questions in the survey are sufficient and satisfactory.*

The other project manager stated that:

> *... this is an interesting study, and the fact is that we have a need for such research because of what I have seen of safety problems during my working time.*

Table 7.25 shows how the model was rated in terms of seven elements. The validation workshop survey results indicate that the experts considered the model correctly identified the major stakeholders' participation in Saudi Arabia construction projects as 33.3% 'very good' and 66.7% 'excellent'. Also, a 100% 'excellent' response rate was assigned by the expert for the correct identification of the influence of the stakeholders' approach on safety issues; and a 50% 'very good' and 50% 'excellent' rate was registered for the correct of identification of enforcements against the stakeholder to improve safety.

With regard to safety culture as exemplified within the model, a majority of the experts rated the four elements of safety culture as 'very good' and 'excellent'. These were: the correct identification of management safety practices (83.3% 'very good'), correctly identifying an organisation's safety attitudes (66.7 % 'very good'), correctly identifying a safety management system (83.3% 'excellent'), and the correct identification of safety performance (100% 'excellent').

The model was also rated as 'very good' in terms of completeness and covering the important aspects of safety culture and stakeholder involvement. On ease of understanding, the model was rated 'excellent' by 66.7% of the participants. On ease of use of the model, differences of opinion by the experts was recorded, with a majority of respondents assessing it as 'excellent' (16.7% 'good', 16.7% 'very good', and 66.7% 'excellent').

In regard to the evaluation of safety culture of a project: the responses for the model providing a systematic view of safety culture on the evaluation of projects shows that 33.3% 'very good' and 50% 'excellent' ratings were given by the participants. Furthermore, 66.7% of the participants rated the applicability of the model to simple projects as 'very good', whereas 100% of the participants rated the model applicability to complex projects as 'excellent'. Finally, majority of the participants chose 'yes' as they would recommend the use of the model on projects with which they were involved.

7.8.1 Comments from the participants

Additional comments and recommendations were provided either in writing or orally by participants about the current less than competitive status of occupational safety in Saudi Arabian construction projects, with additional remarks concerning some of the causes, and how the situation could be resolved. For instance, the majority of the primary stakeholders, such as the project owner, managers, or contractors, expressed a need for greater productivity in their workplaces rather than safety. The first responder stated that:

> *When all stakeholders are focusing only on profits, we have to say goodbye to safety, but when greed disappears and they show compassion, then Occupational Safety emerges*

The second participant observed that:

> *In Arab society the majority don't care about safety, not only by contractors -usually- but also by owners, consultants, insurance companies and even government agencies, and they take action only when accidents occur.*

The third participant noted that:

> *It is obvious that the greatest interest in implementation of occupational safety systems in the construction industry stems from fear of the law, and not from ensuring the safety of people and their humanity, and so often it is considered only in order to obtain certificates.*

The fourth participant stated that:

> *... from my experience, directors don't care about safety without fear of government agencies.*

In regards to the nature of stakeholder involvement in improving safety culture, the government agencies were identified as the main obstacle to improving the situation, because they lack knowledge of international occupational safety requirements. To quote a participant:

> *Most government departments, agencies, and institutions do not have the slightest idea of the preventive safety requirements that are included in either Saudi Arabian legislation or international law.*

In regards to Islam's doctrine upon moral, ethical, and social responsibility, the fifth participant explained how the construction workers must be protected by stakeholders as morally instructed. His comments are summarised below:

> *We are supposed to be, the Arabs in general, and Muslims in particular, the first to apply the Occupational Health and Safety standards because it is derived from Islamic religion: as the Prophet Muhammad (peace be upon him) said: There should be neither harming nor reciprocating harm, All of you are shepherds and each of you is responsible for his flock ..., and ...removing a harmful object from the road is a charity.*

7.8.2 Recommendations from the participants

The participants' recommendations and suggestions were considered and incorporated in the recommendations of this research. Their comments are summarised below:

The first participant suggested that:

> *Government systems alone are able to force business owners to implement safety measures, but must choose inspectors with experience, integrity, and impartiality... and I hope to highlight on the role of the Ministry of Culture and Information on the importance of safety to enrich this topic*

The second participant recommended that:

> *Improving safety is related to some elements such as the role of the government in control of the construction sites and a pervasive culture of occupational safety among stakeholders; therefore designers and engineers must implement the rules of occupational safety and health and the need for continuous inspection of the facilities to achieve genuine occupational safety*

The third participant suggested that:

> *Government forces are the most common reasons that lead to improved occupational safety at work, due to the fear of administrative power, if there is no interest from government agencies to improve safety, other stakeholders will not bother to give adequate attention to occupational safety*

The fourth participant stated that:

> *Improving occupational safety must be the responsibility of government, insurance companies, organisations and their workers*

The last participant suggested that:

> *Involvement of government regulatory powers and authorities will improve the level of safety compliance... and government authorised bodies must do inspection and audits for all projects to ensure effective compliance with guidelines for safety implementation.*

It can be concluded from the above responses that the respondents confirmed the findings of the survey, and that these findings are an accurate reflection of the general situation within the Saudi Arabian construction industry.

Table 7.25 Model validation rating by participants

	Model validation rating by participants					
Elements	**Poor %**	**Satisfactory %**	**Good %**	**Very Good %**	**Excellent %**	**Overall**
Correct identification of the major stakeholder participations?	-	-	-	33.3	66.7	Excellent
Correct identification of the influence of the stakeholder's approach to safety issues?	-	-	-	-	100	Excellent
Correct identification of enforcements against the stakeholder to improve safety?	-	-	-	50	50	Very Good/Excellent
Correct identification of management safety practices?	-	-	-	83.3	16.7	Very Good
Correct identification of the organisation's safety attitudes?	-	-	-	66.7	33.3	Very Good
Correct identification of the safety management system?	-	-	-	16.7	83.3	Excellent
Correct identification of safety performance?	-	-	-	-	100	Excellent
Model completeness 'covering all important aspects of safety culture and stakeholder involvement'?	-	-	16.7	33.3	50	Very Good
Ease of understanding?	-	-	-	33.3	66.7	Excellent
Ease of use of the model?	-	-	16.7	16.7	66.7	Excellent
Providing a systematic view of safety culture based on the evaluation of projects?	-	-	16.7	33.3	50	Very Good
Applicability to simple projects?	-	-	-	66.7	33.3	Very Good
Applicability to complex projects?	-	-	-	-	100	Excellent
Would you recommend the model for use on projects in which you are involved?				**NO**	**YES**	
					100	**%100 Yes**

7.9 Chapter summary

This chapter provided details of the research results for the full structural model. The full model was presented, and then the model was discussed after modification to incorporate a composite for stakeholder involvement and safety culture. The composite was formed to determine if there were any improvement in stabilising the parameter estimates since the use of composites has previously been employed for this purpose. After developing composite variables, it was determined that the initial non-composite model performed well in fitting the full structural model. Therefore, the composite full structural model was selected to form the basis for the discussion in Chapter 8. This model also formed the basis for undertaking tests of a group-moderating variable that evaluated whether the relationships between variables differed from group to group, along with the total effect of stakeholder involvement across the three groups. At the end, this chapter re-examines the hypothesis developed, and identified whether these were supported by the research results.

Discussion and conclusion

The main aims of this research were to determine empirically the extent to which stakeholder involvement impacts on safety culture and safety performance (leading indicators), the nature of this involvement, and to develop a model that could help to assess the specific nature of this involvement within the Saudi Arabian construction industry. In association with these goals, the following secondary objectives were identified:

- Examine the contextual influences on safety culture within the construction industry in Saudi Arabia, including cultural, institutional, legal, and economic. (Chapter 2)
- Identify whether stakeholders are regarded as key to improving safety culture in the context of Saudi Arabian construction projects. (Chapter 2)
- Critically review the literature on accident causation, safety culture, and stakeholder theory to develop an understanding of the factors influencing safety performance in construction projects. (Chapter 3)
- Develop a model based on stakeholder theory and safety culture, and investigate the causal relationship between its components. (Chapter 4)
- Investigate the nature of stakeholder involvement in improving safety matters, and the level of safety culture in the Saudi Arabian construction industry. (Chapter 5)
- Perform SEM analysis to confirm the construct validity of the proposed model. (Chapter 6)
- Perform SEM analysis to examine whether statistically significant relationships exist between stakeholder involvement, safety culture, and safety performance. (Chapter 7)
- Examine the impact of stakeholder involvement on organisational safety culture in regards to organisational size, by performing a multi-group analysis. (Chapter 7)
- Verify and validate the developed model. (Chapter 7)
- Identify areas to improve stakeholder involvement, safety culture, and safety performance in the Saudi Arabian construction industry.

As presented in Chapters 2 to 7, these aims and objectives were successfully achieved. In Chapter 3, an investigation of the root causes of accidents was reported. According to IAEA (1992) a poor level of safety culture is the most common contributing factor to major accidents because of the negative influence of the dynamic combination of management attitudes and activities, behaviour, and site environment (Choudhry, R *et al.* 2007b). Nevertheless, three major shortcomings seemed apparent:

- Edwards, JRD *et al.*'s (2013) conceptual model provides a useful starting point for the traditional concept of safety culture, yet requires a clear justification of its indicators and the performance of a validating conformity analysis to validate the model.
- Safety outcome as safety performance requires more in-depth studies to distinguish between leading indicators and lagging indicators, in order to understand the effect of safety culture on those indicators.
- No safety culture model has been conceptualised employing stakeholder theory and thinking in order to understand the relationships between stakeholders and safety culture in the construction industry, or to discuss the usefulness of their interactions.

Therefore, these shortcomings became the research aims, while a number of research objectives were identified to fill those research gaps. This research achieved its aims and objectives by employing the most appropriate methods for literature review, using a questionnaire strategy, including appropriate sampling procedures, and adopting appropriate data analysis techniques, as well as SEM modelling and multi-group analysis (as presented in Chapter 5).

8.1 Background information

Construction projects are managed by people in order to deliver and meet the requirements of the project objectives. Unfortunately, occasionally this involvement leads to accidents associated with injury, pain and suffering. The construction industry plays a vital role in all countries, especially in rapidly developing Saudi Arabia; but there, construction still lags behind other industries in terms of its safety record, which remains poor. Consequently, safety in construction has become a major concern of both society and government (Choudhry, RM *et al.* 2008; Iain & Billy 2008; Phil 2010; Zou 2011), and serious thought is required in order to improve the safety record in the industry.

The literature revealed that accidents can been linked directly and indirectly to some components of safety culture within the construction industry (Charles *et al.* 2007; Gibb *et al.* 2006) (Charles *et al.* 2007). For many years, researchers have investigated the relationships and interactions between safety culture characteristics in order to identify the causes of the high number of accidents in the construction industry. In Saudi Arabia, particularly in terms of workplace safety in the construction industry, researchers have grappled with the problem of understanding the 'safety' or 'accident' phenomenon. All their endeavours have failed to identify the cause of the high percentage of accidents, however, or to determine the barriers that prevent individual workers, construction companies, and the Saudi government from improving safety performance in the industry.

Furthermore, despite the growing body of safety culture literature in the construction industry, the understanding of the effects of stakeholder involvement in safety culture is limited, and their contribution to safety performance has rarely been studied. The interaction between what stakeholders do and what their aims may be in relation to safety performance appear to be ignored.

However, the current research established the fact that there are relationships between stakeholder involvement, safety culture, and safety performance in the construction industry, provides a greater understanding of their interaction which, in turn, will facilitate safety performance improvement. A conceptual model was developed to achieve the research objectives. The model hypothesised a strong relationship between stakeholder involvement, safety culture, and safety performance, along with their constructs. The hypothesis has been validated by the application of the conceptual model to actual research data.

8.2 Brief reiteration of the results

The section begins with a brief reiteration of the findings reported in Chapters 6 and 7 which described the statistical analysis of the data. *SPSS* and *AMOS* software version 20 were used to analyse the quantitative data, and the results showed that the model was a unidimensional construct. A test of reliability and outliers, convergent, construct, and discriminant validity were also undertaken for all constructs, and showed an accepted level of degree. The results indicated that both the measurement and structural model have satisfactory fit indices, and showed a significant fit in the confirmatory factor analysis. In addition, the structural model was tested and showed that 10 of the 11 hypotheses could be accepted, whereas one hypothesis was not statistically significant and was rejected. Moreover, the model was tested with three other subgroups: small organisations with fewer than 49 employees, a medium organisation with between 50 and 499 employees, and a large organisation with more than 500 employees.

There were several findings from the statistical analysis. The discussion begins with an examination of the nature of stakeholder commitment to safety, and the level of safety culture in the context of the Saudi Arabian construction industry. Secondly, the results of the conceptual model and its components presented in Figure 8.1 are discussed with relevance to the stakeholder involvement model, and the safety culture model. The third section discusses the differences between the three groups (small, medium, and large organisations) and evaluates both the direct and indirect impact on safety performance of stakeholder involvement in safety culture.

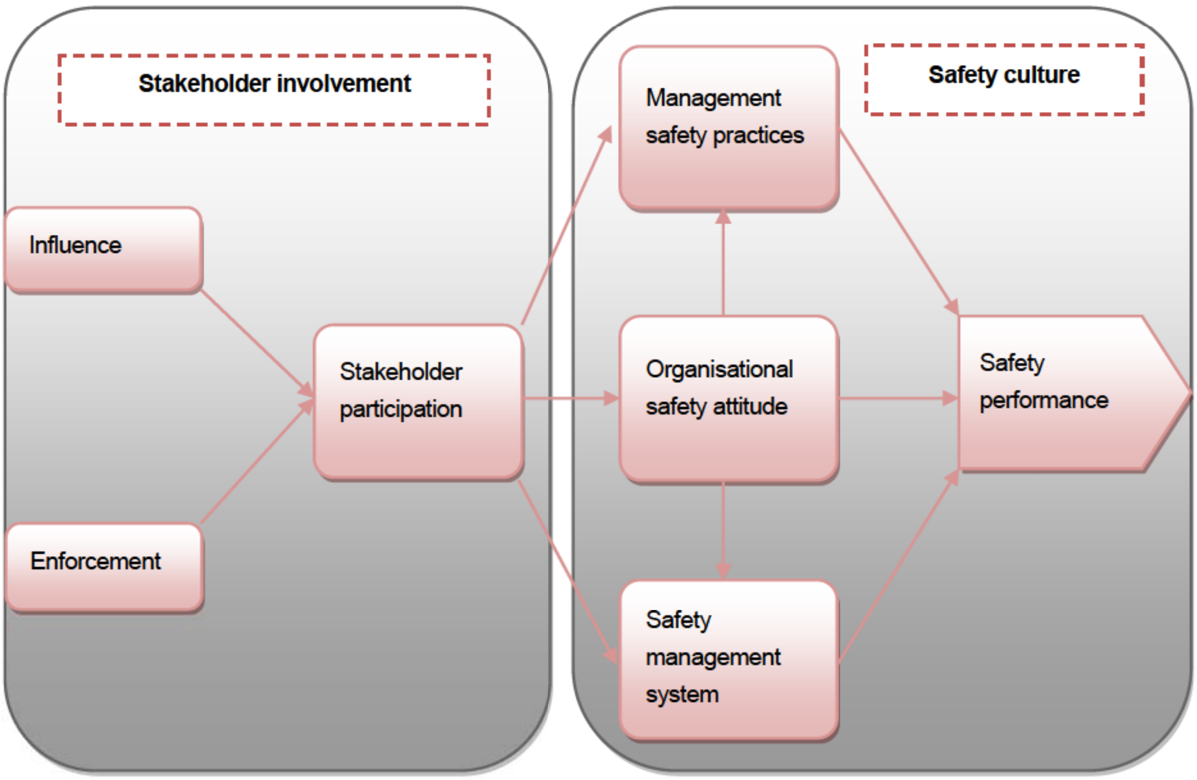


Figure 8.1 The research model

8.2.1 The descriptive data

The data showed that the level of stakeholder involvement and safety culture in the construction industry in Saudi Arabia is highly variable. Of the stakeholders in a position to influence safety culture, the General Organization for Social Insurance (GOSI) recorded the strongest relationship with occupational safety; no other stakeholder demonstrated anything similar. Although GOSI does not use its power to force organisations to improve their safety culture, the results indicate that they do have influence on organisational approaches to safety because of the insurance rates that apply specifically to the delivery of reasonable income and medical benefits to accident victims or their families. Poor safety leads to higher insurance premiums, ensuring the interest of employers in safety and the improvement of safety performance (Jannadi, M 1996).

Project managers were recorded in the results as the group with the greatest influence and participation in safety matters after GOSI, a result supported by Jannadi, A (2008) when he found that most project managers participate in safety to ensure the protection of their workers. Meanwhile, owner/client and main contractors' participation demonstrate a much lower level of involvement in all aspects of safety. The result is consistent with Farooqui *et al.* (2008), who emphasise that, in developing countries, project owners show commitment to safety before a project commences, but tend to pay less attention as work progresses.

Although government participation lags behind both GOSI and the project leaders, it was clear from the results that the government is able to exert the greatest control over workplace safety since it can compel organisations to improve safety – if the government wants to. This is in line with Jannadi, A (2008), who found that among government authorities there was little or no safety regulation enforcement. Indeed, the current study found that the government could improve safety performance if they would, by improving and implementing safety regulations and laws, and aligning this approach with the deployment of highly qualified safety inspectors.

The position of the primary stakeholder in a construction project is unique and their attitude to workplace safety reflects their position as the project instigator in competition with the developers of other projects. The greatest influence exerted on primary stakeholders, therefore, derives from the safety practices of competitors, and from the rates for workers' compensation insurance, both of which threaten the primary stakeholder's bottom line. The lowest level of influence on primary stakeholders was recorded as that exerted by the media, who might attack and organisation for its negligent approach to safety, thus affecting public opinion, but media attack usually affects firms less than any other safety-associated factor (see below).

These results are consistent with Malca *et al.* (2006) who suggest that companies with well-developed safety management lead the drive for improving safety in the workplace. Edwin and Joan (2000) argue that implementing safety best practice could help to improve safety culture in Saudi Arabia, even though those rules do not apply in the Middle East. Workers' compensation insurance premiums were introduced by the GOSI to support victims and their families. However, although the results show that insurance has had some influence on the overall industry approach to safety, the premiums for the construction industry remain the same as other industries in Saudi Arabia, despite the discrepancy in the relevant accident rates.

In regards to the construct of news media, media attacks have no influence on construction companies in terms of their safety culture in Saudi Arabia. There are two possible explanations for this result. Firstly, it may be that the media in Saudi Arabia does not have the power to influence the secondary stakeholders (such as government agencies and insurance companies) to react and enforce organisations to improve their safety culture. Secondly, the Saudi media probably does not see it as advantageous to tarnish the reputations of construction industries. In a similar situation, Elijido-Ten *et al.* (2010) found that the Malaysian media does not have the power to influence a firm's strategies in Malaysia.

On the other hand, in Sweden, a country with a vastly different history, social society and body politic from Saudi Arabia or Malaysia, ,Olander and Landin (2005) note that the media can have a tremendous effect on a project's outcome by influencing decision makers, politicians, and local and national authorities.

The results also show that the attitude of management to overall safety practice demonstrates an extremely variable approach, with actual management involvement in day-to-day activities very low, and safety priority in meetings only a little higher, while contractor management and control appear to be moderately high, being roughly level with management participation in regular safety activities. Allocation of resources for safety is only moderate, as is leadership.

Management commitment appears to be disproportionately high when compared to the foregoing components. Nevertheless, it has been suggested that in developing countries, safety culture could be improved by greater senior management commitment to safety, and continual reflection upon safety practices (Abu-Khader 2004).

Organisational safety attitudes show a high level of management understanding that they are responsible for safety, with low to moderate attitudes in other areas. Safety effectiveness is moderately high, as was adherence to the written rules and regulations, but this is offset by the lower scores of work pressure and productivity versus safety, which demonstrates management assumptions that productivity has a higher priority than safety. These results should not surprise us, but according to Sawacha *et al.* (1999) high productivity and safety performance should not be sacrificed to one another, because they are in fact compatible. However, when the management is applying productivity as a higher priority than safety, and placing increased pressure on workers, the result is an increase in accidents and safety incidents.

Data relating to safety management systems revealed inconsistency in the application of safety procedures and a lack of interest and commitment on the part of everyone participating in the organisation and running of the system. The theoretical objective represented by safety rules and procedures appeared relatively high, but the actual efforts at implementation were low to very low. A possible explanation for these findings is the lack of regulation and legislation governing safety management systems in Saudi Arabia. Baig (2001) supports this view. He found that most of the construction professionals in Saudi Arabia have adequate knowledge about safety rules and procedures, but they have not utilised it effectively to improve safety records.

In effect, all areas of safety performance exhibited only a moderate to very low level of compliance. Training and inspection were undertaken only moderately well, while accident investigation and motivation operated at very low levels. Some of these results were consistent with Tam *et al.* (2004) and Gerbich (2010), who found that in developing countries, lack of training across an organisation or a whole sector is one of the main factors affecting safety performance.

8.2.2 A fragmented approach

When analysed, the results from the data collected during this research made it clear that the Saudi Arabian construction industry lacks both effective occupational health and safety standards and formal safety management systems. Indeed, there is no enforcement to establish safety standards and none yet legally mandated (Baig 2001; Edwin & Joan 2000). Construction workers are not provided with proper protection to prevent accidents, nor sufficient safety education. The absence or insufficiency of occupational safety regulations affects the enforcement of safety in workplaces, and results in making workers vulnerable to accidents and other health and safety issues.

An overview of current laws related to occupational health and safety shows that there are several laws relating to labour; however, they are fragmented. In addition to that, the number and diversity of government agencies responsible for occupational safety and health make the existing laws and regulations hard to follow. The overall consequence of this fragmented approach means there is no comprehensive legislation covering occupational safety and health in the construction industry, and there is no formally legislated authority for the setting up of standards and codes of practice related to occupational safety and health.

8.2.3 The conceptual model and its components

The conceptual model presented in Figure 8.1 illustrates the fact that there were two main strands of research: stakeholder involvement and safety culture. *Stakeholder involvement* was identified as a gap in the literature during the literature review while the idea of a safety culture model was based on the work of Edwards, JRD *et al.* (2013), who conceptualised and distinguished the interrelationship between the characteristics of the safety performance, organisation safety attitudes, management safety practices, and safety management system.

The examination of both safety culture and stakeholder involvement began with a comprehensive literature review, consistent with the approach of .Guldenmund, FW (2000), Mohamed (2002), Flin, R *et al.* (2000), and Fernández-Muñiz *et al.* (2007). Then, the model's dimensions were validated by experts' opinions and perspectives in an approach consistent with the suggestions provided by García-Valderrama and Mulero-Mendigorri (2005) and Nunnally (1970).

One-factor model analysis and confirmatory factor analysis. The conceptual model contained seven latent variables: organisational safety attitudes, safety management system, management safety practices, safety performance, enforcement on stakeholders, influence on stakeholders, and primary stakeholder participation. The following is a summary of the variables extracted through the one-factor model analysis and confirmatory factor analysis.

- *Safety performance* is about how well the organisation manages its hazards (Reason, JT 1997), which can increase its resistance and lower the risk of accidents by positive safety performance, or decrease its resistance and increase the risk of accidents by negative safety performance (Nevhage & Lindahl 2008). The safety performance components, which include four observed variables, were adopted and modified from the scale by Wu, T-C *et al.* (2009) and recommended by Petersen (2005). They were *safety inspection, accident investigation, safety training,* and *safety motivation*. The scale of Wu, T-C *et al.* (2009) produced a good construct, validity and internal consistency using exploratory factor analysis.
- In this research, by using confirmatory factor analysis (CFA), three observed variables – *safety inspection, accident investigation, and safety motivation* – were confirmed and under safety performance the results showed good validity measures. However, in an effort to show how the measurement scale can be improved, safety training was dropped from the CFA because of the lack of training in the context of the research case study (Jannadi, O & Bu-Khamsin 2002).
- *Organisation safety attitude* is about safety behaviour and attitudes, and the beliefs, values, and assumptions, which are shared by members of an organisation, and could be used to determine whether the organisation will accept or reject the best implementation of safety culture to align within organisational culture (Edwards, JRD *et al.* 2013), and the ability to explore how safety culture is understood by its member (Baram & Schoebel 2007). This research identified nine common factors as observed variables in the literature. Using CFA, four of the variables were confirmed, and fall under organisation safety attitude: *the clarity of the safety rules and regulations, work pressures, reporting injuries and accidents*, and *safety awareness.*
- *Management safety practices* are part of the safety culture of organisational managers and practitioners (Edwards, JRD *et al.* 2013). In the literature, this research identified nine common factors as observed variables. Six were confirmed and fell under management safety practices after CFA. These were: *senior management commitment, management*

involvement with day-to-day safety activities, two-way communication, resource availability for safety, safety meeting, sharing safety matters with contractors, and *management's safety leadership.*

- *The last dimension of the safety culture model, safety management system, was considered as a set of integrated aspects of organisational design* (Antonsen 2009b; Fernández-Muñiz *et al.* 2007), which could be used as a solution or tool for an organisation to improve or maintain safety outcomes by evaluating safety culture (Frazier *et al.* 2013). In this research, eight observed variables were identified from the literature. Four observed variables were confirmed and fell under safety management system following CFA: s*afety planning, hazard identification, safety rules and procedures*, and *safety review*.

8.2.4 Stakeholder involvement

Primary stakeholders are those who have a direct impact upon an organisation and have formal or contractual relationships with the organisation, such as the client/owner, project managers, and contractors. In this research, CFA confirmed that those stakeholders fall under the primary stakeholder construct, and had a good construct validity and internal consistency.

Secondary stakeholders are those who are indirectly engaged in the organisation's activities but are able to enforce the organisation's decisions, such as government agencies, authorities, and insurance companies (Savage *et al.* 1991). Through their rules and regulations, secondary stakeholders can exercise authority over organisations. Therefore, it was decided to group the secondary stakeholders under a construct called *safety enforcement*. CFA confirmed that these observed variables the *government inspectors, the Ministry of Labour, and the General Organization for Social Insurance* fell under safety enforcement as secondary stakeholders.

Safety influence. In this research, three main factors – *the rates of workers' compensation insurance, the safety practices of competitors, and media attacks or social media* – were identified and adopted as observed variables that could influence the primary stakeholders' approach to safety and the shaping of plans and action. CFA confirmed that the first two of these observed variables fell under one construct called *safety influence*, whereas, media attacks was dropped from the CFA to show how the measurement scale could be further improved.

Therefore, the factor-structure confirmed by CFA was possibly most appropriate, as the seven latent constructs with their observed variables were obtained from a comprehensive literature review and 381 valid questionnaires, and had a good construct validity and internal consistency.

8.2.5 Comparison of ideas of safety culture

Dimensions and factors of safety culture measurements are the major features of safety culture. Table 3.4 in Chapter 3 shows a number of attempts have been made to construct the dimensions of safety culture, which differ from one industry to another, and from one level to another. Brown, RL and Holmes (1986) have concluded that the dimensions that measure safety culture within one population may not be valid in another, and according to Coyle *et al.* (1995) there is no universal set of safety climate factors. However, from a comprehensive literature review and experts' feedback, a reasonable and satisfactory questionnaire for the construction industry that covered most dimensions of safety culture along with stakeholder involvement, was developed for the current study.

Among the large number of research studies focusing on safety culture, a few review papers were more closely aligned with this study than others, and they summarised the contributions of numerous research studies in the area. **Fernández-Muñiz et al. (2007)**, for example, considered safety culture to be a management tool to help and control employee beliefs, attitudes, and behaviour in regard to safety. Their study is in line with that of Donald and Young (1996), who carried out a review of the previous studies of safety management systems in which they identified some key dimensions of safety culture and safety management. They conducted a survey on safety culture in which 40 factors were extracted from 57 questions, but 29 useful factors were listed by using exploratory factor analysis and confirmatory factor analysis.

By evaluating the reliability and validity of the proposed latent constructs and their items, Fernández-Muñiz *et al.* (2007) suggest the final composition of a safety culture scale as follows:

- managers' commitment
- employees' involvement
- safety performance (lagging indicators)
- safety management system.

Another study by **Frazier et al. (2013)** extracted four latent constructs from a 92 item questionnaire. The authors had constructed a safety culture survey by evaluating literature and conducting expert analysis. The 92 questions were organised into four scales: *management concern for safety; peer support for safety; personal responsibility for safety;* and safety management systems. By using exploratory factor analysis and hierarchical confirmatory factor analysis, the authors extracted 12 items: training, caution others, risk behaviour, respectful feedback, reward/recognition, supervisor concern, senior management concern, discipline and investigation, incident reporting behaviour, communication, supervisor/management blame, and management work pressure.

Al-Refaie (2013) identified a range of factors divided into four levels, including organisational, safety management, work group, and safety performance level factors. The *organisational level* includes five factors: management commitment to safety, interrelationships, continual improvement, blameless culture, and employee empowerment. The *safety management level* includes four factors: safety activities, safety management system, reward system, and safety reporting system. The *work group level* involves supervision and teamwork. The *performance level* includes three factors: safety self-efficacy, safety awareness, and safety behaviour. By conducting a self-administered questionnaire and using confirmatory factor analysis, Al-Refaie (2013) extracted those four groups.

Comparing the current study with previous research in regards to safety culture constructs and other involvement is important for understanding the contribution made by the current study to the body of knowledge related to workplace safety. In general, the current study and the previous studies, presented in Table 8.1, have many traits in common. Typically, all of the studies identify the safety factors of *commitment, communication, safety system, safety attitudes and behaviours*, and *safety regulations and rules*.

For example, **commitment** typically refers in the literature to senior management considering safety a high priority (Al-Refaie 2013; Frazier *et al.* 2013), which is the same as manifesting a strong commitment to safety (Fernández-Muñiz *et al.* 2007). **Communication** refers to the transfer of information to workers about the possible risks in the workplace (Fernández-Muñiz *et al.* 2007), and communication of safety goals (Frazier *et al.* 2013), and communication safety policies and knowledge, and promotes safety practices (Al-Refaie 2013).

The third factor, **safety systems**, encompasses many aspects of an organisation's safety management system, including policy, incentives planning, control, training (Frazier *et al.* 2013), safety procedures, preventive actions, assessment of the safety condition (Al-Refaie 2013), discipline, and rewards and recognition (Fernández-Muñiz *et al.* 2007).

The fourth factor, **safety attitudes and behaviours**, refers to the perception of management attitudes and behaviours around safety (Frazier *et al.* 2013) and positive and supportive attitudes toward safety management activities (Al-Refaie 2013; Fernández-Muñiz *et al.* 2007). The last factor, **safety regulations and rules**, covers the perceptions of safety rules, attitudes to compliance and rules, and violation of safety procedures (Al-Refaie 2013; Fernández-Muñiz *et al.* 2007; Frazier *et al.* 2013).

Table 8.1 Comparison of safety culture dimensions between the current study and the previous studies

Current Study	(Fernández-Muñiz et al. 2007)	(Al-Refaie 2013)	(Frazier et al. 2013)
safety performance • safety inspection • accident investigation • safety motivation **org. safety attitude** • the clarity of the safety rules and regulations • work pressures • reporting injuries and accidents • safety awareness **mgt. safety practices** • senior management commitment • management involvement with day-to-day safety activities • tow-way communication • resources availability for safety • safety meeting • sharing safety matters with contractors and • management's safety leadership **safety mgt. system** • safety planning • hazard identification • safety rules and procedures and • safety review	**safety performance** • (lagging indicators) **employees' involv.** • compliance with safety regulations • participation in devising executing and monitor safety plans **managers' commit.** • attitudes • behaviours **safety mgt. system** • policy • incentives • training • communication • planning • control	**organisational level** • management commitment • interrelationships • continuous improvement • blaming culture • employee empowerment **safety mgt. level** • safety activities • safety management system • reward system • safety reporting system **work group level** • supervisor • teamwork **safety performance** • safety self-efficacy • safety awareness • safety behaviour	**personal resp.** • supervisor/mgt blame • risky behaviour • incident reporting **peer sup. for safety** • caution others • respectful feedback **mgt. concern for safe.** • supervisor concern • senior management concern • work pressure **safe. mgt. systems** • training • communication • rewards and recognition • discipline

stakeholder involvement		
primary stakeholders • client/owner • project managers • contractors	**secondary stakeholders** ***enforcement*** • local government • agencies ***influence*** • workers' compensation • competitors	

There are, however, some important differences that were identified during the current study. The current study has adopted different measurements for safety performance, which include leading indicators instead of lagging indicators, as advised by Choudhry, R *et al.* (2007a) in order to focus on safety activities to attain system success, rather than system failure. Whereas Fernández-Muñiz *et al.* (2007) used lagging indicators, while other studies had no safety performance as an outcome from safety culture.

Earlier research and the current research did not always agree on the common factors of a safety culture, and, in fact, the current research developed and confirmed a new factor that related to stakeholder involvement and approach to safety by using the concept of stakeholder theory. This factor was divided into three subgroups: stakeholders' participation, enforcement on stakeholders, and influence on stakeholders.

Therefore, this research used the developed safety culture dimensions and adopted stakeholder theory and thinking in order to understand the relationships between the stakeholders of the construction industry and safety culture.

The next section evaluates the impact of stakeholder involvement and safety culture dimensions on safety performance.

8.2.6 Evaluation of the impact of safety culture on safety performance

This research found relationships between safety culture and safety performance. The proposed safety culture model derived from Edwards, JRD *et al.* (2013) was tested by using the structural equation modelling statistical technique. The goodness-of-fit indices of the Edwards, JRD *et al.* (2013) model indicate a good model.

H6 *Organisational safety attitude is positively associated with safety performance.*

H7 *Organisational safety attitude is positively associated with management safety practices.*

H8 *Organisational safety attitude is positively associated with the effectiveness of the safety management system.*

With regard to testing the hypotheses put forward, the coefficients reflected in the model confirmed that *organisation safety attitude* has a direct, positive, and statistically significant influence on *safety performance*, *management safety practices*, and *safety management system*, corroborating hypotheses H6, H7, and H8, respectively. The demonstrated result between organisational safety attitude and safety performance is supported by Wadsworth and Smith (2009), Wu, T-C *et al.* (2008), and Sawacha *et al.* (1999); this is a positive association, and could enhance safety performance by encouraging positive attitudes toward safety.

The result between organisational safety attitude and management safety practices is supported by Fernández-Muñiz *et al.* (2007) and Sawacha *et al.* (1999), and could influence the improvement of safety practices such as commitment, and the establishment of regular, effective safety meetings. The result between organisational safety attitude and the safety management system is also supported by Hsu *et al.* (2008), Aksorn and Hadikusumo (2008), and Fernández-Muñiz *et al.* (2007). Successful implementation of safety management systems needs an appropriate attitude from senior management.

H9 *Safety management system is positively associated with safety performance.*

Hypothesis H9 is also accepted, since the results show that safety systems exert a significant, direct, and positive influence on safety performance. The results are consistent with the findings of Frazier *et al.* (2013), Fernandez-Muniz *et al.* (2009), and Robson *et al.* (2007). They found that these interventions indicated consistently positive effects on safety performance.

However, the results show that management safety practices have a positive, but not significant influence on safety performance (leading indicators), which rejected hypothesis H9. This finding is partially supported by Cheng *et al.* (2012) who found that safety management practices were positively, but not significantly, related to project performance, while Ali, H *et al.* (2009) found that there is a relationship between management practices in safety culture and safety outcome (lagging indicators) and reduced injury rates. A possible reason for this result is that there may be no relationship between management safety practices and safety performance as leading indicators, or this relationship may not be worthwhile in the context of the research's case study.

It would appear that where there are positive safety attitudes available inside a construction firm, better management safety practices and safety outcomes, and an effective safety management system are the results. Thus, through its positive safety attitude, a construction firm exerts a greater sustained effect on improving safety performance.

8.2.7 The effect of primary stakeholders on safety culture

The current study proposed a new model by integrating stakeholder involvement into the safety culture model. The interaction between the key elements of safety culture and stakeholder involvement were examined. The statistical results confirmed the existence of a very strong relationship between both stakeholder involvement and safety culture elements. The section below discusses the relationship between stakeholder involvement and safety culture.

In construction projects, a project stakeholder needs to purposefully engage in order to promote a positive safety culture and create a higher level of safety outcome (Huang, X & Hinze, J 2006a; Loebbaka & Lewis 2009; Zou 2011). The coefficients reflected in the model confirmed that the primary stakeholder has a direct, positive, and statistically significant influence on organisation safety attitudes, the safety management system, and management safety practices, verifying hypotheses H3, H4, H5, as explained below.

H3 *Primary stakeholder involvement is positively associated with organisational safety attitudes.*

The results of this current study indicate that the primary stakeholder has a positive, direct, and significant influence on the safety attitudes of construction firms. The results confirmed that the primary stakeholder 'client/owner, projects managers, and contractors' can influence their organisation's safety attitudes by demonstrating to their workers that safety is important in their daily routines by:

- making safety rules easy for people to follow
- making sure that workers don't break safety rules when there are work pressures
- encouraging their workers to report all minor injuries and incidents
- creating safety awareness among their workers regarding safety instructions and rules.

The results are consistent with previous studies, for instance, Huang, X and Hinze, J (2006a), who found that owners/clients possess the capacity to influence safety at projects in positive ways by their participation in safety activities at each stage of the project, encouraging their workers to report unsafe acts, and through the development of a safety culture. Furthermore, project managers can enhance safety outcomes by increased awareness of safety issues (Geldart *et al.* 2005), personal involvement in safety activities, and open two-way communication between worker and management on reporting safety issues (Dejoy 1985). Contractors are also responsible for enhancing the safety of their workers by emphasising to employees that safety is important, and ensuring that work pressures do not lead workers to break safety rules (Hinze, J & Wiegand 1992).

H4 *Primary stakeholder involvement is positively associated with management safety practices.*

In regard to the relationship between primary stakeholders and safety management systems, the results confirmed that the primary stakeholder has a positive, direct, and significant influence on the safety management system, as they have the power to integrate safety planning with the other areas of their organisation, identifying hazards and risks, by ensuring existing safety rules and procedures are followed in order to protect workers from accidents, and by implementing an auditing program in their organisational sectors for safety at work.

These results are consistent with earlier studies. For instance, Saurin *et al.* (2004) examined the effectiveness of safety planning integration in the control process of construction projects. They suggest that clients, managers, contractors, and subcontractors should be involved in the decision-making process, and also the integration of other core managerial processes, such as cost and human resources management, and design, as an essential provision for the overall enhancement of on-site safety.

Furthermore, on-site hazards and risks have been identified as a fundamental factor in improving safety at projects as part of client/owner, project managers', and contractors' responsibilities (Hinze, J & Wiegand 1992; Huang, X & Hinze, J 2006a; Mohamed 1999). Regarding the effectiveness of safety rules and procedures, Huang, X and Hinze, J (2006b) observed that the client/owner can influence construction project safety by providing adequate safety procedures for their workers to follow. Additionally, management needs to develop safety activities, such as safety auditing in order to maintain consistency in safety performance indicators (Health and Safety Executive HSG65 1997).

H5 *Primary stakeholder involvement is positively associated with the effectiveness of the safety management system.*

In regard to the relationship between primary stakeholder and management safety practices, the present study confirmed that the primary stakeholder can have a positive, direct, and significant influence on management safety practices by showing their commitment to safety, by becoming involved with day-to-day safety activities, effectively communicating safety concerns to their workers, promoting better on site safety during negotiations with contractors before signing any contracts, and by using their authority to require subordinates to reach safety targets. The results are consistent with previous studies.

For instance, a strong commitment to safety on the part of clients/owners, managers, and contractors has been found to be a fundamental factor in enhancing project safety performance (Hinze, J & Wiegand 1992; Huang, X & Hinze, J 2006a; Mohamed 2002). Primary stakeholder involvement with day-to-day safety activities (Trethewy 2003), and continual safety communication (Huang, X & Hinze, J 2006a) with contractors and subcontractors (Hislop 1999; Huang, X & Hinze, J 2006a) are also considered critical to superior safety within the workplace.

It would appear that primary stakeholders play a vital role in influencing the establishment and maintenance of a safety culture. Their influence in changing the organisational safety attitude, improving management safety practices, and implementing a safety management system is a fundamental aspect of ensuring a better safety performance.

8.2.8 The effect of secondary stakeholders on safety culture

The role of government as secondary stakeholder is identified by Kartam *et al.* (2000) as influential in enhancing construction safety outcomes. The results of this study show that the safety legislation and regulations of government bodies and regulating agencies exert a direct, positive, and significant enforcement on the primary stakeholders and their organisations, and indirect and positive enforcement on safety culture, which confirms hypothesis H2.

H2 *The safety regulations and procedures of the government agencies are positively enforcing the primary stakeholders to enhance safety culture.*

This result is supported by Fassin (2009). Government bodies and regulating agencies enact laws and impose regulations, then order organisations to take on certain responsibilities for workers' well-being; this derives from the moral and ethical obligation of government bodies and agencies to ensure the safety of their citizens, and by corollary, of construction projects within their country (Smyth 2008). Government as stakeholder can limit the resources available to firms (Frooman 1999), or projects (Aaltonen *et al.* 2008) and demand changes in safety culture. Therefore, the licenses and permits are obviously resources for government bodies. By holding the right to grant permissions and approvals, they can force the construction firms to adopt certain safety requirements, before permission is granted for commencement of their projects. In addition, the results imply that the government bodies and regulating agencies can be considered as holding a moral and ethical stake in a project, with a more explicitly tangible legal stake, so that the construction industry has a concrete moral and legal framework within which to act.

Lastly, the results show that both the impacts of the rates of workers' compensation insurance and the practices of competitors have a positive, direct, and significant influence on the primary stakeholders, and indirect and positive influence on safety culture, partially corroborating hypothesis H1. This finding is in accordance with other studies; the primary stakeholder could be influenced to improve safety at workplaces by insurance premiums (Everett & Yang 1997; Mearns, Kathryn & Håvold 2003) and safety practices of other competitors (Malca *et al.* 2006; Sulaiman 2008).

H1 *The impact of the rates for workers' compensation insurance, safety practices of competitors, or social media are positively influencing the primary stakeholder to approach safety.*

To conclude, this research identified complex relationships between primary stakeholders (client/owner; project managers; contractors) and safety culture, and between secondary stakeholders (government bodies, regulation agencies, insurance companies, competitors, media) and primary stakeholders with regard to the improvement of safety performance.

The research results permit conclusions about stakeholder involvement with the construction industry in favour of a positive safety culture and performance. The results permit the acceptance of the hypotheses that primary and secondary stakeholders exert pressure on organisations and positively influence and enforce their safety culture. The results from the current research support the idea that proactivity towards the establishment and maintenance of safety culture is associated with greater pressure from primary stakeholders.

On the other hand, a reactive mood predominates when pressure is applied by government bodies and regulation agencies. Primary stakeholders influence proactive safety behaviour in three constructs – organisational safety attitude, management safety practices, and safety management systems – in order to improve safety performance.

In regard to stakeholder theory, Frooman (1999) proposes two dimensions that classify stakeholder influence on organisational strategies by using the theory of resources dependence. The stakeholders, such as government bodies and regulatory agencies, which provide the organisation with resources can threaten to impose conditions for the continued supply of resources, or suspend supply entirely. On the other hand, other stakeholders, such as insurance companies, competitors, and the news media, use their influence to manipulate the resources flow to the organisations. However, data in the current study indicated that the news media has no influence on organisational strategy.

8.2.9 The effect of the organisation's size on safety culture

The size of the organisation has been found to be associated with safety performance in construction projects (Lin & Mills 2001). Therefore, a multi-group analysis of variance was performed on stakeholder involvement and the safety culture model among three groups (small organisations versus medium, and large, and medium organisations versus large).

Analysis of data from small and medium size organisations uncovered a significant difference in two critical safety areas. The results indicated that the impact of the primary stakeholders on organisational safety attitudes differ significantly between small and medium organisations. Small organisations demonstrate a strong, positive effect on organisational safety attitudes by primary stakeholders. For medium organisations, however, the effect of the primary stakeholders on the same safety construct is doubled.

Data analysis also indicated that the impact of the primary stakeholders on safety management systems differed between small and medium organisations. In small organisations, the effect was positive between primary stakeholders and the safety system, but it was not significant, whereas the influence of stakeholders on medium organisations was strongly positive and significant. This implies that the moderating variable exerts a moderating effect on these relationships.

Analysis performed on results between small and large organisations indicates that the impact of the primary stakeholders on organisational safety attitudes differs significantly between small and large organisations. Data from small organisations reveal a strong positive affect between primary stakeholders and organisational safety attitudes, whereas the effect of stakeholder behaviour and attitudes on the organisational safety attitudes of large organisations was greater than 399%.

In a multi-group analytical comparison between medium and large organisations, the results demonstrate a slight, but not significant, difference. In fact, the results show that the impact of the primary stakeholders on organisational safety attitudes differs only slightly between medium organisations and large organisations. Medium organisations exhibit a strong positive effect between primary stakeholders and organisational safety attitudes, whereas large organisations have the strongest positive affect among the three groups on the same path between the primary stakeholder and organisational safety attitudes.

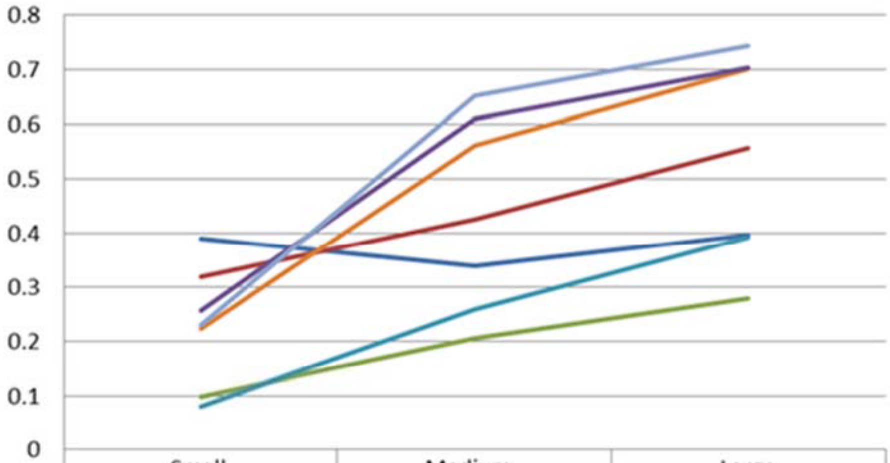
The research results supported by some studies show that the safety performance of small firms is relatively poor when compared with larger firms (Lin & Mills 2001; Vickers *et al.* 2005). For instance, Lin and Mills (2001) found that small organisations perform poorly compared to larger organisations, generally because their projects are smaller and there are fewer hazards and risks, encouraging senior management to only weakly commit to safety performance improvement.

Larger organisations, on the other hand, have more reasons to commit strongly to safety compared to smaller ones. Their tasks are usually larger and more complicated, workforces are larger and there is a high degree of risk from the greater amount of activity. Larger organisations also usually face greater scrutiny from more and varied primary and secondary stakeholders. It is therefore worth their while to commit more resources to the implementation of better safety procedures (Lin & Mills 2001). In addition, as Vickers *et al.* (2005) point out, small organisations often have lower awareness of potential hazards, as well as less knowledge of safety requirements.

In larger construction organisations, then, primary stakeholders appear to be more proactive about improving the safety culture, a result consistent with Finneran *et al.* (2012), who found that clients, leaders and contractors were active in the sphere of workplace safety, improving and enhancing safety outcomes in major projects.

8.2.10 The relationship between the organisation's size and stakeholder involvement on improving safety culture

Figure 8.2 demonstrates the ways in which the standardised total effects differ across small, medium, and large organisations. The results show a dramatic change across the three groups. In general, in small organisations, the primary stakeholder has the lowest positive effect on safety culture and safety performance, whereas, in large organisations, the primary stakeholder has the greatest positive effect on the same paths. However, enforcement from a secondary stakeholder (government bodies, authorities, and insurance companies) remains steady across small, medium, and large organisations.



	Small	Medium	Large
ST_ENFORCE- ST_PARTIC	0.391	0.338	0.397
ST_INFL - ST_PARTIC	0.319	0.426	0.557
ST_PARTC-OSA	0.223	0.561	0.702
ST_ENFORCE- SP	0.1	0.206	0.279
ST_PARTIC - SP	0.257	0.61	0.704
ST_INFL - SP	0.082	0.26	0.392
ST_PARTC-SMS	0.23	0.652	0.744

ST_ENFORCE –(Enforcement by secondary stakeholder), ST_PARTIC- (Primary Stakeholder Participation), (ST_INFL : Influence on primary stakeholders), (SP: Safety Performance)

Figure 8.2 The standardised total (direct and indirect) effect for stakeholder involvement

The results are supported by some studies. Vickers *et al.* (2005) they point out that safety regulations and laws apply equally to organisations of all sizes. Also, Lin and Mills (2001) found that the safety regulations employed by governments place significant pressure on both smaller and larger organisations, but that small organisations do not in general have either the safety commitment from senior management, or the ability to achieve a greater level of safety when compared to larger organisations.

The effect of the other secondary stakeholders' influence (insurance premiums and competitors) on primary stakeholder and safety performance, on the other hand, dramatically affects all three groups of business organisations. These results are consistent with accounting literature. Everett and Yang (1997) point out that larger construction organisations pay more attention to insurance premiums than do smaller organisations, because larger organisations have more risks, just in the number of employees and amount of equipment. As Malca *et al.* (2006) observe, competition among businesses tends to lead the drive to improve safety in the workplace when safety is seen as a competitive advantage. And, increasingly, consumers and investors do consider workplace relations when buying and investing in businesses.

8.2.11 Summing up

Ten of the 11 hypotheses were supported. Only management safety practices were not associated positively with safety performance. Compensation insurance, the safety practices of competitors, as well as the regulations and procedures of government agencies and activities of social media that positively influence the primary stakeholders' behaviour thereby contributing to a positive safety attitude and culture. The safety management system put into place in these circumstances will be positively associated with and encourage good safety performance.

The conceptual model used in this study, and the methods could usefully be applied in other circumstances, particularly developing countries that are at the point of establishing more sophisticated and safer construction industry workplaces in order to gain competitive advantage in world markets.

Table 8.2 **Summary of hypothesis relationships identified**

No	Hypothesis	Level of support	The big picture
H1	The impact of the rates for workers' compensation insurance, safety practices of competitors, or social media are positively influencing the primary stakeholder to approach safety.	Supported	The current research confirms that in Saudi Arabia, the factors identified as influential in workplaces worldwide are also having an impact on the kingdom's primary stakeholders, although the effects of social media are, on the whole, less extensive because the use of social media is also less extensive.
H2	The safety regulations and procedures of the government agencies are positively enforcing the primary stakeholders to enhance safety culture.	Supported	The current research confirms that in Saudi Arabia, government regulation influences the behaviour of primary stakeholders who, in turn, commit themselves to actions that enhance safety culture. However, government regulations need to be consistent and consistently applied.
H3	Primary stakeholder involvement is positively associated with organisational safety attitudes.	Supported	When the primary stakeholders become involved in ensuring that the workplace is safe, the positive attitudes are reflected throughout the organisation.
H4	Primary stakeholder involvement is positively associated with management safety practices.	Supported	When the primary stakeholders become involved in ensuring that the workplace is safe, the positive attitudes are reflected in management safety practices because of the positive leadership.
H5	Primary stakeholder involvement is positively associated with the effectiveness of the safety management system.	Supported	Positive leadership creates a positive safety culture. This, in turn, is reflected in the effectiveness of the safety management system through consistent, regularised practices.
H6	Organisational safety attitude is positively associated with safety performance.	Supported	Safety performance in SA organisations is highly dependent on organisational safety attitudes established by primary stakeholders.
H7	Organisational safety attitude is positively associated with management safety practices.	Supported	Management safety practices reflect organisational attitudes established by primary stakeholders. Without a positive attitude, practices tend to lack commitment, consistency and meaningful activity.
H8	Organisational safety attitude is positively associated with the effectiveness of the safety management system.	Supported	It requires commitment and consistency to establish a safety system. Safety management systems reflect the safety attitudes of the organisation.
H9	Safety management system is positively associated with safety performance.	Supported	Safety management systems result in better safety performance because they are put in place by an organisation interested in safety.

H10	Management safety practices are positively associated with safety performance.	Not Supported	Management safety practices can be poorly conceived and conducted, and do not necessarily assist with improved safety performance.
H11	Construction organisations with few employees are less likely to get influenced and enforced by stakeholders to approach safety matters. Those with a larger number of employees are more likely to get influenced and enforced by stakeholders to approach safety matters.	Supported	Larger organisations in SA are often more advanced in their safety awareness and appreciation of legal obligations and the economic benefits of having a safe workforce. They exhibit a more safety conscious culture than smaller organisations that are not equipped with such a well-organised and experienced staff or overseas experience.

8.3 Knowledge contribution

Despite the large number of studies that have addressed the concept of safety culture and safety performance, only limited studies have focused on:

- stakeholder involvement and safety culture in the construction industry with particular reference to developing countries
- an inter-cultural study of Saudi Arabian culture.

In the majority of existing studies, researchers have either replicated an already tested model in order to improve its' adequacy or to develop a new model. Furthermore, to the best of the researcher's knowledge, none of the existing studies has explored the extent to which stakeholders promote a positive safety culture within the Saudi Arabian construction industry. For the first time, the work concluded through this study has looked at the inter-cultural aspects of Saudi Arabian construction stakeholders and senior management in regards to safety, and then attempted to assess the influence of the stakeholders on safety culture and safety performance and the impact of the enforcement of safety policy.

Therefore, the current study adds to a growing body of empirical research concerning construction safety culture in developing countries, and its relationship with its stakeholders. The most notable contribution of this study is the examination of the relationships between stakeholders (primary and secondary) and safety culture dimensions in order to improve safety in the workplace. In addition, it has opened up a future area of research to clarify these relationships, in particular by considering stakeholder theory and construction safety culture.

8.3.1 Theory building

The study makes a contribution to workplace safety theory in a number of ways:

- Firstly, based on extensive reviews of the relevant literature (Chapters 3 and 4), this study proposed a conceptual model for understanding the relationships between safety culture's dimensions and stakeholder involvement in Saudi Arabian construction projects. The model encompasses most of the factors that affect safety performance, identified during the current study as seven dimensions.

  ***Each dimension in the conceptual model contains a number of measuring constructs derived from the relevant literature. Four dimensions of the seven (safety practices, attitudes, system, and performance) are highlighted in Edwards et al's study (2013) to indicate the greater depth and practical applicability of safety culture. The finding from the conformity analysis in this study demonstrates that the constructs load onto seven variables: safety enforcement and influence from secondary stakeholders, primary stakeholders' participation, organisational safety attitudes, management safety practices, safety management system, and safety performance.

- Secondly, the conceptual model was found to be a highly valuable tool for examining the extent to which stakeholders are involved in promoting a positive safety culture in the Saudi Arabian construction industry. This model will also be of value to other researchers interested in investigating stakeholders and safety culture in areas other than construction projects.
- Thirdly, in order to assess the correct participants, stakeholder identification is a crucial step. Therefore, this research identified the types of construction stakeholders based on the work of Chinyio and Olomolaiye (2009) and Mitchell *et al.* (1997). As a result, the types of stakeholders were identified as those existing within the context of the Saudi Arabian construction industry. The client/owner, project managers, and contractors were recognised as primary stakeholders, whereas government bodies and regulators were identified as secondary stakeholders. Unions, inspectors, and standards authorities were excluded from the research because they either do not exist in Saudi Arabia or do not deal with workplace safety in any way relevant to the research.
- Fourthly, the current study applied stakeholder theory in an effort to understand how key stakeholders enforce and influence directly and indirectly the safety culture at construction projects. The work of Frooman (1999) was also consulted. Frooman pointed out that the behaviour of stakeholders is based on the dependencies between stakeholders and organisations, and argued that the type of stakeholder influence is a function of the type of resource relationship the stakeholders have with an organisation. The resources on which an organisation may be dependent are physical, financial, and informational (Frooman & Murrell 2005).

  The current research found that the primary stakeholder – client/owner, project managers, and contractors – has a vital role in the outcome of safety culture, because they are dependent on their organisation and the organisation depends on them. However, the secondary stakeholders (government bodies, regulation agencies) that provide the organisation with resources can threaten to impose conditions for the continued supply of these resources. On the other hand, other stakeholders (insurance premiums, competitors, or media) can influence or manipulate the resources flow to the organisations. However, the media in this study were accorded no influence on organisational strategies by the research participants, because media are not dependent on a construction firm, and organisations, in turn, are not dependent on the media.

- Fifthly, the current study has helped to clarify the relationship between stakeholder involvement and safety culture, and also between the safety culture's dimensions. The results from the structural equation modelling support the inter-relationships of the influence of stakeholders on a positive safety culture, and the inter-relationships of the safety culture's dimensions, which are organisational safety attitude, management safety practices, safety management system, and safety performance.
- Finally, the study led to the identification of the 14 principle factors related to safety culture dimensions, and to eight principle factors related to stakeholder involvement that can impact on improving safety outcomes in Saudi Arabian construction projects. The principle factors related to safety culture dimensions, extracted from one-factor models in Chapter 6, were:
  - first dimension, *organisational safety attitudes*, which has four factors, namely: the clarity of the safety rules and procedures, work pressures, reporting injuries and accidents, and safety awareness
  - second dimension, *management safety practices*, has seven factors, namely: top management commitment, management involvement with day-to-day safety activities, two-way communication, resources availability for safety, safety meeting, sharing safety matters with contractors, and management safety leadership
  - third dimension, *safety management system* has four factors, namely: safety planning, hazard identification, implementing safety rules and procedures, and safety review
  - fourth dimension, *safety performance*, has three factors as leading indicators, namely: safety inspection, accident investigation, and safety motivation.

Stakeholder involvement was divided into three elements, along with its principle factors. Firstly, primary stakeholders who can participate directly to improve safety culture are the client/owner, project managers, and contractors. Secondly, there are two types of secondary stakeholders who indirectly influence workplace safety – those who can force organisations to improve safety culture, such as government bodies and regulatory agencies; and those who can influence organisations to enhance their safety culture, such as insurance companies and competitors who benefit in the market from improving organisational safety culture. The existence of these factors is essential to the effectiveness of any attempt to enhance safety matters within the context of Saudi Arabian construction projects.

This study examined the impact of stakeholder involvement on organisational safety culture in relation to the organisation's size by performing a multi-group analysis. The study results indicated that the larger Saudi Arabian construction firms are the ones most likely to respond to stakeholder influence and enforcement, and that primary stakeholders in larger organisations have the greatest positive effect on safety culture, whereas secondary stakeholders have less effect. Firms with fewer employees are less likely to turn their attention to safety at their workplace, because the primary stakeholders are inadequately involved with safety concerns and do not enforce regulations. In addition, the results showed that secondary stakeholders have a small effect on the safety cultures in smaller organisations, whereas, primary stakeholders had the lowest positive effect or influence.

The research approach and the results have, therefore, contributed to a greater understanding of the complexity of safety culture implementation in the context of stakeholder theory and stakeholder theory development. Furthermore, the research has provided a better understanding of the requirements for measuring a reflective model, where inclusion or exclusion of one or more of the indicators will not change the validity of the latent constructs (Baxter 2009; Coltman *et al.* 2008), as well as the specific results that were identified in this study that contribute toward filling in gaps in the relevant literature, that is, insight into the factors that contribute to the positive and advanced development of management safety practices, organisational safety behaviour, safety management systems, safety performance, stakeholder enforcement and influence, and stakeholder participants.

8.3.2 Practical implication

The construction industry in Saudi Arabia lacks the infrastructure for advanced occupational safety enforcement and influence. This study makes a contribution at the applied level by providing insights for practitioners and main policy makers that may readily be applied with a view towards stimulating stakeholder and safety culture activities. From a practitioner perspective, the model can be used to assess the extent to which primary and secondary stakeholders are involved and participate in safety matters, and to measure safety culture in organisations.

Study findings indicate that the effects of stakeholder involvement on the safety culture of construction projects is crucial to the well-being of the workers. Positive organisational safety attitudes and the implementation of safety management systems all depend on client/owners, project managers, and contractors who take time to focus on workplace safety.

Normally, construction stakeholders believe that preventing accidents is worthwhile for a variety of reasons. Accident prevention helps avoid harm to workers and their families. It helps to remove the threat of prosecution as a consequence of non-compliance with safety laws. In addition, it helps avoid the costs that are inevitably associated with accidents. Accident prevention is beneficial in helping strengthen employee morale (Holt 2008); and finally, putting the safety and health of workers at risk through negligent attitudes to safety is morally unacceptable.

Unfortunately, in the case of this study, most of these reasons for the pursuit of workplace safety were not proving very persuasive. For example, the current safety legislation in Saudi Arabia does not force primary stakeholders to improve safety matters and covers only some basic requirements (see Chapter 2). The next section addresses this issue by providing a practical guide to improving safety culture in Saudi Arabian construction projects.

8.4 Policy and practice

As results from this study indicate, in order to have a positive safety culture, stakeholder behaviour needs to be changed by provoking safety awareness and commitment, but it is quite difficult to do this without appropriate laws that are consistently enforced while developing other less formal methods of motivation. In order to solve this dilemma, this study focused on the three principle factors which are most suitable for the current case study (see Figure 8.3). These three main factors are: enforcement factors, influence and motivation factors, and organisation safety culture.

Figure 8.3 **The proposed process to improve safety culture and performance**

8.4.1 Enforcement factors

The history of imposing occupational safety and health law is obvious in the developed countries. In the United States, the *Occupational Safety and Health Act 1984 (United States)* is known as one of the most powerful enforcement agencies within the government structure, and it has been granted regulatory powers to promote standards, inspect workplaces, investigate accidents and work conditions, and issue citations and penalties for safety violations (Mintz 1984).

In the United Kingdom, the *Health and Safety at Work ETC. Act 1974* is the major piece of health and safety legislation, which is specifically designed to promote, encourage, and stimulate high safety standards (Ogus 1995). In Canada, the government established the Canadian Centre for Occupational Health and Safety in order to reduce the frequency of accidents and deaths by imposing safety regulations and standards, and preventing work-related injury, illness, and death (Charles *et al.* 2007). In Australia, the *Safe Work Australia Act 2008* was passed to improve occupational health and safety outcomes and workers' compensation arrangements, and to provide national policy, regulation, and standards for all workers and workplaces (Australia 2011).

Enforcement factors are about imposing the minimum requirements for safety to prevent incidents, and include the following:

- *safety regulation and law*

  In the case of Saudi Arabia, there is a need to be aware of safety problems and their causes, and to implement strategies for prevention, which can only be achieved through the enactment of laws. The existing occupational safety and health legislation is limited and incomplete, and in any case, covers only protection against occupational hazards, protection against major industrial accidents, and worker's compensation (see Chapter 2). Therefore, it would be desirable for the Ministry of Labour to establish a separate department to regulate occupational safety and health for all industry, and especially for the construction industry. This department would need to be established with a membership from different backgrounds, such as members who represent government, members who represent the interests of workers, and members who represent the interests of employers.

- *safety standards*

  National standards relevant to occupational safety and health need to be issued by the Ministry of Labour requiring employers to adopt practices necessary to protect workers on the job, and to comply with these standards. These standards should cover a wide range of workplace hazards, such as electrical hazards, fall hazards, machine hazards, trenching hazards, explosion and fire hazards, and dangerous environments.

- *first aid regulation*

  First aid regulations need to be considered as a basic legal requirement under occupational safety and health regulations. Basic duties of the employers, such as the duty to provide first aid arrangements and equipment, need to be explained under this regulation. The principles of first aid are to sustain life, to prevent deterioration of an existing problem, to control bleeding, and to prevent collapse. Regulations should explain these principles, and the equipment and first aid requirements necessary to fulfil them.

- *safety requirement*

  A legal requirement for organisations to create and publish safety policies should be added to the new safety regulations. This would require all employers to write safety policy statements which include the responsibilities at each level of management, and how safety and health will be managed. The aim of this policy should be to express the management's intentions in relation to safety and compliance with safety regulations.

- *contractors and law*

  Contracting activities also need to be covered under safety regulations. Contractors employed by an organisation are engaged in performing activities on the organisation's premises. Normally, the organisation is subject to prosecution if there are breaches of safety provisions on its premises caused by the main contractor or one of the subcontractors. Therefore, the new regulation needs to emphasise that an organisation must take all reasonable measures to ensure compliance with safety regulations and then ensure that they are carried out throughout its premises. Also, the organisation must ensure that the contractors make appropriate arrangements for safety provision and then carry them out.

- *penalty and punishment*

  Under new safety regulations, regulators would need to provide a penalty system for employers who failed to comply with the published standards and regulations. Normally, employers will find it in their interest to address safety requirements and standards in order to avoid the penalties and save their human assets.

- *inspectors 'as representative of the legal authority/of the law'*

  Occupational safety and health inspectors need to be appointed under any new safety regulations, and to have the following powers as a minimum:

  - to enter an organisation's premises at any time if they believe there is a dangerous situation
  - to enter the premises accompanied by police if they believe that they may be obstructed from entering the premises in the exercise of their duties
  - to make examinations and investigations to determine whether there has been a breach of the law
  - to take photographs, measurements, and samples
  - to question any person who may have relevant information
  - to take copies of any documents which are required under safety previsions
  - to assume any other powers necessary to enable them to carry into effect the relevant safety provisions.

- *enforcement strategy*

  Enforcement activities play an important role in regulatory efforts to reduce incidents in workplaces. Through a new safety enforcement program, the authorities will send a clear message that this mission will be taken seriously. Enforcement strategies must target organisations that have a history of poor safety management, as well as organisations that wilfully and repeatedly expose their workers to serious hazards, and refuse to correct violations.

- *safety measures*

  Safety measurement: regulators need to adopt two types of measurements: leading indicators and lagging indicators. Leading indicators use proactive measurements that focus on safety activities known to attain system success rather than system failure, such as safety training and education, hazards identifications, communications, safety motivation, safety planning and administration, and accident investigation; whereas lagging indicators are basically only a reactive measurement of an historical safety event, used as an indication of the level of safety failure by assessing downstream consequences, such as worker's compensation; or accident rates.

- *occupational safety and health*

  The Ministry of Labour would need to provide a national occupational safety and health management system in order to help organisations demonstrate compliance with their duty of care under new safety laws. The minimum components of this system may include: a policy in written form, guidelines, a safety management plan, safety procedures, a hazard register, training techniques, and review and audit documents.

- *safety information access*

  After developing occupational safety and health regulations, standards, requirement, first aid regulation, contractor law, penalty systems, safety inspectors, enforcement strategy, and safety measurements, the authorities need to provide a wide range of information for construction safety and health; these range from published books to the journals of professional associations and societies, and consultants. This kind of information needs to be free to access through the internet, and written in two languages, Arabic and English. Thus, organisations will assess their situation and it could be improved by implementing that safety information in their daily rotations.

8.4.2 Influence and motivation factors

Safety is not purely an administrative or structural practice. It has a social dimension, such as organisational culture (Mol 2003). Influence and motivation techniques help to encourage organisations and their workers to improve their safety culture by shaping safety plans and actions. The reduction of incidents in construction projects can be attributed directly to the attainment of good safety behaviour and work practices. In the case of Saudi Arabian construction projects, the following is needed to influence and motivate all stakeholders:

- *setting a national goal*

  Setting attainable national safety goals must be implemented in order to motivate all stakeholders in the construction industry. For example, in Australia, the national safety target was to reduce the incident rate of compensated work-related injury fatalities by at least 20% by 30 June 2012. There was a resultant 41% decrease, as Australia achieved more than twice the desired result (Safe Work Australia 2015).

In the case of Saudi Arabia, the national safety strategy needs to set targets for achieving short and long term occupational safety improvement and to effectively change the safety culture by identifying the main priorities, such as eliminating hazards at the design stage, improving the skills of construction industry managers and workers for effective safety management, reducing the impact of risks, and strengthening the capacity of government to enforce and influence safety performance. The benefits flowing from a national strategy are the provision of a framework for ensuring that there is a substantial and sustained improvement in Saudi Arabia's occupational safety over the next decade.

- *safety awareness campaign*

  Safety awareness campaigns are one of the principle tools for raising awareness of occupational safety and promoting the idea of the goodness of a positive safety culture at workplaces. Such a campaign would involve government authorities, construction organisations, safety consultants, and others, and include conferences, workshops, posters, training, films, competitions, and suggestion schemes. Also, self awareness can include a good practice awards competition as a way of promoting safety.

- *media and safety*

  The news media in Saudi Arabia will have to gain more power before it can influence government authorities and organisations to improve occupational safety at workplaces. Reporting the consequences of an accident as just a number of injuries and fatalities is not enough to have an impact on other stakeholders, whereas reporting a proper investigation with comprehensive details of what happened and why, and who is responsible, along with the effect on the injured worker's family, the overall direct and indirect costs, and the name of the organisation and project where the accident happened, would gain the attention of other stakeholders, and act as an incentive to improve safety at workplaces.

- *religious motivation*

  Saudi Arabia is a Muslim country; Islam insists that workers are not exploited; their working conditions must be suitable for the performance of their duties; and the organisation must look after the welfare of its workers (Lingard & Rowlinson 2005). Violation of worker's rights is prohibited in Islam. Therefore, Islamic values must be used when motivating and influencing all stakeholders to promote safety culture.

- *workers' compensation insurance*

  Worker's compensation insurance premiums are a significant cost in the construction industry. The rate for the insurance premium should be modified to reward organisations that attempt to achieve a good safety performance, while organisations with poor safety records should pay higher premiums. This strategy may help to force organisations to improve safety and thus reduce costs.

- *incentive programs*

  It has been found that incentive programs have a positive effect on organisations and their workers. Offer incentives for change and explain how this change will benefit the organisation. In an incentive program, it could be proposed that if construction companies and their projects finish without an accident, they would receive some kind of award. Obviously, it would create a peer pressure situation inside organisations, and they would encourage their workers to look out for each other in order to keep anyone from getting hurt and losing that reward.

- *inspectors 'as advisor'*

  During inspection of a project site, safety inspectors could be advisors for the organisation. Inspectors could provide organisations with more information about prevention techniques suitable for their site, and direct them to the right resources by employing one of two different ways, as described by Stranks (2005): *improvement notices and prohibition notices*. These notices would carry the weight of a legal requirement, and thus influence organisations to improve their safety management, rather than risk the notices being used against them as evidence in a prosecution.

- *using compensation data to influence occupational safety*

  Compensation and incident reports need to be published in local newspapers and other print and online communication resources. There are sound reasons why these reports should published: 1) The moral reason: this information needs to be made public, and passed on in order to prevent incidents occurring again; 2) the pragmatic reason: publicity will encourage the sharing of information, and discussion of methods of prevention; and 3) economic reasons: some organisations spend more money on preventing accidents than others. Sharing this information would encourage the others to adopt similar practices, which will ultimately prevent accidents and reduce costs.

8.4.3 Organisation safety factors

Safety enforcement and influence from secondary stakeholders are not enough to develop a positive safety culture in construction projects, but primary stakeholders can exert more influence by their actions and attitudes. They should implement strategies to comply with regulations and standards and to change the safety behaviour of their organisations. The strategies include safety leadership, commitment, establishing a positive safety culture, initial occupational safety and health review of their facility, accident investigation, training, and a focus on the effectiveness of the safety management system, such as hazards identification, risk assessment, and risk control.

Organisation safety culture is about the steps that need to be taken by construction companies in order to improve their safety situation, which include the following:

- *safety leadership*

  As indicated by this study, there is a lack of safety leadership at the senior management level. According to Chinda and Mohamed (2008) safety leadership is recognised as a fundamental component of a positive safety culture. Therefore, owner/client, project managers, and contractors should develop positive attitudes among their staffs by coaching their workers in a friendly way about how to carry out safety activities, and by showing respect and concern for their workers' needs, and an understanding of their problems. Furthermore, they need to control safety matters by creating a system to set standards of behaviour for workers, using authority to correct violations, and technology to monitor safety performance.

- *safety commitment*

  Commitment to safety is regarded as an essential component of a positive safety culture (Chinda & Mohamed 2008). Owner/client, project managers, and contractors should demonstrate commitment to workplace safety, support safety promotions and campaigns. This is a form of indirect leadership and sets an example, encouraging workers to also show a positive safety attitude.

- *establishing a positive safety culture*

  The first step towards establishing a positive safety culture – obtaining safety leadership and commitment from the primary stakeholders – is vital. It is the primary stakeholders who can most effectively be role models for their workers, their actions matching their words, and to offer resources and time to safety. According to Cooper, D (1998), there are three levels involved: the immediate, intermediate, and ultimate levels. The immediate level focuses on examination of workflow processes and its supportive functions, establishing control systems, identifying accountability, and organising procedures and rules. The intermediate level includes creating feedback and monitoring systems, correcting errors, solving problems, and forward safety planning. The ultimate level of effort focuses on having developed dynamic, living control, and feedback systems.

- *initial occupational safety and health review of their facility*

  Organisations must identify their current safety position to establish the baseline for development of occupational safety and health. Basically, this step can be done by reviewing the existing administrative control, inspecting the work environment, consulting and interviewing workers, and analysing hazards and risks of job tasks. The purpose and scope of this initial occupational safety and health review is to create a gap analysis against the safety requirement.

- *accident investigation*

  The aims of accident investigation are to identify causes, so that similar accidents can be prevented in future. At workplaces, the investigation must be conducted as soon as possible after the accident in order to determine and verify what happened and which factors contributed to the event.

- *training*

  The aims of accident investigation are to identify causes, so that similar accidents can be prevented in future. At workplaces, the investigation must be conducted as soon as possible after the accident in order to identify what happened and which factors contributed to this event.

- *hazards identification, risk assessment, and risk control*

  Hazards identification is about finding any potential for harm to the safety, health, or welfare of workers (Hoła 2010). Hazards identification could be carried out by checking the records of injuries and incidents that have occurred, conducting internal inspections, consulting with workers and listening to their job problems, and reading in advance some publications that help to identify potential hazards.

  When hazards have been identified, each hazard can be assessed according to its risks. The risk is the likelihood that the hazard will cause injury, illness, or disease. Risk assessment includes evaluating the probability and consequences of injury, illness or disease arising from exposure to an identified hazard or hazards.

  When hazards have been identified and the risks assessed, appropriate control measures should be developed and implemented. The aim is to eliminate or minimise the risk.

The foregoing factors are only provided to assist the development of a construction safety program. Because all construction projects are unique, each organisation should be aware of all safety regulations and standards in order to behave appropriately whatever the circumstances.

8.4.5 Time frame for implementation

Table 8.3 summarises all the suggested factors, along with its time frame for implementation (now, soon, or later). Using these suggestions, government bodies and authorities and regulators could start to implement and encourage the following:

- support for safety inspectors
- adherence to safety regulation and the law
- knowledge of and adherence to first aid regulations
- setting a national safety goal
- organising a safety awareness campaign
- understanding the relationship between media and safety
- religious motivation.

Construction organisations should implement the following immediately:

- safety commitment
- safety leadership
- an initial review to determine the position of the firm in terms of observance of occupational safety and health principles.

In the very near future, the government bodies and authorities' regulators will need to establish safety standards, legal guidelines for contractors, an enforcement strategy, safety measures, guidelines for the use of safety inspectors as advisors, and publish compensation and incident reports. Construction organisations then can then begin to establish a positive safety culture, accident investigation team, and safety training.

Later on, the government bodies and authorities' regulators can introduce safety requirements, a penalty and punishment system, safety management system, safety informant access, workers' compensation insurance, and an incentive program. These safety tools can then be used for hazards identification, risk assessment and risk control to improve the safety in the workplace.

Table 8.3 Summary of the three suggested factors

Factors / Time frame	Now	Soon	Later
enforcement factors	• safety inspectors • safety regulation and law • first aid regulations	• safety standards • contractors and law • enforcement strategy • safety measures	• safety requirement • penalty and punishment • OSHMS • safety information access
influence and motivation factors	• sitting a national goal • safety awareness campaign • media and safety • religious motivation	• safety inspectors 'as advisor' • published compensation and incident reports	• workers' compensation insurance • incentive program
organisation safety factors	• safety leadership • safety commitment • initial occupational safety and health review	• establishing a positive safety culture • accident investigation • safety training	• hazards identification, risk assessment, and risk control

8.5 Strengths and limitations of the research

The strengths and limitations of this study have to be considered when assessing the overall scholarly value of this research. One of the most important strengths is derived from the sources of the research. The model was derived from a set of factors and constructs different from preceding studies, and offered a firm base for building a comprehensive and detailed conceptual and empirical study.

A second strength of this research is its originality, since the operationalisation of measurements for some of the stakeholder and safety culture constructs identified in this research are new to the literature. This empirical research into Saudi Arabian construction projects was developed through a widespread process of comprehensive literature review, interviews, and a pilot test before producing a final questionnaire. A further strength of this research is that it covered different sizes of organisations.

However, in line with certain strengths, this research also possesses certain limitations that need to be acknowledged. Firstly, the research focused solely on organisations within the Saudi Arabian context. Although the sample population was randomly selected, some restrictions applied. These restrictions almost certainly influenced the results, which consequently may not be generalisable to other geographical areas. However, because, the country's legal system is based on Islamic law, further research should explore the influence of the country's laws on other factors such as organisation culture and leadership style.

In addition, this research collected data only from construction projects. Therefore, although the results are themselves informative and valid, they are definitely not generalisable to other industry sectors. It must also be kept in mind that this research was conducted in March 2013, so since that time some circumstances considered in the research may have changed.

Lastly, for statistical reasons, in the final model this research used only two items to measure the latent construct *stakeholder influence* (SL-Influ), whereas the recommended practice is at least three items (Hair *et al.* 2013). However, Edwards, JR (2001) believes it is sufficient if a latent construct has at least two items.

8.6 New research directions

A number of possible future research directions are offered in this section in relation to the findings presented above. Firstly, while this study focused on safety culture in the Saudi Arabian construction industry and to what extent stakeholders can influence that safety culture, there is an opportunity to replicate this study from the context of other developed or developing countries. Such an analysis would provide data to determine whether influence preferences may vary between different legal, religious, political, and cultural settings.

Secondly, while the targeted participants were in senior positions to facilitate the capture of a macro-level perspective of stakeholders' involvement and safety culture, there remains an opportunity to carry out a comparison study between senior management and workers' perceptions, and capture the macro-level, as well as micro-level perspectives.

Thirdly, most of the attributes associated with each latent variable were extracted from international literature, and the final model gives a good representation of safety culture and stakeholder involvement in the Saudi Arabian construction industry. However, this study was not designed to strictly control these attributes, and a different experimental design would be needed in order to perform a more comprehensive test of possible influence between the latent variables.

Fourthly, the current study was conducted at a single point in time. However, conducting the same study over a period of time to investigate the results might help further refine the model.

Lastly, in determining the different types of stakeholders according to their attributes and social responsibilities, as defined by Mitchell *et al.* (1997), qualitative methods need be used to evaluate the stakeholder attributes of power, legitimacy, and urgency, whereas the research reported in this thesis was fundamentally quantitative. Therefore, a different experimental design would be needed in order to perform a more definitive test of possible stakeholder attributes.

8.7 Summary

This research was conducted in response to the need for more empirical research focusing on the characteristics associated with stakeholders and safety culture in Saudi Arabia, particularly from a construction industry perspective. The study investigated the extent to which stakeholders endorse a positive safety culture on Saudi Arabian construction projects. To achieve these aims, a model was developed comprised of seven constructs, namely:

1 enforcement

2 influence

3 stakeholder participation

4 organisational safety attitudes

5 management safety practices

6 safety management system

7 safety performance.

The model and its hypotheses were assessed using a series of quantitative techniques – reliability analysis, construct validity, confirmatory factor analysis (CFA), and structural equation modelling (SEM). These techniques were conducted on data obtained from a questionnaire survey of 384 valid responses.

The qualitative findings confirmed the significance of stakeholders' involvement in enforcing and influencing a positive safety culture, and revealed certain safety issues specific to Saudi Arabian construction projects. Furthermore, the results showed that the stakeholders' involvement is positively associated with organisation safety attitudes, management safety practices, the effectiveness of the safety management system, and safety performance in the context of Saudi's construction industry.

The model provided in this study was a systematic approach to assess the safety culture of construction organisations and guide them in self-assessment. The thesis contributes to the literature pertaining to assessment of stakeholders' involvement and safety culture. Furthermore, it offers a valuable tool to government bodies and regulatory agencies for assessing their efforts in improving safety culture.

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Appendices

Appendix A: Ethics Approval

Appendix B: Letter of Introduction (English Version)

Appendix C: Survey Questionnaire (English Version)

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Appendix F: Workshop Guideline and Questions

Appendix A

Ethics Approval

THE UNIVERSITY of ADELAIDE

RESEARCH BRANCH
OFFICE OF RESEARCH ETHICS, COMPLIANCE AND INTEGRITY

SABINE SCHREIBER
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12 November 2012

Dr B Elsey
Entrepreneurship Commercialisation and Innovation Centre

Dear Dr Elsey

PROJECT NO: H-2012-148
The problems of safety provision in Saudi Arabian construction projects with special reference to stakeholders' involvement and their influence to improve workplace safety

I write to advise you that on behalf of the Human Research Ethics Committee I have approved the above project. Please refer to the enclosed endorsement sheet for further details and conditions that may be applicable to this approval. Ethics approval is granted for a period of three years subject to satisfactory annual progress reporting. Ethics approval may be extended subject to submission of a satisfactory ethics renewal report prior to expiry.

The ethics expiry date for this project is: 31 October 2015

Where possible, participants taking part in the study should be given a copy of the Information Sheet and the signed Consent Form to retain.

Please note that any changes to the project which might affect its continued ethical acceptability will invalidate the project's approval. In such cases an amended protocol must be submitted to the Committee for further approval. It is a condition of approval that you immediately report anything which might warrant review of ethical approval including (a) serious or unexpected adverse effects on participants (b) proposed changes in the protocol; and (c) unforeseen events that might affect continued ethical acceptability of the project. It is also a condition of approval that you inform the Committee, giving reasons, if the project is discontinued before the expected date of completion.

A reporting form for the annual progress report, project completion and ethics renewal report is available from the website at http://www.adelaide.edu.au/ethics/human/guidelines/reporting/

per **Dr John Semmler**
Acting Convenor
Human Research Ethics Committee

Appendix B

Letter of Introduction (English Version)

THE UNIVERSITY OF ADELAIDE AUSTRALIA

ECIC Entrepreneurship Commercialisation and Innovation Centre

LETTER OF INTRODUCTION

DEAR PARTICIPANT

We wish to invite you to participate in an important study of workplace safety practices in the context of projects at management level in Saudi Arabia and Gulf state, which is being undertaken as a doctoral research at the University of Adelaide, Australia.

Your participation in this project is voluntary, and you are free to withdraw at any stage without affecting your status now or in the future. There is no risk to you in being involved in this project. On the other hand, the analysis of data that you and others provide for the study, and recommendations flowing from it, will be critical to improve safety provision and practices at workplace.

ABOUT THE SURVEY

The survey includes four safety factors which are associated with safety performance. The survey aims to assess the safety culture maturity of your organisation or an organisation you dealt with according to those safety factors in the context of projects at management level in Saudi Arabia and Gulf state.

WHY PARTICIPATE?

As a participant in the study, you will receive a summary report of this study. The underpinning belief of this research is that professionals are happy to reflect on their experiences and to arrive at some kind of formative assessment of practices. This research on various aspects of workplace safety provides such an opportunity.

WHAT ARE THE EXPECTED OUTCOMES?

The study will enable us to benchmark how well workplace safety in Saudi Arabia perform against safety best practice at national and international level and how we can improve it.

WHAT ABOUT PRIVACY?

The researcher will take every care to remove any identifying material from responses as early as possible. Likewise the data will be used for academic papers and conference presentations and individuals' responses will be kept confidential by the researcher and not be identified. The data will be retained for five years within the Entrepreneurship, Commercialisation and Innovation Centre (ECIC), University of Adelaide.

This project has ethics approval from the University of Adelaide. You are welcome to contact the Human Research Ethics Committee's Secretary on phone (+618) 8303 6028 if you have any concerns or questions. Also you can contact the research team if you have any questions.

Yours sincerely,

Dr. Barry Elsey
Senior Lecturer and Doctoral Advisor
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Appendix C

Survey Questionnaire (English Version)

Problems of Safety Provision in Projects with Special Reference to Stakeholder' involvement and their Influence to Improve Workplace Safety

DEAR PARTICIPANT
We wish to invite you to participate in an important study of workplace safety practices in the context of projects at management level in Saudi Arabia and Gulf state, which is being undertaken as a doctoral research at the University of Adelaide, Australia.
Your participation in this project is voluntary, and you are free to withdraw at any stage without affecting your status now or in the future. There is no risk to you in being involved in this project. On the other hand, the analysis of data that you and others provide for the study, and recommendations flowing from it, will be critical to improve safety provision and practices at workplace.

ABOUT THE SURVEY
The survey includes four safety factors which are associated with safety performance. The survey aims to assess the safety culture maturity of your organisation or an organisation you dealt with according to those safety factors in the context of projects at management level in Saudi Arabia and Gulf state.

WHY PARTICIPATE?
As a participant in the study, you will receive a summary report of this study. The underpinning belief of this research is that professionals are happy to reflect on their experiences and to arrive at some kind of formative assessment of practices. This research on various aspects of workplace safety provides such an opportunity.

WHAT ARE THE EXPECTED OUTCOMES?
The study will enable us to benchmark how well workplace safety in Saudi Arabia perform against safety best practice at national and international level and how we can improve it. Also, the researcher will use the data for academic papers and conference presentations.

WHAT ABOUT PRIVACY?
The researcher will take every care to remove any identifying material from responses as early as possible. Likewise the data will be used for academic papers and conference presentations and individuals' responses will be kept confidential by the researcher and not be identified. The data will be retained for five years within the Entrepreneurship, Commercialisation and Innovation Centre (ECIC), University of Adelaide.
Please contact the research team if you have any questions.
This project has ethics approval from the University of Adelaide. You are welcome to contact the Human Research Ethics Committee's Secretary on phone +61 (08) 8303 6028 if you have any concerns or questions.

Yours sincerely,

Dr. Barry Elsey
Senior Lecturer and Doctoral Advisor
University of Adelaide
barry.elsey@adelaide.edu.au

Torky Althaqafi
Researcher
University of Adelaide
Torky.Althaqafi@adelaide.edu.au

1. General Information (if you want results & to be included in the draw to win the reward, please provide your contact details)

Name	
Email	
Your Organisation	
Your Position	

Thank you for participating in this survey. The purpose is to get you to reflect on your views and experiences. There are no right or wrong answers. The result of this survey will be used in the development of workplace safety.

The following questions present statements about your organisation or an organisation you dealt with. These questions are broken into categories that correspond to different safety factors in the organisation.

*2. Type of the organisation......

- Government
- Semi Government
- Private Organisation
- Multi-national Organisation
- Other, Please state ......

*3. Type of project........

- Industrial Projects (such as manufacturing, power generation, petroleum, etc......)
- Residential Projects (houses, apartments, etc......)
- Commercial (towers, hospitals, schools, shopping centres, warehouse, hotels, etc....)
- Building (small renovations such as addition of a room.....)
- Highway Construction (roads, highways, bridges, etc....)
- Heavy Construction (water and sewer line projects, dams, etc......)
- Other, Please state ......

*4. How many people are employed in the organisation?

*5. In the last 12 months, in this organisation how many

a. accidents were reported

c. injuries occurred

d. fatalities occurred

*6. How many years has the organisation been operating?

The following statements relate to your organisation or an organisation you dealt with, Please choose the score that reflects the level of your agreement or disagreement with each statement.

*7. In this organisation top management...

	Never	Rarely	Sometime	Often	Always
a. use their authority to require subordinates to reach safety targets					
b. make clear that safety is more important than productivity					
c. participate in regular safety activities					

*8. The following statements relate to organisational & management practices in this organisation.

	Never	Rarely	Sometime	Often	Always
• In this organisation safety has been taken seriously					
• Management is involved with day-to-day safety activities					
• Safety concerns are effectively communicated to workers					
• Sufficient resources are available for safety					
• In meetings, safety issues are given high priority					
• Safety provisions in tender documents are clear for promoting better safety on site					

*9. The following statements relate to organisational safety behaviour in this organisation.

	Strongly Disagree	Disagree	Neither agree nor Disagree	Agree	Strongly Agree
• Daily routines show that safety is important					
• Achieving regulatory compliance is not the only objective of organisation					
• Management understands that they are responsible for safety					
• There is pressure to put safety before production					
• The written safety rules are easy for people to follow					
• If there is work pressure, workers don't break safety rules					
• Workers don't hesitate to report minor injuries and incidents					
• Workers understand all the safety warnings and posters					
• In general, workers are aware of safety rules and instructions					

*10. The following statements relate to safety management system in this organisation.

	Strongly Disagree	Disagree	Neither agree nor Disagree	Agree	Strongly Agree
• This organisation clearly states that safety is important in its policy					
• This organisation has clear goals and targets for safety					
• Safety planning is integrated with the other areas of the organisation					
• This organisation has a useful safety system					
• Safety inspections are effective at identifying hazards and risks					
• Current safety rules and procedures are made available to protect workers from accidents					
• Current safety rules and procedures are constantly reviewed for better outcomes					
• The organisation has an auditing program in all its sectors for safety at work					

*11. The following statements relate to safety performance in this organisation.

	Strongly Disagree	Disagree	Neither agree nor Disagree	Agree	Strongly Agree
• The safety environment of the workplace is always inspected					
• The causes of accidents are carefully analysed					
• Workers received adequate safety training related to their job					
• The organisation implements safety incentive programs					

Stakeholders' involvement
The following statements relate to stakeholders' involvement with workplace safety practices.

*12. Stakeholders' Participation

Q: on a scale between 1 to 5, with 1= no involvement and 5= fully involvement to what extent are the following stakeholders involved in safety?

	1= No involvement	2	3	4	5= Fully involvement
• Clients / Owners					
• Designers/ architects					
• Main-contractor					
• Government Authorities					
• Insurance Company					

*13. Influence of stakeholders

Q: on a scale between 1 -5, with 1= no influence and 5= very influential to what extent do the following influence the organisation's approach to improve safety?

	1= No influence	2	3	4	5= Very influential
• The rates for workers' compensation insurance					
• Safety practices of competitors					
• Media attacks					

*14. Enforcement of stakeholders:

Q: on a scale between 1 -5, with 1= no enforcement and 5= extensive enforcement to what extent the following enforce your organisation's approach to improve safety?

	1= No enforcement	2	3	4	5= Extensive enforcement
• Safety Regulations in Workplaces					
• Government Inspectors					
• Safety Requirements from Ministry of Labour					
• Safety Requirements from the General Organization for Social Insurance					
• Safety Requirements from the General Presidency of Meteorology and Environment Protection					
• Safety Requirements from Civil Defence					

15. Please make any additional comments about your perceptions of workplace safety practices.

Thank You for Your Participation, End of the Survey

Appendix D

Letter of Introduction (Arabic Version)

THE UNIVERSITY OF ADELAIDE AUSTRALIA

ECIC Entrepreneurship Commercialisation and Innovation Centre

مقدمة

المشارك الفاضل

يسـرنا دعوتك للمشـاركة في إحدى الدراسـات الهامة المتعلقة بالسـلامة المهنية في اماكن العمل على المسـتوى الإداري للمشروعات التي يتم تنفيذها في كل من المملكة العربية السعودية ودول الخليج وهي الدراسة التي نقوم بها كموضوع بحث لرسالة دكتوراة بجامعة أديلايد باستراليا. إن مشاركتك في هذه المشروع تعتبر مشاركة تطوعية, ولك الخيار في الانسحاب في أية مرحلة دون أن يؤثر ذلك على وضعك حالياً أو في المستقبل. كما لن يكون لاشتراكك في المشروع أي خطر عليك. ومن ناحية أخرى سـيكون لتحليل البيانات التي سـتمدنا بها أنت والآخرون في إطار هذه الدراسـة وما سـيسـتتبعها من توصيات أثرا هاما في تحسين مستوى شروط وممارسات السلامة في مكان العمل.

نبذة عن المسح

يتضـمن هذا المسـح علي أربعة عوامل سـلامة أسـاسـية ترتبط بأداء السـلامة. ويهدف المسـح إلى تقييم مدى توافر ثقافة السـلامة في شـركتك أو في إحدي الشـركات التي تعاملت معها وفقاً لعوامل السـلامة في مجال المشـاريع على المسـتوى الإداري في المملكة العربية السعودية ودول الخليج.

ما هي النتائج المتوقعة؟

سـوف تمكننا هذه الدراسـة من إيضـاح الفرق بين جدوة ممارسـات السـلامة في أماكن العمل في المملكة العربية السـعودية وممارسـات السـلامة المثلى على المسـتويين المحلي والدولي وكيف يمكننا تحسـينها. كما سـيسـتخدم الباحث البيانات في رسالته العلمية وكلمته بالمؤتمر.

ماذا عن السرية ؟

سوف يبذل الباحث كل ما في وسعه لحذف أي بيانات قد تحدد هويتك من الإجابات في أقرب وقت ممكن. كما سيقوم باستخدام هذه البيانات في رسالته العلمية وكلمته بالمؤتمر، كما سيراعي الحفاظ على سرية الإجابات وعدم تحديد هوية من أدلى بها. وسيتم الاحتفاظ بهذه البيانات لمدة خمس سنوات بمركز الابتكار والترويج التجاري والمشاريع ECIC بجامعة أديلايد.

لمزيد من الاستفسارات يرجى الاتصال بفريق البحث.

د. باري إلسي
كبير المحاضرين واستشاري رسالات الدكتوراة
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تركي الثقفي
باحث
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Appendix E

Survey Questionnaire (Arabic Version)

شكرًا على مشاركتك في هذا الاستبيان، الذي يهدف إلى الاستفادة من آرائك وخبراتك. علماً بأنه ليس هناك إجابات (صحيحة) أو (خاطئة). وسوف تستخدم نتيجة المسح في الارتقاء بالسلامة المهنية في مكان العمل.

وتتناول الأسئلة التالية البيانات المتعلقة بشركتك أو بإحدي الشركات التي تعاملت معها. حيث قمنا بتقسيم هذه الأسئلة إلى مجموعات تتفق مع عوامل السلامة المهنية المختلفة في الشركة.

1) معلومات عامة

الاسم: ....

البريد الإليكتروني: ....

المنشأة: ....

المسمى الوظيفي: ....

2) نوع المنشاة:

- o حكومية
- o شبه حكومية
- o شركة خاصة
- o شركة متعددة الجنسيات
- o نوع آخر , يرجى ذكره: ....

3) نوع المشروعات:

- o مشروعات صناعية (كالتصنيع وتوليد الطاقة والبترول الخ...)
- o مشروعات سكنية (منازل , شقق , الخ...)
- o مشروعات تجارية (أبراج, مستشفيات, مدارس، مراكز تسوق, مخازن, فنادق, الخ...)
- o مشروعات بنائية (كالتجديدات البسيطة مثل إضافة حجرة...)
- o إنشاءات الطرق والكباري (الطرق, الطرق السريعة, الكباري, الخ...)
- o الإنشاءات الثقيلة (مشروعات خطوط المياه والمجاري , السدود, الخ...)
- o مشروعات أخرى, يرجى ذكرها: ....

4) كم عدد الأشخاص العاملين بالمنشاة ؟ (..........)

5) خلال 12 شهراً الأخيرة في هذه المنشأة ، كم عدد:

أ- الحوادث التي تم الإبلاغ عنها (...........)

ب- الإصابات التي حدثت (............)

ت- حالات الوفاة لا سمح الله التي حدثت (............)

6) منذ كم سنة تعمل المنشأة؟ (.......... سنة)

ترتبط البيانات التالية بقيادة السلامة وممارسات الإدارة في هذه الشركة. يرجى اختيار الدرجة التي تعكس مدي توافر أو عدم توافر كل عنصر:

1	2	3	4	5
مطلقاً	نادراً	أحياناً	غالباً	دائماً

7) في هذه المنشأة, موظفي الإدارة العليا:	الدرجة				
أ- يستخدمون سلطتهم في مطالبة المرؤوسين بتحقيق أهداف السلامة المهنية	1	2	3	4	5
ب- يوضحون أن السلامة المهنية أكثر أهمية من الانتاجية	1	2	3	4	5
ت- يشاركون بصورة منتظمة في أنشطة السلامة المهنية	1	2	3	4	5

8) الممارسات التنظيمية والإدارية للسلامة المهنية	الدرجة				
في هذه المنشأة تؤخذ السلامة المهنية على محمل الجد	1	2	3	4	5
تشارك الإدارة بأنشطة السلامة المهنية يوميا	1	2	3	4	5
يتم إيصال المسائل المتعلقة بالسلامة المهنية بصورة فعالة إلي العاملين	1	2	3	4	5
يتم إتاحة موارد كافية للسلامة المهنية	1	2	3	4	5
في الاجتماعات تعطى الأولوية لمسائل السلامة المهنية	1	2	3	4	5
تظهر شروط السلامة في مستندات العطاءات و العقود	1	2	3	4	5

ترتبط البيانات التالية **بالسلوك التنظيمي للسلامة المهنية** و **نظام إدارة السلامة** و **أداء السلامة** في هذه المنشأة. يرجى اختيار الدرجة التي تعكس مدي توافر أو عدم توافر كل عنصر:

5	4	3	2	1
أوافق بشدة	أوافق	لا أوافق ولا أرفض (محايد)	أرفض	أرفض بشدة

9) السلوك التنظيمي للسلامة المهنية:	الدرجة				
	1	2	3	4	5
يظهر نظام العمل اليومي أهمية السلامة المهنية	1	2	3	4	5
تحقيق الالتزام بانظمة السلامة المهنية ليس هدف المنشأة الأوحد	1	2	3	4	5
تدرك الإدارة أنها مسئولة عن السلامة	1	2	3	4	5
هناك ضغوط لإعطاء الأولوية للاسلامة المهنية على الإنتاج	1	2	3	4	5
من السهل على الأشخاص إتباع قواعد السلامة المكتوبة	1	2	3	4	5
لا يخرق العاملون قواعد السلامة إذا كان هناك ضغط عمل	1	2	3	4	5
لا يتردد العاملون في الإبلاغ عن الإصابات والحوادث مهما كانت درجتها	1	2	3	4	5
يفهم العاملون جميع تحذيرات وملصقات السلامة المهنية	1	2	3	4	5
بوجه عام, يدرك العاملون قواعد وتعليمات السلامة المهنية	1	2	3	4	5

10) نظام إدارة السلامة المهنية:	الدرجة				
تقر المنشاة صراحة بأهمية السلامة المهنية في سياستها	1	2	3	4	5
للمنشاة أهداف واضحة فيما يتعلق بالسلامة المهنية	1	2	3	4	5
تندمج خطط السلامة المهنية مع المجالات الأخرى بالمنشاة	1	2	3	4	5
تمتلك المنشاة نظام سلامة مهني فعال	1	2	3	4	5
إجراءات التفتيش المتعلقة بالسلامة ذات فاعلية في تحديد المخاطر	1	2	3	4	5
تم وضع قواعد وإجراءات السلامة الحالية من أجل حماية العاملين من الحوادث	1	2	3	4	5
تتم مراجعة قواعد وإجراءات السلامة بصفة مستمرة من أجل الحصول على نتائج أفضل	1	2	3	4	5
لدى المنشاة برنامج مراجعة في كل القطاعات لتحقيق السلامة في العمل	1	2	3	4	5

11) أداء السلامة المهنية:	**الدرجة**				
يتم التحقق دائماً من وجود بيئة عمل آمنة	**1**	**2**	**3**	**4**	**5**
يتم تحليل أسباب الحوادث بعناية	**1**	**2**	**3**	**4**	**5**
يتلقى العاملون التدريب الكافي على السلامة المهنية فيما يتعلق بوظائفهم	**1**	**2**	**3**	**4**	**5**
تطبق المنشاة برامج السلامة المهنية التحفيزية	**1**	**2**	**3**	**4**	**5**

مشاركة المساهمين:

12) سؤال: إلى أي مدى يشارك المساهمون المذكورين أدناه في إجراءات السلامة؟

	1= عدم المشاركة	2= مشاركة قليلة	3= مشاركة مقبولة	4= مشاركة جيدة	5= مشاركة كاملة
العملاء / الملاك	○	○	○	○	○
المصممون / المعماريون	○	○	○	○	○
المقاولون الأساسيون	○	○	○	○	○
الهيئات الحكومية	○	○	○	○	○
شركات التأمين	○	○	○	○	○

تأثير المساهمين

13) سؤال: إلى أي مدى تؤثر العناصر التالية على أسلوب المنشأة في تحسين السلامة؟

	1=عدم التأثير	2= تأثير قليل	3= تأثير مقبول	4= تأثير جيد	5= تأثير كبير
تكلفة التأمين على العمال	○	○	○	○	○
ممارسات المنافسين فيما يتعلق بالصحة والسلامة المهنية	○	○	○	○	○
وسائل الإعلام	○	○	○	○	○

إجبار المساهمين

14) سؤال :إلي أي مدى تجبر العناصر التالية المنشأة على تحسين إجراءات السلامة؟

	1= عدم الاجبار	2= أجبار قليل	3= اجبار مقبول	4= اجبار جيد	5= اجبار كامل
المتطلبات القانونية	❍	❍	❍	❍	❍
المفتشون الحكوميون	❍	❍	❍	❍	❍
متطلبات السلامة الصادرة عن وزارة العمل	❍	❍	❍	❍	❍
متطلبات السلامة الصادرة عن الهيئة العامة للتأمينات الاجتماعي	❍	❍	❍	❍	❍
متطلبات السلامة الصادرة عن الرئاسة العامة لحماية المناخ والبيئة	❍	❍	❍	❍	❍
متطلبات السلامة الصادرة عن وزارة شئون البلدية	❍	❍	❍	❍	❍

يرجى ذكر أي تعليقات إضافية من وجهة نظرك حول الممارسات المتعلقة بسلامة مكان العمل:

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نهاية الاستبيان . نشكرك على إجابة الأسئلة

Appendix F

Workshop Guideline and Questions

Interview Guidelines

Development of a Model for Stakeholder Involvement and Safety Culture in the Saudi Arabian Construction Industry

The goal of this interview is to seek your opinions on the usefulness of the model and to determine the stakeholder influence and enforcement to improve safety culture.

Background

The impact of accidents in the construction industry has been clearly classified and well documented from 2003 to the present in Saudi Arabia by the General Organization for Social Insurance, and the accident rate has remained consistently high. As a result, an important study of workplace safety is needed, which has led to the questions below.

- Why do occupational health and safety have such a poor level of provision?
- Is it the absence of a legal and regulatory framework?
- Is it a problem of attitude and behaviour in the industry?
- Is it a deeper cultural attitude?
- If there is a safety management system, how well is it developed?
- What kind of leadership supports the safety management system?

The Model

A model has been developed to assess stakeholder involvements and safety culture in the context of construction projects at the management level in Saudi Arabia. The model has seven elements, as explained below.

Elements of the Stakeholder Involvement and Safety Culture Model

Element 1: This involves the elements that influence the stakeholder's approach to safety.

Element 2: This deals with the elements that force the stakeholder to improve safety culture.

Element 3: This is concerned with the stakeholder groups in construction projects.

Element 4: This deals with the assessment of the organisation of safety attitudes.

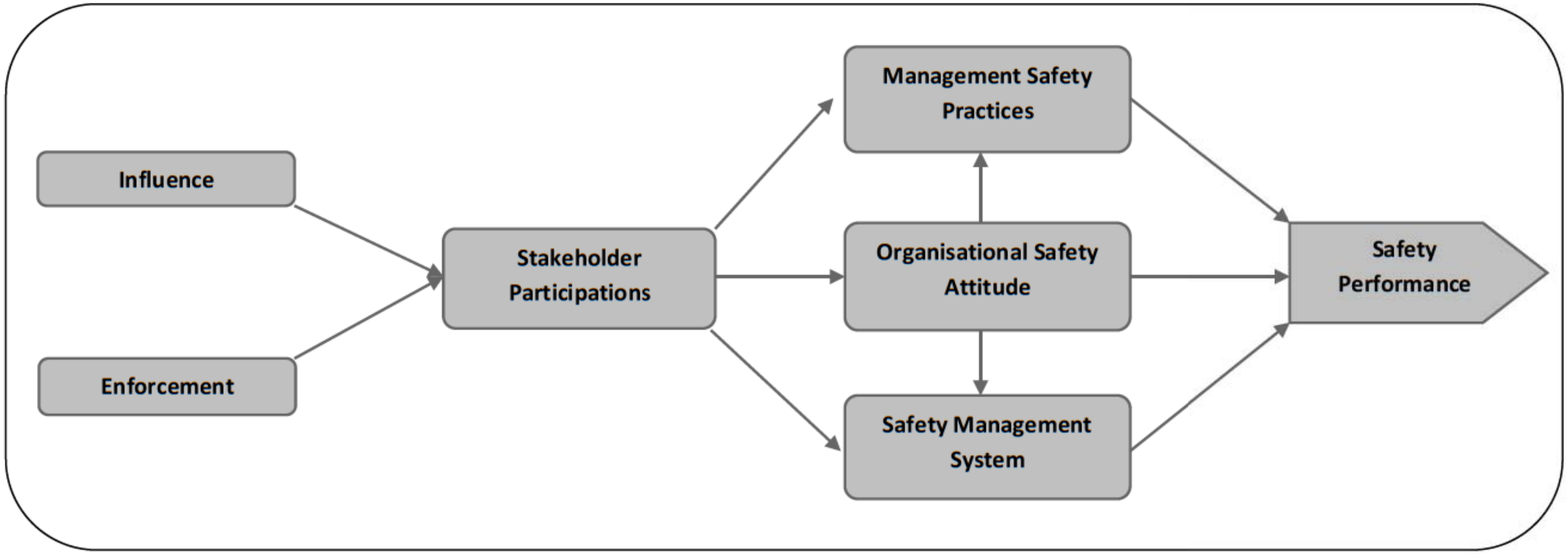
Element 5: This is concerned with the assessment of the management of safety practices.

Element 6: This involves the assessment of the safety management system.

Element 7: This deals with the assessment of safety performance.

Figure 1:

The Model for Stakeholder Involvement and Safety Culture



Influence	Enforcement	Stakeholder Participations	Organisational Safety Attitude	Management Safety Practices	Safety Management System	Safety Performance
1- The rates for workers' compensation insurance. 2- Safety practices of competitors ~~3- Media attacks.~~	~~1- Safety Regulations in Workplaces.~~ 2- Government Inspectors 3- Safety Requirements from Ministry of Labour 4- Safety Requirements from the GOSI ~~5- Safety Requirements from the GPME~~ ~~6- Safety Requirements from Civil Defence~~	1- Clients / Owners 2- Projects Managers 3- Contractors 4- Government Authorities 5- Insurance Company (GOSI)	~~1- The effectiveness of safety efforts.~~ ~~2- The trust between management and workers.~~ ~~3- Management attitude toward safety.~~ ~~4- Productivity vs safety.~~ 5- The clarity of the safety rules 6- Work pressures 7- Reporting ~~8- Workers competence.~~ 9- Safety awareness	~~1- Commitment to safety~~ 2- Involvement with day-to-day safety activities 3- Communication 4- Resources availability. ~~5- Safety meeting~~ ~~6- Sharing safety matters with contractors.~~ 7- Safety leadership (~~coaching, caring,~~ and controlling).	~~1- Safety policy~~ ~~2- Safety goals~~ 3- Safety planning ~~4- Safety program~~ 5- Hazard identification ~~6- Safety rules and procedures~~ ~~7- Safety review~~ 8- Safety auditing	1- Inspections 2- Safety training ~~3- Accident investigations~~ 4- Motivation

Note: Item with a line through the middle of the text it has been deleted from the model after doing a conformity analysis

As part of the validation process, we request your comments on the usefulness of the stakeholder involvement and safety culture model for construction projects in Saudi Arabia (see figure 1). Please provide your views based on the following questions.

Q1) How would you rate the "stakeholder involvement and safety culture model" in terms of the

(1 = Poor through to 5 = Excellent)

Elements	Poor Excellent
1- Correct identification of the major stakeholder participations?	1 2 3 4 5
2- Correct identification of the influence of the stakeholder's approach to safety issues?	1 2 3 4 5
3- Correct identification of enforcements against the stakeholder to improve safety?	1 2 3 4 5
4- Correct identification of management safety practices?	1 2 3 4 5
5- Correct identification of the organisation's safety attitudes?	1 2 3 4 5
6- Correct identification of the safety management system?	1 2 3 4 5
7- Correct identification of safety performance?	1 2 3 4 5
8- Model completeness "covering all important aspects of safety culture and stakeholder involvement"?	1 2 3 4 5
9- Ease of understanding?	1 2 3 4 5
10- Ease of use of the model?	1 2 3 4 5
11- Providing a systematic view of safety culture based on the evaluation of projects?	1 2 3 4 5
12- Applicability to simple projects?	1 2 3 4 5
13- Applicability to complex projects?	1 2 3 4 5

Q2) Would you recommend the model for use on projects in which you are involved?

◯ **Yes** ◯ **No**

Q3) Please provide additional comments on the applicability of the model.

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Q4) Do you believe that safety concerns are perceived as important by your organisation's major stakeholders? Why?

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Q5) What stakeholder groups impact the decision to deliver positive safety culture?

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Q6) Is there anything else you would like to add, i.e. other concerns related to stakeholder involvement and safety culture?

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- ✓ Name of Participant……………………………………………………………………
- ✓ Your Organisation ……………………………………………………………………
- ✓ Your Position ……………………………………………………………………
- ✓ Number of years of work experience……………………………………………

END OF QUESTIONNAIRE

Thank you for your time and co-operation.