“INFLUENCE OF MANAGEMENT SYSTEMS IN DEVELOPING SAFETY CULTURE: CASE OF CONSTRUCTION INDUSTRY IN THE UNITED ARAB EMIRATES (UAE)”

A thesis submitted to the
University of Petroleum and Energy Studies

For the award of
Doctor of Philosophy
in
HSE

BY
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February 2020

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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text.

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This is to certify that the thesis entitled **"Influence of Management Systems in Developing Safety Culture: Case of Construction Industry in the United Arab Emirates (UAE)"** is being submitted by **Govindan Pradeep Nair** in fulfillment for the Award of DOCTOR OF PHILOSOPHY in (Science) to the University of Petroleum and Energy Studies. .Thesis has been corrected as per the evaluation reports dated **23/01/2020** and all the necessary changes / modifications have been inserted/incorporated in the thesis.

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EXECUTIVE SUMMARY

Much has been discussed in the past literature about the factors that influences safety performances in Organisations. In the wake of new technological advances, the study in the past had focussed on engineering improvements in reducing accidents at workplaces. However, some of the industrial disasters in the recent past has brought to light the need to have a more holistic approach towards identifying the root causes of accidents. Technological improvements alone cannot bring down the accident levels to 'zero' unless it is enhanced through organisational and behavioural interventions. The studies have since focussed more towards addressing the 'human factors' through identifying factors that have a direct and indirect influence on them. Hence, the concept of Safety Culture has emerged.

In spite of many studies in the past focussing on safety culture, it remains a vague concept. None of the researches could bring together a comprehensive list of factors that can be called as determinants of safety culture in an organisation. There is even no unanimously accepted the definition of safety culture and climate. Safety culture was initially applied to explain the deficiencies and inadequacies of safety management that leads to major disasters, but in the recent past there has been an increased effort to connect individuals to this concept and to explain how unsafe behaviours are created, that leads to accidents. Individual behaviours are seen to be influenced more by organizational culture than the personal and job factors, which could then become a reason for accidents/ worker injuries. The past studies on Safety culture are limited to non-construction related industries and are missing in the context of UAE and Middle East businesses. Most of the existing studies focused on various elements and influences of safety culture. These influences vary

depending on the type of business, management style and external geographical, regulatory and political factors. None of the studies could confirm a comprehensive list of unique factors that influence the safety culture in the United Arab Emirates (UAE) construction industry. Management system has been factored as an important factor for safety climate assessment of an organisation by most of the studies conducted in recent times. They have focussed more on the influence of management system on safety outcomes/performance, but not on the collective values and attitude that underpins the safety culture of the organisation. Correlation studies have confirmed a positive correlation between the management system and safety culture. However, there have been no causative relationships established regarding the extent of influence of a formal management system on the overall perceptions and culture of an organisation.

UAE Construction Industry is second only to Oil & Gas in terms of contribution to the country's GDP. There are adequate regulatory frameworks related to health and safety that's been established by the local authorities. However, the enforcement of the same has been de-centralised to each sector regulatory authorities. More often, the influence of regulations on individual companies heavily relies on how well it has been enforced on to them. Sector regulating authorities often expect organisations to self-regulate themselves. Unlike countries like Singapore, the regulations in UAE is establishes only broad expectations from employers while allowing employers to devise means and methods to achieve them. There are no prescriptive requirements regarding health and safety that organisations can rely on. This makes the organisations have a very subjective interpretation of laws and often fail to comply with the key requirements. There is no unanimity in the approach to managing health and safety of workers; This is an issue particularly relevant to the construction companies in UAE. They have a different management style and culture, depending on whether the company is a locally managed company or a branch of a multinational company. Moreover, the transient nature of construction companies poses a significant challenge in investing in people and promote a positive safety culture.

Safety management systems are often neglected in every corner of the world, irrespective of the industry. This is mainly a problem in the construction industry of UAE, due to the reasons stated earlier. This study through its framed objectives and hypothesis aims to bridge the gap in awareness about a systems approach in managing safety in UAE construction industry. The study highlights the inter-relations and influences of management system in safety culture and performance. It highlights the key concerns in a system approach and its dependencies. The study enriches the information related to the various dimensions of the safety management system performance measurement. The study highlights organisational factors that encourage or hinder the creation of a safety culture and the implementation of a safety management system. This will be invaluable to organisations in defining areas where they need to progress if they wish to improve their safety performance.

Organisations are not isolated entities, and they are influenced by the larger economic, social and geopolitical factors. Within organisations they are influenced by the various sub-cultures, which is not limited to the way job is perceived, designed, developed and performed. The influences on the job culture is an iterative process and continuously evolving. It involves the close interaction between hardware and behaviours of people. The interface between them is the systems that are put in place. If the system does not suit the people or the hardware/engineering aspect, the system would fail and could result in a loss incident. Therefore, it becomes necessary for organisations to adapt their systems to suit their specific environment and requirements.

The aim and objectives of this study is to critically analyze the current safety culture, management system and practices of Construction companies in UAE. The study also aims to establish the differences in safety culture/perception among people with different demography (ethnicity, language, education and skills). To achieve these aims, two hypotheses have been created, which are:

H1: "Companies with a Certified Corporate driven Safety Management System in place have a more positive safety culture than companies who are deficient of it."

H2: "A positive safety culture influences the development and implementation of an effective Safety Management System."

Four leading Construction (Building & Infrastructure) Companies operating in UAE has been chosen as the sample for the study. The name of the company has been purposefully not revealed due to confidentiality and ethical issues. One of the companies (A) is an MNC based in the United States of America (USA), and operates a corporate-driven certified safety management system, while the rests rely more on a project based safety plans and procedures to manage health and safety of their employees.

Perception surveys are widely used in the industry to measure safety culture, as perceptions are perceived as more influential than 'reality'. Perceptions create expectations and motivations in individuals and groups within an organisation. Hence, it is essential to understand how individuals perceive the safety culture and management system attributes of their respective companies. For the study, an independent survey using a structured questionnaire (5 points Likert scale) is used as the quantitative tool. Qualitative data are collected by personal interviews with key senior staffs of all the four companies. To collaborate on the information collected, records of key performance indicators were taken from all the four companies. Past literature related to safety culture and management systems are reviewed and corroborated with this study. The collected data were analysed using SPSS software. The analysis included covariance and correlation analysis, t-tests and ANOVA to understand the difference in perceptions among different demographic groups. Independent t-test is done to check the difference in perceptions among the four companies. To study the mutual influences of safety culture and management system, regression analysis was done by inter-changing the dependant and independent variables.

The response rate from the sample was satisfactory (75%), and there was equal participation from all the four sampled companies. The degree of distribution/normality of data received was tested, and the kurtosis and skewness values confirmed normal distribution. Reliability of data was tested, and the CITC values indicated that the scale is reliable and confirms uni-dimensionality. Findings from this study support the theories established in the past literature, that the broader cultural and behavioural factors influence the effectiveness of a formal safety management system in construction industries. All the correlations and variance analysis are statistically significant ($p<0.5$). However, the study also discovers that the reliability and effectiveness of individual factors are neither necessary nor sufficient to promote safety culture and performance. This contradicts the past research findings and the standard belief that there is a strong correlation between reliability of management systems and safety performance. This study confirms the correlation, however, discusses it to be weak and often indirect. The regression results indicate that the organizations which has an informal and more localized system influences safety culture more (R^2 – 0.429) than the organizations that have a more rigid and mechanized off-site driven system (R^2- 0.81). More ownership is experienced with a local system thon the other. Study also highlights that the safety culture has a greater influence (R^2- 0.632) on management system compared to management system's influence on safety culture (R^2 - 0.438). Among the system performance dimensions, the deployment of the system has a greater influence (R^2-0.52) on the performance compared to the capacity and compliance to expectations (R^2 – 0.364). It's needless to say that irrespective of the robustness of the system with resources identified and provided to achieve the set standards and goals, it may not be sufficient to promote a safety culture. However, if the system is designed, developed and implemented through a formal approach of collective engagement of all the stakeholders, the perceptions of individuals would improve. This will be critical for a positive safety culture to emerge and sustain.

Management commitment has always been associated with strong system development. However, in this study management commitment was seen

inversely correlated to the management. The study confirms that safety is a systems property. The systems dynamics takes into consideration the complex interaction of various elements, one complementing and supporting the other. Failure of one component need not fail the entire system. Therefore, the overall effectiveness of the management system element does not rely on any single safety culture factor. It is rather a complex system where there is a dynamic interaction between various elements configured non-linearly. The study highlights that measuring a system by its output/failure data may be grossly inadequate, as the system may continue to work safely, despite weakness and drawbacks in the individual elements. Hence, there is a need for a holistic approach and focus on the various interconnected system elements, which works unit. Instead of focusing on individual components, it is essential to look at its influences and interactions on the overall system.

Therefore, a robust and high capacity safety management system alone will not provide direct solutions to safety problems on site. It is critical that a more conducive ecosystem be created for a system to originate, grow and sustain. Availability of resources and user-friendly technology is critical in such ecosystems. In other words, a safe workplace must exist, and safety shall be integrated into all decisions made by the company leadership including the decision to bid for the project. The system that will take shape will entirely depend on the leadership and the context of the project/business. Instead of a set of prescriptive rules in the management system, the system must have a risk-based approach. The study highlights that the management system and safety culture are two different properties of a high performing organization. A reliable system can be unsafe, and a safe system can be unreliable. Reliability is improved if it is designed, developed and deployed by all the stakeholders who are responsible for implementing it. Findings from this study indicates that having a mechanistic style of management system will not assure safety it people using it do not take ownership. If employees do not value and accept the relevance and importance of the system, they will not be motivated to use them.

The study helps the construction companies in UAE to understand the need for a careful selection of a management system model that suits their specific

project requirement. The need for having a formal approach to demonstrate visible leadership, management commitment, and employee engagement is highlighted. This study also helps the organisation to have better clarity on the concept and dynamics of safety culture change and its relevance to the management system. Safety culture being the larger macro environment comprising of people's shared values, attitudes and perceptions about safety system. The perception is important for the quality and implementation of system and processes to deal with health and safety risks. This system could be a formal or an informal one. This study was focused and limited to the aims and objectives set out in, and therefore, it does not explore all the influences on Safety maturity of an organisation. This study was also limited to the construction industry in UAE and therefore do not capture the broader influence of the country across all the businesses. The findings from this study open doors to more research on safety culture, particularly establishing specific influences on individual factors that have been discussed in this study.

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ABBREVIATIONS

ANOVA – Analysis of Variance

EHS – Environmental Health and Safety

GDP – Gross Domestic Product

HASAWA – Health and Safety at Work Act (United Kingdom)

HSE – Health and Safety Executive (United Kingdom)

ILO – International Labour Organisation

IMF – International Monetary Fund

ISMEC – Identification Strategy Measurement Evaluation Correction

LLC – Limited Liability Company

MNC – Multi National Company

MS – Management System

NSC – National Safety Commission

OHS – Occupational Health and Safety

OHSMS – Occupational Health and Safety Management System

OSHA – Occupational Safety and Health Administration

OSHAD – Occupational Safety and Health, Abu Dhabi

PDCA – Plan, Do, Check, Act

SC – Safety Culture

SD – Standard Deviation

SMS – Safety Management System

Chapter 1: Introduction

1.1: General

Many studies in the past have highlighted the significance of Occupational Health and Safety (OHS) management in building a sustainable business. The concept and practices in this field are fast evolving due to the increased technological developments. Gupta (2002) highlights the changes that occur in the industries across the globe after the Chernobyl disaster in Ukraine in 1986 and other industrial disasters across other industries around the world in the last two decades. Gupta., 2002 highlighted the growing need and importance of a holistic approach to identifying the root causes of occupational accidents. Extensive research has been carried out across all industries especially in engineering related fields about occupational safety to derive the root cause of these occupational accidents and to identify methods and techniques to reduce the impact of these occurrences (Hola et al., 2014).

Accident investigations have started focusing on management/ organizational failures rather than the technical failures and human errors. Investigations and analysis of Catastrophes such as Chernobyl might have changed this viewpoint (Gupta, 2002). Rameezdeen et al. (2016) have highlighted the impact and influence of organizational and management factors on occupational accidents. Through the Accident prevention advisory unit, the Health and Safety Executive (UK) indicates that 90% of casualties are preventable and from these, 70%-75% relates to failures in management practices and control (HSE, 2016). Health and safety are traditionally managed with a focus on the technical/ engineering aspects of work (Lawler, 1974), i.e. the plant, equipment, premises, guarding, etc. This was an approach reflected in the UK legislation and other earlier regulations (Factories Act 1961., HASAWA 1974). By complying with these regulations, companies were able to reduce their accident numbers and ill-health

but found it difficult to reduce them to zero. Saari (1990) pointed out that there is a limit to which technology can be improved regarding safety and hence, it is more important to focus on other aspects such as improving the organizational and cultural factors. Cullen's (1990) report on piper alpha accident stated that it was not the presence of policies and procedures that would prevent accidents from happening. It is the atmosphere or culture in which policies and procedures are understood and accepted as number one priority, and implemented (Vinodkumar et al., 2009; Weichbrodt, 2015; Bird et al., 1985) that will prevent accidents in the workplace.

The concept of safety culture and climate stems out from this need to connect human and social attributes to workplace OHS interventions. These factors represent the underlying perception, attitudes and habitual behaviours of the employees at various levels (Kennedy et al., 1995). These values and mindsets for safety are substantial elements that influence the technique to work, as well as ultimately to an organization's health and safety performance. In other words, creating a well-designed workplace, providing safe and sound equipment/hardware, systems and procedures to prevent incidents will be grossly insufficient if the collective culture is not favourable for a safe and healthy working (Varonen et al. 2000).

Safety culture was initially applied to explain the deficiencies and inadequacies of safety management that leads to major disasters, but in the recent past there has been an increased effort to connect individuals to this concept and to explain how unsafe behaviors are created, that leads to accidents (Mearns et al., 2003). Individual behaviours are seen to be influenced more by organizational culture than the personal and job factors, which could then become a reason for accidents/ worker injuries (Glendon et al., 2001). Within an organizational culture, it is the more localized factors like line supervision and interpretation of safety policies that influence the individual behaviour more than the overall culture. For, e.g., - different departments of the same organization would have varying attitudes towards the safety processes, depending on the competencies and level of understanding and involvement of the line management. Glendon et al., (2001) explains this as a localised culture, which is more susceptible to

changes due to internal (production demand, competency, control & communication etc.) as well as external influences (enforcement, legislation etc.). This dynamic nature of local safety culture makes it more difficult to measure and assess.

Measuring Safety performance of an organisation must be done on various levels using different indicators (reactive and proactive). Measuring safety attitude is only one of them (Ojanen et al., 1988). By measuring the perceptions and attitudes of the workforces, we get a clearer picture of the culture of that workplace. Traditional safety measurement tools like accident/ injuries, ill-health statistics, non-conformities etc. are reactive instruments which do not predict the future performance of the organisation (Bottani, 2009). It has many limitations like reporting biases, fear of retributions, bureaucracies etc. However, Safety climate/ culture surveys are more proactive and have known to overcome most of these limitations. Analyzing safety culture can help us in understanding the organisational psychology (Guldenmund, 2018) and to identify the gaps in risk controls (Rasmussen, 1997). According to Ojanen et al., (1988), the safety culture questionnaire tool can quantify safety culture in an organisation, and it indicates the changes formed in the organisational safety behaviour, thereby being useful for evaluating safety programs and managing systems. However, Mearns et al. (2003) highlight that the relevance of the safety culture concept about individual accidents is not established yet.

1.2: Background

The construction industry is a dominant, dynamic and challenging industry that attracts capital investment, new brains and latest innovated technologies. Various literature sources have concluded the features of construction projects and its intricacy that include factors such as cost and time and level of risk that are linked to the safety management practices (Azadzie et al., 2008; Jackendoff, 2008; Othman et al., 2013; Bottani et al., 2009). In developing countries, commercial projects are the largest sector in the construction industry that aims

to transform the Country's infrastructure with the art of the latest building technologies that are engrossed to accomplish a significant contribution to the national economic development (Liang, 2017).

The construction development in the United Arab Emirates (UAE) started four decades ago with the construction of Dubai Creek and soon after the exploration of the oil during 1960, which had also raised the country's economy. Since then the country's infrastructure started developing, and the role of civil construction played a crucial role in building today's smart city (Oryx Middle East, 2010). The major construction boom was in the year 2006 noted in Assaf and Hajj, (2006) studies. It was highlighted in the Oryx Middle East Report, (2010) that the construction industry economic output to 62 billion dollars during the year 2006. Today the country is equipped with the latest infrastructure and holds a significant share in UAE GDP is reaching to 10.3% in 2011 and aiming to achieve 11.5% by 2020 (Abu Dhabi Municipality Report, 2015). IMF Report (2015) has also highlighted the increase in the population of UAE reaching six million in 2015 from a noted increase of 5.4 million in 2010. From the IMF report, it can be concluded that the rise in construction projects has a direct link to the rise in population. In the context of UAE, the construction industry contributes significantly to the economy, and it remains unique. The UAE government's strategic vision 2030 is attracting foreign investment, and the construction activities are flourishing.

Keeping this in view, it would be vital to understand and analyse the impacts of safety practices in the United Arab Emirates. Thus, for this study, four companies have been randomly chosen to understand the safety management practices and systems in Abu Dhabi (UAE). The shortlisted organizations are as follows:

Table 1.1: Sampled Companies Profile

SN.	Category*	Company Name
1	Company A	ABC L.L.C. is a leading construction company in UAE which was established in 1975. The company is into business will all construction types like high rise, small and medium construction projects. The company is ranked amongst the top 150 Global Contractors and follows a strict protocol on developing, implementing and monitoring safety regimes. It is an MNC based in the USA and has a corporate-driven certified integrated management system (ISO 9001, 14001, OHSAS 18001)
2	Company B	BCD LLC is a joint venture company between a UK construction company and a GCC based company. Founded in 1984 and is commonly regarded amongst the leading construction firms in the UAE and has added to the swiftly transforming face of Abu Dhabi, driven to success by the interest and efforts of its staff as well as project partners. It is an ISO 9001 Certified firm as well as has executed the building and construction of high rise structures, townships, business and domestic facilities, processing sectors, parks, recreation facilities, port centres etc. Though they have a corporate safety policy, the systems and processes follow the contractual requirements.
3	Company C	XYZ LLC is the largest construction company in GCC, with a very large footprint in UAE. They specialise in Engineering, Procurement, and Construction (EPC) mode of project delivery. The business's activities consist of civil design, pipeline building and construction, turnkey industrial plants, mechanical as well as electrical installations. All legal and contractual agreements in line with OHS management are in place and runs with a centralised HSE management.

4	Company D	123 LLC is an MNC based in the UK, with mixed joint venture projects with local partners operates within the Abu Dhabi region. They are engaged in Civil engineering, Electromechanical, Marine works, Joinery and General Maintenance. All OHS management is strictly followed based on the contractual requirements.

**The actual names of the companies are kept confidential for ethical purposes.*

1.3: Problem Statement

There are enough indicators to show that despite having safety systems in organisations, there is no significant reduction in incidents and accidents (Eleonora et al., 2009). There are also negligible efforts by management in assessing/measuring the risk perceptions, safety awareness and motivational programs to assure promoting a high health and safety standards. Having a high capacity management system with all required resources and information will be of very little use, if the people who are designing, developing and implementing these systems do not have the right perception, attitudes and competencies to drive them.

The Environmental Health and Safety (EHS) policy of Abu Dhabi (UAE) government approved on December 6th, 2006, by the executive council aims for health, safety and environment management excellence (EHS, 2016). This initiation by the government is to put continuous efforts to reduce industrial accidents. The policy which came into force in 2008 made it mandatory for public and private sector companies to undertake responsibilities to ensure a safe and sustainable work practice. However, the accident figures of the past indicated that despite having a management system in place the accidents rates are steadily increasing. The reasons for this can be attributed to the high priority given to profit, productivity and to increase the market share (Hinze et al., 2014). Several studies have demonstrated that even though management systems are in place, there are insufficient incentives for motivating and improving safety (Yuling et al., 2018).

The government established 'Occupational Safety and Health Abu Dhabi' (OSHAD) to monitor organisations and to guarantee the best safety practices. The OHS guidelines are established in line with the EHS framework adopted by the Abu Dhabi Government. Currently, there are nine sectors with private entities reporting to the Sector Regulatory authority (SRAs). The Abu Dhabi Municipality is the regulatory authority for the building and construction sector. All entities in the private sector are required to develop an 'Occupational Health and Safety Management Systems' (OHSMS) in accordance with the government framework. The implementation must be further reviewed and approved by the SRA. Despite the presence of these policies and legal frameworks, there has been an increase in levels of the accident as per the published data of Emirates Strategic Centre (2013). See the table below:

Table 1.2: Rate of Accidents recorded per million working hours

Economic Activity	2012	2011	2010
Industry	62.8	43.70	54.23
Construction	36.4	43.74	47.81
Services	77.7	84.00	82.21
Transport	86.5	19.38	19.46
Trade	59.0		

**Retrieved from Emirates Strategic Centre (2013)*

It has been noticed that the accident rate In the industrial sector has been increasing day by day where as in the construction sector, the accident rate has decreased (Table 1.2). Most of these organisations have a management system in place in accordance with the rules and regulations of the Abu Dhabi Government. However, most of these companies it is believed that they give high priority on the profit, mission, productivity or the strength to increase their market share and safety tends to come second in the list (Hinze, 2014). Several studies have demonstrated that even though management systems are in place,

there are insufficient incentives for motivating and improving safety (Arocena et al.,2010). Motivational programs have to be implemented to promote safety in the workplace, which will reduce or prevent occupational injuries and illness and this should be the primary focus of any organisation involving in construction activities. Glendon and Litherland, (2001) demonstrated that the majority of construction-related safety studies in developed countries, have created a new framework or replicated the existing framework with additional tools for enhancing the systems. In context to developing countries, there is a deficiency of studies in this field that highlights the needs for specific requirements. UAE construction sector is currently booming with multi-billion dollar projects and especially Abu Dhabi, whose 2030 vision focuses on substantial construction activities in the near future. Accordingly, it is a requirement to boost the degree of awareness within the OHS fraternity and an unceasing effort made to elevate the awareness of both employees as well as the employer.

Kennedy and Kirwan (1998) pointed out that organisations running with OHS management systems demonstrate difficulties in enhancing safety performance. The study points out that these difficulties are a lack of evidence and non-availability or establishment of a safety culture. Safety practices, guidelines and management systems exist in the document, but in reality, they are not followed by many companies (Cheng et al., 2012). Accordingly, safety climate and culture concepts play a prominent role as these represent the work environment underlying practices, perception, values, and attitudes at all levels (Choudhry et al., 2007).

Organisations are heavily depended on management processes, which directly impacts both performances as well as the robustness of safety systems. Robust OHS management systems can for that reason act as an accelerator of Safety Culture (Reason 1990, 1998). It will not be sufficient for an organisation to have a formal safety management system, as the effectiveness will depend on how organisations would actively implement and monitor these systems. Therefore, an Organisation would require both formal OHSMS and a positive Safety Culture to create a safe work environment. They are like the body and soul and

ought to strengthen each other. The former will establish and build up competencies and the latter the commitment required to maintain an injury-free workplace successfully.

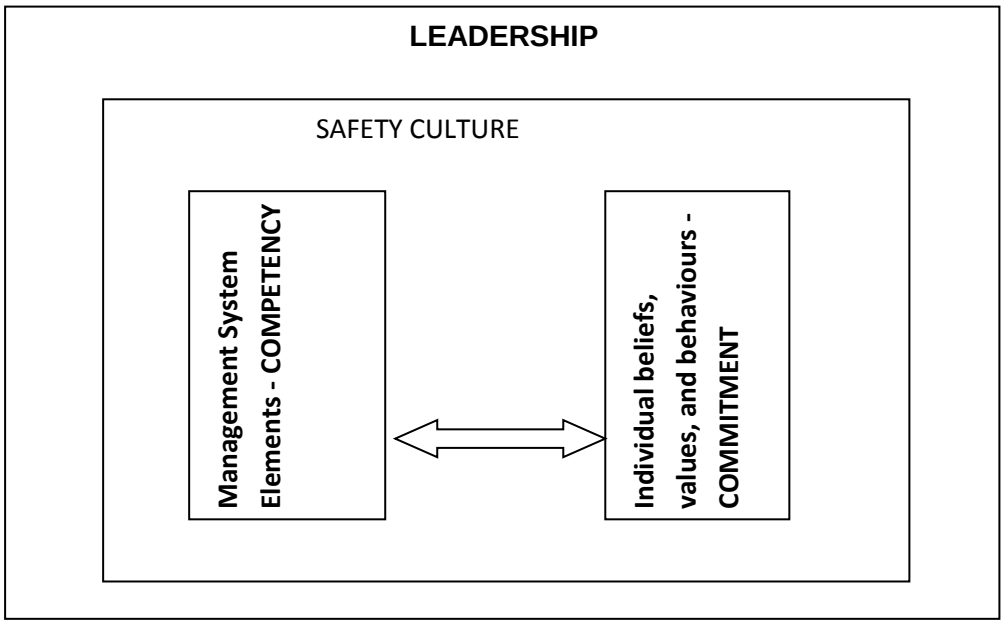


Figure 1.1: OHSMS and Safety Culture Linkage

Therefore, a management system can be established in the construction sector to develop and promote a positive safety culture that will improve the effectiveness of health and safety processes. The following steps shall summarise the process.

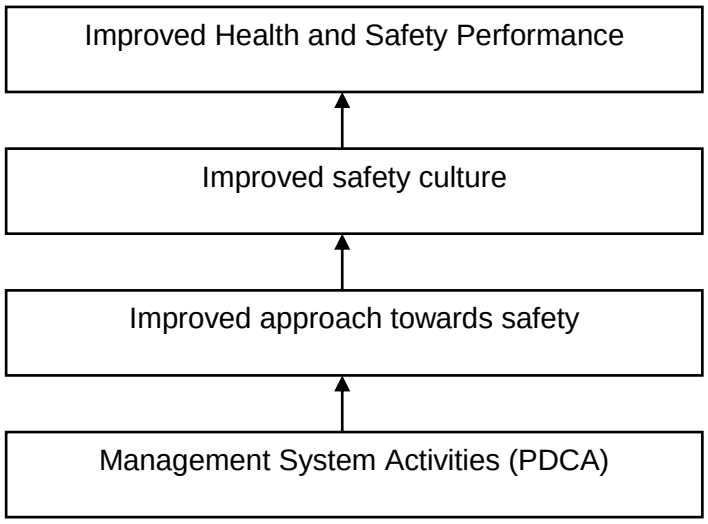


Figure 1.2: MS Activities linkage to Performance

1.4 Research Gap & Theoretical Framework

Studies on Safety culture are limited to non-construction related industries and are missing in the context of UAE and Middle East businesses. Most of the existing studies focused on various elements and influences of safety culture. These influences vary depending on the type of business, management style and external geographical, regulatory and political factors. None of the studies could confirm a comprehensive list of unique factors that influence the safety culture. Management system has been factored as an important factor for safety climate assessment of an organisation by most of the studies conducted in recent times. Correlation studies (Anastacio et al., 2018. Coyle et al., 1995., Fernández-Muñiz et al., 2007) have confirmed a positive correlation between the management system and safety culture. However, there have been no causative relationships established regarding the extent of influence of a formal management system on the overall perceptions and culture of an organisation.

Safety management systems are documented tools utilised by organisations to improve the effectiveness of their safety processes. None of the study reviews had explored safety management system holistically considering all its internal and external influences (Yuling et al., 2018. Coyle et al., 1995., Fernández-Muñiz et al., 2007). Past studies related to management systems effectiveness have mainly focussed on the performance data related to incidents and losses. None of the studies has focussed on the various dimensions of the system inputs, and how they influence the outputs and safety culture. Very little literature is available related to the efficiency of the systems (Thomas 2012. Bottani et al., 2009).

Even though the studies of safety management system discussed in the literature section have studied the influence of systems in performances, some argue that the results are ambiguous, as the actual performance is primarily influenced by the behaviour and safety climate in the workplace. Valid research to date is unavailable to assess the impact of management systems on safety outputs. From external influence point of view, legislation and its enforcement significantly differ in different parts of the globe. While adopting a management

system approach is purely voluntary, Singapore is the only country that had mandated it in the construction sector. The literature review of regulatory frameworks and requirements points out that both developing and developed nations have various types of regulatory frameworks. In UAE, adopting a management system is voluntary, and the enforcement model is self-regulatory. There are no researches done to study the effect of this self-regulatory approach to implementing the management system. The past literature proved that there exists a knowledge gap in identifying a fully-fledged efficient safety management system that includes attributes of culture and performance outputs in UAE construction companies. Accordingly, the conceptual frameworks of this study have been developed.

Organizations are not isolated entities and are actively influenced by both internal and external factors. Within an organisation, there are numerous sub-cultures exist which collectively defines the organisational culture. The most significant is the job culture on the shop floor, which is the dynamic interaction between hardware/engineering, software/administrative and behaviours/ human. The management system can be considered as an administrative arrangement which acts as an interface between the engineering elements (equipment, tools etc.) and the human element (behaviours) and helps a successful task completion. However, this job culture is greatly influenced by the safety culture existing in the company, which is measured through the perceptions attitudes and values of management and its employees towards safety. There is no comprehensive list of safety cultural factors that can be summed up into one. However, most of the literature has identified Leadership, commitment, employee participation, reporting and rewarding systems, mutual trust and risk-taking attitudes as significant internal influences on safety culture. Among the external influences, legal environment and the compensation/insurance requirements influence the safety practices to a considerable extent. This influence is iterative, both safety culture and the job culture mutually acting as enablers and barriers to safe performance.

As shown in figure 1.3, the overall safety performance of an organisation had numerous factors interlinked and depended on each other for its success. It

would be only prudent to assess the management system and its influencing factors holistically. The management system is a micro factor in the context of organisational culture, which is primarily influenced by the perceptions, attitudes and behaviour of people driving it. The safety culture is the macro factor or the 'environment' within which the system can form, develops and continuously improves. The outcome of which is 'safe performance' or reduced losses. This study explores these interdependencies of macro (culture) and micro factors (system) and its outcome concerning safe performances (key performance indicators).

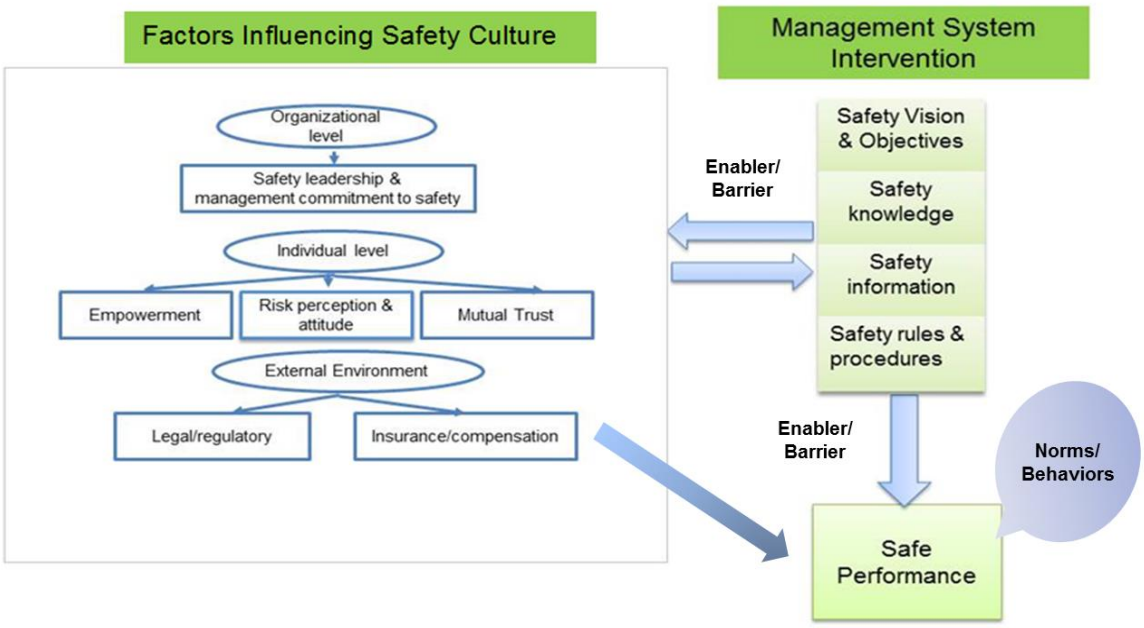


Figure 1.3: Theoretical Framework of Research

1.5: Aim of the Research

The study aims to understand the safety climate, culture, practices and management systems that are currently in practice in construction companies in Abu Dhabi and to compare the effectiveness between the companies that do have a management system in place and that does not have a management system.

1.6: Objectives of the Research

The framed objectives for this study include the following:

1. To critically analyse the current safety culture and practices of Construction companies in Abu Dhabi.
2. To examine and quantify the effectiveness of the Management System in promoting and improving safety culture.
3. To establish the variances in safety culture/perception among people with different demography (ethnicity, language, education and skills).
4. To recommend further improvements.

1.7: Research Questions

1. What safety attitudes, motivations and perceptions exist in the UAE construction sector?
2. What is the level of understanding of people on the need and importance of a formal management system?
3. What factors of a formal management system influences the safety culture?
4. Does a corporate-driven management system is more effective than a project level system on a construction site?
5. What are the specific relationships between demographics and safety culture perception?
6. Do employees with different 'communication' skill have different safety culture/perception?
7. What is the relationship between people from different geographical regions and skill/competency in different trades?
8. How does the legal and compensation environment in UAE influence management systems?

1.8: Hypothesis

Accomplishing the above research objectives will answer the research Hypothesis which is:

H1: "Companies with a Certified Corporate driven Safety Management System in place have a more positive safety culture than companies who are deficient in it."

H2: "A positive safety culture influences the development and implementation of an effective Safety Management System."

1.9: Scope of the Research

The research is limited to construction companies operating within the geographical region of Abu Dhabi. The data for the study is gathered through documentation, interviews, information collected from site survey of the completed and delivered projects and the projects under construction. The current practices of safety management practices in the construction industry have been analysed on a broader perspective through the scope of this research study. Accordingly, the issues are identified, and the solutions are suggested through this research study which can be useful to companies across the globe to focus on tools that can enhance the safety practices. This study is related to safety practices within the jurisdiction of UAE government regulations which in turn makes this research a significant advantage for construction companies operating within the geographic limits of UAE. The scope of this study is described as under:

- The study will cover the OHS systems, provisions, safety measures and requirements, general OHS standards at construction sites as well as duties and responsibilities of all stakeholders;
- The safety values, perceptions and attitude of individuals on the various safety cultural attributes;
- OHS processes that need consideration in the whole life-cycle of a typical construction project to provide a safe working environment;

- Explore and confirm that OHS management systems are efficiently followed within the selected organisation.

1.10: Significance of the Research

There is a growing debate on the effectiveness and use of a formal safety management system to control and minimise the workplace accidents and losses within UAE construction companies. Companies often ignore the importance of a proactive systems approach in dealing with OHS issues and rely on a more supervisory and 'policing' approach to deal with OHS issues which tends to become reactive and seldom effective in controlling their losses. There is an increasing perception among the construction site personnel that the management systems are only for auditing, while the site needs to be handled daily, as the situation develops.

UAE Construction companies tend to focus more on explicit contractual obligations and requirements to fulfil the short-term project goals and do not look beyond it to build a team driven/inter-dependent culture and commitment of the people employed. In the bargain, the companies experience an increase in staff turnover, absenteeism, low productivity due to lack of morale and end up in a loss in most of the projects.

There is a lack of awareness about the significance of a formal systems approach towards OHS management among the managers in most of these companies. This study will be able to highlight this significant gap in awareness and help assist companies to manage safety issues more actively through a formal management system driven by strong leadership at all levels and will be able to improve their performance continuously.

The findings from this study will enhance the existing knowledge in this field and will be much useful for construction companies across UAE for a better and enhanced understanding of safety cultural interactions with OHS systems and practices. Thus, the outcomes of this study will act as a reference guide for the construction sector.

1.11: Organization of the Study

The study is organized into the following chapters:

Chapter 1: Introduction, problem statement, theoretical background of this study, the research gap and theoretical framework along with the aims and objective

Chapter 2: This chapter will provide the secondary data analysis, i.e. the literature review.

Chapter 3: Describes the methodology followed for the research with justification to meet the research aims.

Chapter 4: Presents the findings from the data analysis.

Chapter 5: Presents the findings and discussions

Chapter 6: Presents the conclusion, recommendation and way forward.

Chapter 2: Literature Review

2.1: Introduction

The construction industry has a significant contribution to any developing or developed nation's GDP. Both economically and socially the industry is imperative and has a significant impact on the health and safety of its workforce (Yoon et al., 2013). Construction workers execute a multiplicity of tasks, and there are unambiguous risks associated with these tasks. These associated risks are unswervingly exposed to the worker and inertly exposed to risks produced by workers nearby (Pinto et al., 2011). From site to site, it is highly essential for construction workers to adapt to the learning curve of the projects under construction as the dimensions and uniqueness of the scope of the work vary from one project to another. Accordingly, there is a high level of associated injuries at each point of the work process (Grant and Hinse, 2014). Thus, the construction industry is rated as high-frequency accident industry, and researchers debated the unsafe nature of the industry (Pinto et al., 2011). There are a set of accidents noted in this sector, and the degree of safety is not known. Hola and Szostak (2014) have stressed the importance of the knowledge of accidents in each situation that will enable to assess the level of safety and measures necessary for a change to reduce the risk of such occurrences. Since the beginning of the 21st century, studies related to OSH in the construction industry started discussing various perspectives using diverse methods and tools to study and investigate the numerous factors leading to accidents in the construction industry (Sousa et al., 2014). An important study by Zhou et al. (2015) highlighted that most of the studies are related to the safety management process, and others relate to accident causation. This review will focus on the safety culture concept, practice, safety management systems and other attributes relevant to the research topic.

2.2: Definition and Concept of Safety Culture

Safety Culture is an abstract concept, and it was always challenging for researchers to come up with a comprehensive list of factors that influence culture and performance. There are many dentitions in the past literature, as culture is a factor that is difficult to define. The past research revolves around the characteristics of culture. Stated in the studies of Hea et al., (2012) culture comprises behaviours, norms, values and material objects encircling people to share and to express on these variables. Varner and Breamer (2005) described culture as common, profound unstated experiences that members of an organisation share. Organizational culture is developed through social interactions, and each organisation has their unique cultural identity which is dominated by its values and behaviour (Naoum, 2001). It was noted in the studies of Booth (1995) that safety culture term was first discussed by International Automatic Energy Agency (IAEA) while analyzing the disaster in Chernobyl nuclear power plant. Cooper (2002) defined it as a subset of organisational culture that encompasses the workforce mindset and behaviours towards safety practices and its continued development.

Cooper (2002) gave a theoretical definition "safety culture is all about the workforce thoughts and mindset to deal with health and safety". As stated above safety culture is a subset of organisational culture, and both are interconnected and influence each other. For example, the performance that influences the safety culture will in turn influences the organisational performance. The research on safety carried out in the past indicated that safety climate assessments are likely to be directly proportional to the safety performance. In this perspective, organisational safety culture can be improved by analyzing the perceived safety culture of the organization.

The previous studies which were done in the past indicated that only little consensus had been extended to the various facets of the commonly connected concept of safety culture. Shuang and Xue-feng, (2007) stated that the theory of safety culture and its aspects links to four levels and these four levels comprise of a system of institutional, physical, behaviour and spiritual culture (Yongjun and

Dexin, 2011). Industrial standards are vital for the directives for construction sectors as these standards assist the organisation in developing a safety culture. Various literature to this aspect has concluded, and defined safety culture is an assortment of safety problems (Pidgeon, 2001). The definitions of safety culture cited in Wiegmann et al. (2002) studies and are listed in the table (2.1):

Table 2.1. Definition of Safety Culture (Wiegmann et al., 2002)

Authors/ Industry	Definition
(Carroll 1998) Nuclear power, United States of America	Safety culture is referred to as a priority for workers as well as public safety. It also highlights the expectations that each will act to the sphere and improve safety by taking up his or her obligation to his or her accountability for safety
(Ciavarelli and Figlock 1996) Naval aviation, US	The researcher has defined safety culture as values that are shared, norms, understandings and assumptions that have a direct influence on organisational decision making.
(Cooper 2002) Theoretical	Sub-facet of organisational culture that touches the organisation's workforce attitude and behaviour in the context of the organisation safety culture and its development
(Cox and Cox 1991) Industrial gases, European	Values, attitudes, beliefs and perceptions that workforce share about safety
(Eiff 1999) Aviation, US	The study highlights the importance of every individual's responsibility and their active role in eliminating and preventing error and the organisational support

Authors/ Industry	Definition
(Pidgeon 2001) Driver Behaviour	An assortment of safety problems and this depends on the associated practices and their assumptions

2.3: Elements of Safety Culture

It can be inferred from the past literature that elements of safety culture include organisational leadership, management assurance and participation, employee empowerment, reporting and rewarding system, attitude towards risk-, mutual trust etc. All these factors combine to formulate safety culture and the proficiency of its visible systems. External influences such as the regulatory environment and compensation environment also play a very significant influencing role in developing, maintaining and maturing the safety culture of an organization, by directing/shaping the visible systems. Numerous studies to this extent are available focusing on essential features of safety culture and creating measurement scales for them. All these past literatures focused on numerous elements and dimensions of safety primarily on management focus and potential problems in different industries. Moreover, none of them has conducted or derived all the above said nine elements (Hea et al., 2012). Some of the past research detail is given in the below tabe (2.2):

Table 2.2: Past studies attributes of safety culture

Elements	Authors
The study highlights the elements of leadership and its behaviours, the management role subordinate and leadership risk assessment.	(Skeepers and Mbohwa, 2015); Zohar, (2000); Daniel (2015)
Management effectiveness, personal skills and employees attitude	Liang (2017); Minhong (2001)
Job satisfaction, management style, communication system, risk behaviour and risk awareness.	Tengilimoglu, Celik and Guzel, (2016); Littlejohn, Lukic and Margaryan, (2014)
Vision, mission and commitment in promoting safety, safety systems and safety training and awareness of safety measurements	Han and Lee (2013); Bajjou, Chafi and En-Nadi, (2017)
Safety systems, influence on employee performance, safety training and employee participation in safety	Cheng, Ryan and Kelly (2012); Yan (2012)
Management commitment, leadership effectiveness and communication	Liang (2017); Choe et.al (2016)
Management's commitment, safety attitude, employee responsibility, working environment and risk identification	Liang (2017); Rameezdeen and Gunarathna, (2012)
Safety environment and safety rules and regulations, employee empowerment and safety behaviour	Alazzaz (2015); Weichbrodt, (2015)

Stewart (2002) highlights that safety culture is a natural outcome of good safety management practices and the tools employed for ensuring its effectiveness. The study further identifies some critical tools that are

important for the efficiency of the system. These tools include the management vision, obligation and drive, ownership of safety, training, participation in safety activities, linking safety specializing and aligning it with the organisational objectives as independent variables. The safety awareness and equipment safety as dependent variables and each variable depend on multiple dimensions of safety. Based on Stewart (2002) study and other literature referred in the above table (table 2.2) about the elements of safety culture, it can be concluded that safety components incorporated in a safety culture include the following:

- Safe Work Environment
- Safety Rules and Procedures
- Commitment to Safety
- Safe Training
- Safety Leadership
- Risk Management
- Worker Empowerment
- Safety Promotion
- Legal Compliances
- Performance Measurement
- Communication method
- Management of Change
- Safety awareness and attitude
- Contractor Management
- Safety knowledge and attitudes
- Workers participation in safety activities
- Safety Behavior

2.4: Organization and Leadership Commitment

Occupational safety and health links to the multidisciplinary notion that focuses on safety, health and the betterment of the workforce deliberated Bhagawati (2015). OHS drives to accomplish organisational goals capturing the mental, emotional and physical wellbeing of the workforce that results in a positive work environment (Tawiah et.al.2011). Gyekye (2006) research highlights that there are enormous safety related issues which cause high injuries and death from the data available. This has also been highlighted in NSC (2004) stating that both developed and developing nations work-related injuries, deaths and accidents are surprising and extremely at a high rate. ILO reports estimates that these work-related accidents cause more than 2.3 million deaths and 25% of these are caused due to workplace accidents. Further ILO report points out that 264 million accidents are occurring each year leading to hospitalisation of the workers and this may lead to the worker's absence at the worksite for several days based on the fatality of the accident. ILO report further highlights that the estimated occupational illness and accidents have risen to additional financial burdens of approximately USD 2.8 trillion (ILO, 2014). Seo et al. (2004) noted that industries across developing nations are facing enormous economic loss due to work-related incidents. To this perspective it should be noted that if the organization is capable enough to recognize the importance of OHS, it will create a work environment where the workforce will have a feeling of safe work practices, level of performance increases and they develop emotional attachment which will further contribute to their obligation to organization commitment (Zanko and Dawson, 2011). An organisation which do not recognise this aspect, it is seen that employees have a negative attitude and causes of accidents are high. It is vital for management to institute sound and proper policy measures for the health and safety needs and these policies should protect the workers from getting injured or ill-health (Yoon et al., 2013).

The commitment and awareness of the Organisational leadership in construction health and safety management are vital. Leadership roles will create a positive influence on workers' health and safety behaviours identified by Lees and Austin (2011). Oloke (2010) research stressed the fundamental

difference between the leadership in the construction management process and argued that the leadership in the construction management process and health and safety management is not aligned to create desired behaviors. Often construction projects are fast-paced with tight schedules, frequent changes in the scope due to inadequate planning by the client/owner. This forces safety to be managed with a supervisory control where the focus is limited to complying to minimum contractual requirements and lose focus on improving behaviors, which requires some time and a great deal of stability in the work conditions (Oloke, 2010). The referred literature highlights the importance of various leadership roles in the construction site and how they contribute to the betterment of the health and safety improvement at worksites. All key project stakeholders' leadership plays a dynamic role in influencing health and safety behaviour. For a Construction Company, focusing on safe behavior is vital as the workforce is the critical resource for the construction sector. As Zou (2011) stated – "the productivity of the workers could be maximised by improving the working conditions giving priority to health and safety". This is possible through commitment and an enthusiastic leadership at all levels.

Organizations are not an isolated entity; they have their influences from external factors. The most significant being the legal and regulatory environment. If laws are precise, prescriptive and have active enforcement by the local authorities, management tends to have a more significant interest and focus on OHS matters (Lees et al., 2011). Another influencing factor is the insurance companies, which could force organizations to change their ways and improve their systems related to safety to get them covered.

Organisational leadership along with management commitment goes a long way in influencing and predicting the employees' commitment and compliance in OHS matters. Setting self-example, being visible on worksites, engaging and empowering employees in making decisions related to safety, encouraging reporting and rewarding for safe behaviours, trust and support are key leadership and commitment attributes (Musonda and Smallwood, 2008).

2.5: Employee Empowerment and Workforce Participation

It is widely recognised that employee ownership is key to improving organisational performance in many dimensions, including effective H&S management (HSE, 2013). Previous research has shown that a company's H&S culture is a critical factor in achieving and maintaining good H&S performance (HSE, 2013). Worker engagement was found to enhance their commitment to implement decisions and to enhance cooperation and confidence as they actively participate in those decisions (Bell and Phelps, 2011). There are two main barriers to labour market participation (HSE, 2005). First, sensitive employees are aware of good H&S practices and are reluctant to receive advice. Second, they believe that those who were unable to shape or modify their behaviour.

Despite the existence of a law which requires employers to consult with employees on health and safety issues, a standardized method is not adopted by all. Employers who do not have formal consultation arrangements have other means to achieve the goal of worker participation. The law provides a framework for worker participation arrangements but is rarely the only way to achieve active engagement of employees (Shearn, 2004). Also, a recent survey in the United Kingdom showed that very few employers know of the H&S standards for employee consultation (Hillage et al., 2000, 69). Financial incentives also recognise the value attached to the role of labour market participation, if employers are even convinced of the commercial benefits of such incentives (Cotton, 1993). The nature of participation and consultation should be influenced by many factors, such as work, workplace, personnel and management decisions, time constraints and resources (Shearn, 2004). By informing a committee to discuss H&S issues, some authors are monitoring the involvement of workers in determining the factors that need investigation (Strauss, 1977), p. The way employees are chosen profoundly to affect the balance of forces that can set programs and baselines for action (Dachler and Wilpert, 1978).

2.6: Commitment Levels

The success of all participation initiatives in the workplace is based on the visible/tangible involvement of management (HSE, 2005). Employee participation is just as crucial as job-insertion initiatives must be. According to research, these questions are not restricted to non-nationalized jobs (Shearn, 2005), though minor differences can occur in non-nationalized jobs. It is generally reported that co-determination and management level of employees are significant contributes to the effectiveness of job engagement activities. Equally important are the assessment of employee engagement and the involvement of management with the intention of closing any gaps (Bell & Phelps, 2001).

Inadequate management practices or lack of involvement of management in H&S were identified as a significant barrier to employee engagement. (Fuller, 1999). Senior management engagement is essential in all OHS programs, including employee consultation. The consultation does not eliminate the employer's right to make and make the final decision (HSE, 2002). In most companies, most of the incentives for business practices have come from the highest level of management, as the study shows that this may be the situation, about OHS surveillance. A CEO must be visual and have a coherent vision and can be delivered (BSC, 2010). Earlier scientists have indeed recognised the need for senior leadership in board meetings. Kochan et al. (1977) noted in her study that the visibility of leadership and the standard approach was a decisive factor and crucial to the success of the board.

2.6.1: Management Commitment

The existence of a leadership commitment to participatory initiatives is an essential prerequisite (Goldstein et al., 1990) for counselling the workforce. The effectiveness of a workforce initiative depends on specific management assurance (Boden et al., 1984). Modelling of appropriate behaviours by managers and other leaders contributes primarily to creating and supporting a good culture of dialogue (HSE, 2007). Moreover, good dialogue cultures will

invariably influence better workforce participation. There is a definite need for management dedication in the direction of participatory strategies and also their objectives from the senior most person in the organisation (Biggins & Farr 1988a). An important factor in acquiring the commitment of management is that they have a vital role in licensing any change or recommendation which may develop from employee engagement campaigns (Locke et al., 1994). The commitment of the management must also be expressed by earmarking specific resources to carry out the tasks or by adding the management of the elderly in participatory procedures (Rahimi, 1995). Various authors (Mackmurdo 2002, Penzer 1990) if the management does not set the tone, other staffs and line supervision will not demonstrate a real interest in the initiatives. Workers could, therefore, diminish the value of participatory initiatives.

Providing a useful environment has proven to be a reliable way to promote the creative thinking and progress of the team (Vinodkumar et al., 2009). Monitoring assistance is a great way to strengthen the real commitment of superiors and recognise that the work environment is at the top of organisational priorities (Penzer 1990).

2.6.2: Worker Commitment

Participation programs of the workforce will become ineffective if they do not have a clear role in the committee. If they are not involved in setting objectives and other agendas, they could perceive that these initiatives do not concern them (Latham et al., 1994). Previous researchers have consistently established that employees do not want to play a pro-active role in managing H&S, and the engagement differs among people and situations (HSE, 2005). Significant growth from the evaluation process is the full participation of the employee in the active input in the joint analysis of H&S issues (HSE, 2007).

This is an example (unclear) that the realisation of labour consultation activities will undoubtedly be contingent on the assurance of workers. Literature shows

that engagement is unlikely to be useful if people do not favour participation, or do not see the campaign in their area of interest (Biggins et al., 1991). Some authors have made recommendations to increase engagement, although there are evidence that low-skilled employees have shown greater motivation to participate in participative activities (Locke & Schweiger, 1979) - the partnership has them Feeling of control manifesting in a more significant involvement in the task. Employee engagement can be improved by guaranteeing access to decision-making and the formulation of each outcome (Cotton, 1993). Another approach to achieving employee engagement is the signing of an H&S agreement (Alder, 2000) that could determine the acceptance of roles and responsibilities related to employee stock ownership plans.

2.7: Competence and Risk Perception

Knowledge and competence are fundamental prerequisites for any form of participation (Lippin et al., 2000). The effectiveness of the involvement will be closely linked to the expertise and contribution of participants (Bryce & Manga, 1985). Formal training methods focus more on developing "more difficult" technical knowledge such as risk assessment methods or H&S regulations (HSE, 2007). The overall ability to attract H&S professionals is always driven and developed by informal business processes based on a robust culture of dialogue rather than training. It is needless to say that beliefs and knowledge are essential determinants of risk perception and associated behaviour. People need to know what safe conduct is (HSE, 2007). Therefore, education and training in all HSE programs are essential. The effectiveness is directly linked to the knowledge and expertise of the participant (HSE 2005). Inclusion criteria based on the involvement in specific social contexts are typically based on technical or experiential knowledge (O'Toole, 1999). The study identifies that training is a prerequisite for participation in many cases. It has also been found that training influences participants' commitment to changing their H&S. Employees can also participate in the provision and design of H&S training through safety standards (HSE, 2007). It is generally recognised and acknowledged that

awareness is an essential foundation for building a culture of dialogue (HSE, 2007). When employees receive regular training and information, they understand why specific actions are being taken. Competency of the members also plays a vital and decisive part in the success of safety committees. Eaton & Nocerino (2000) explains the decisive role played by training in the perception of committee members. All participants in the safety committee should receive training to help them in fulfiling their responsibilities, such as~~: As~~ an example, H&S training issues, work and participation in decision making. A buddy system where an older worker mentors a new employee is another way to improve the skills of the workforce (Bell and Phelps, 2001).

2.8: The Scope of Construction Industry and its Related Problem

Researchers have classified the physiognomies of the construction sector into numerous fragments which are housing, industrial, commercial and infrastructure works. In this view it can be defined that the process of construction is unswervingly or circuitously influence by a mixture of different organization such as property developers, architects, quantity surveyors, financial experts, numerous contractors (electrical, plumbing, civil), Management contractors, other key stakeholders and specialist trades (Xue and Zhang, 2017). Most of these construction works include hazardous operations that comprise of handling and use of dangerous materials. The range of activities associated with a construction project includes site clearance, demolition, use of plants/heavy machinery and building of horizontal and vertical structures (Ilvonen, 2013). Hazardous nature of the construction work includes fabrication, installation, removal and maintenance of services such as water and electricity, gas, telecommunication, network connection etc. Other elements of construction work comprise the carpentry which involves woodworks; these are also categorised under hazardous nature as it is associated with heavy machinery and other chemicals such as painting (Alkilani, Jupp and Sawhney, 2013) Furthermore these wood works often required to work in confined spaces. Accordingly, the nature of the risk increases. Therefore, the industry is classified into the most hazardous sector and across in both

developed and developing countries. Construction industry's safety standards are alleged to be unsatisfactory and not at par with other industry due to the increased accident rates (ILO, 2017). It should be noted that the workplace of the construction projects includes all these hazardous activities ~~and~~ due to the temporary nature and continually changing process, issues related to health and safety are sometimes drawn to compromise, and elements of safe re-routing of site traffics are dodged (Lv, 2014).

The nature of construction projects are temporary and involves fragmented activities and involvement of multiple contractors and suppliers making the workplace more complex. Often these contractors have different involvment and influence on the characteristics of the project. Therefore, it becomes imperative that all the stakeholders involved in the construction project should be oriented well and given appropriate training on safety practices. It has been noted in the research studies of Alazzaz (2015) and Whyte (2015) that influential supervisors who have a positive attitude and relationship with the workers have accomplished a positive safety performance record. However, Smallwood (2008) highlighted that building a positive relationship with workers is quite harder, because of poor competency and higher demands placed on them. This expectation of high requirements often fails to accomplish a positive safety record (Llvonen, 2013). The past literature suggests that the subcontractors cause major accidents related to occupational safety and health-related issues because of their unenthusiastic to implement OHS (Lv, 2014).

2.9: Construction Safety in the Region

The research report of GOSI, (2011) highlighted that the Saudi Arabia construction industry rated a total of 48% injuries in 2011. Elsafty et al. (2012) highlighted that there were a 33% injury noted in the construction sector in Egypt in 2008 and these were mostly caused due to falls from different levels. Hannanein and Hanna (2008) noted in their studies that these accidents are caused because of the less formal safety programs charted by the contractors. The research studies of Al-Tabtabai, (2002) concluded that 17% accident rate in Kuwait during 1999 was mainly caused due to falling. This has been further

corroborated in the research studies of Humaidi and Tan (2010) that all these major accidents are caused by falling or moving the object. He highlighted that these problems occurred due to the unstructured and poorly organization labour work structure, poor safety programs and reporting systems, extensive use of the workforce and lack of safety regulations. Kartam et al. (2000) stated that the most prevalent problem in the region that the workforce did not undergo adequate safety training programs before the start of their job and most not aware of the organisational safety management process.

2.10 UAE Construction Sector

2.10.1: An Overview

The construction industry is unique by their transient, fragmented and heavily resource-driven nature (Aftab et al., 2014). After the last economic crisis in 2008, the construction industry in UAE has grown exponentially with many multi-million-dollar projects (Oryx Report, 2010). The contribution of the construction industry to the country's GDP (non-oil) has grown from 8% to 12% between 2008 and 2010. UAE continues to invest and plans to invest worth AED 330 billion as part of its vision 2021 and 2030 (Michael, 2005). From the researcher's point of view, it can be concluded that UAE will witness a meaningful change in the construction sector with a huge infrastructure project based on the government vision of 2030

2.10.2 Work Practices in the Construction Sector in UAE

Safe work practices by employees are a direct outcome of a conducive work environment and excellent procedures developed and communicated by the employer (Anker et al., 2002). Al Hajeri et al. (2012) discusses in his study that balancing work and social life is critical while designing work systems. In the current global environment, reasonable and safe workplaces have become the necessity to demonstrate social justice (Bisom, 2011). There are no clear definitions or pre-requisites listed about what is a reasonable work environment in the construction industry, because of the transient and varying requirements of construction projects. Bakshi and Kerr (2008) highlight the vagueness in

defining the term of decent work practices internationally for the construction industry. Some guidance on safe practices can be obtained from ILO labour standards which can be adopted or adapted by individual countries. Today the Government of UAE has imposed standards and procedures for construction companies to adapt especially in the health and safety related areas of the construction workers. These mandated rules and regulations by the UAE government as per the government vision 2030, will establish the construction sector a place of decent work practices.

2.11: Legislations Governing Health & Safety

In this section, a detailed review is presented regarding the OHS legislation in the construction sector. A robust OHS management system will assist people to address the risk from time to time and will create a safe work environment which is the prime aim of all H&S laws. All management systems shall have a well establish risk reduction and control tools. Apart from this, structured enforcement actions are initiated by local authorities if someone is suspected of negligence. Accordingly, all individual countries create a legal framework of health and safety to protect the right of the citizens if negligently causing injuries at the workplace.

2.11.1: Global Review

Developed and developing nations across the globe are continuously improving their standards and principles to establish a working environment which is free from injury and illness (Holder and O'Brien, 2007). They state that certain countries entirely rely on governments to take control of safety at the worksite. Companies frame their H&S regulations at their worksites in line with the mandatory legal requirements. However, researchers argue that maintaining this will not eliminate or guarantee and excellence in health and safety performance as these frameworks have insignificant precautionary methods (Jahn, 2016). Most countries across the globe have regulated framework of law related to safety to the workers from injuries and illness. This legal frame highlights

requirements of generally accepted safe technical practices. In context to the USA, the practice is regulated by the governmental body OSH administration (OSHA), providing criteria for construction companies to adopt. These OHSA regulations apply to all construction groups at a site such as contractors, sub-contractors, suppliers' other revelries at the site. OSHA highlights the employer's responsibility in maintaining a safe working environment and further points out the importance of regular inspection at the worksite by a competent designated individual (Clendenin and Garcia, 2013). Endroyo et al., (2015) deliberated the importance of safety training which should be a mandatory regulation, giving safety training for workers would create greater responsibility for individuals itself and this will contribute to the prevention of unsafe conditions or hazards at the workplace. Holder and O'Brien (2007) point out those countries such an s UK and Singapore and even Hong Kong have a legal mandate to develop and implement a formal safety management system. In European countries, the legal regulations related to health and safety is accepted by the member state and the European Commission.

Each member states have their responsibility for maintaining their legal laws. In the European Union, the safety standards are mainly focused on harmonising workplace standards to incorporate them into the national law of each member state. The health and safety at Work Act (HSW Act, 1974), is the basis of UK's H&S laws. These laws highlight the legal framework for contractors and one of the significant points to stress here is the requirement of forming Health and Safety Executive (HSE) and the Health and Safety Commission (HSC) to accomplish the requirements of HSW Act (Rawlinson and Farrell, 2010). Compared to Singapore the legislation is governed by the UK Factories Act (1961). These regulations point out the mandatory requirements of contractors having to construct work above the value of US Dollars Ten Million to maintain a safety management system, and this legal framework is detailed separately under 1999 code (CP 79) of practice for safety management systems at a construction site (Kamardeen, 2009). Zanko and Dawson, (2011) highlighted in their research review about health and safety at Finland, the Labour Inspection Services enforce the legislation, and the OHS legally is the responsibility of the

employer. China has a separate ministry known as the ministry of construction which mandates the legislation for the construction sector (Zeng, Tam and Tam, 2008).

In the Middle East especially the Arab countries most of them have endorsed national legislation to protect the workforce at the site. Most of these countries run under legal frameworks which have committees or ministries for OHS. However, the studies of Jannadi and Bu-Khamsin, (2002) noted that these legislations are very limited in the Arab countries. Moreover, there is a conflict of regulations as these committees or ministries in collaboration with international bodies have created varying guidelines in H&S for construction sites (Gangopadhyay, 2012). For example, in Kuwait the legislation is governed by two government entities one is the Municipality, and the other is the Ministry of Public Works, and further, there is a high committee in each state to control the safety and security. However, compared to Kuwait, Saudi Arabia did not have any government entities to govern the legislation but made it mandatory for contractors to take over the legal responsibility. The top management of any construction company is made accountable for enforcing the regulations (Jannadi and Bu-Khamsin, 2002). In Qatar, the health and safety regulation is stipulated by the Ministry of labour.

2.11.2: Health and Safety Legislation in UAE Construction Sector

In context to UAE, the existence and application of OHS regulations are widely spread across the different emirates (Al Kaabi, 2003). The studies of Al Kaabi (2003), highlights the fragmented framework of OHS which is ineffectively spread, due to the varying requirements in different emirates and local authorities within them. The main issue with UAE is not the absence of health and safety requirements, but the lack of a unified entity for the enforcement of laws (Jackson, 2012). Entities are often left to interpret and apply the requirement themselves. The very fast changing environment of Construction projects makes it more challenging for the management to maintain focus on

the broader regulatory requirements. They tend to focus more on the immediate and explicit contractual requirements (Al Hajeri et al., 2012). This is more of an issue with construction companies who do not have a systems approach in identifying all stakeholder requirements.

Apart from legal reasons, organisations have a moral/humanitarian and economic reasons for adequate safety management practices in place. It is noted that particularly in the United Arab Emirates only a few studies have been conducted related to construction industry health and safety management. Al Kaabi (2003) studies can be referred to as the first documented study related to this subject which focuses on the safety practices of construction companies in UAE. This study demonstrates that fatal accidents are caused because of the absence of safety personals supervision at the site and a 25% of the companies does not provide safety equipment's to people at work and a significant point the study noted ~~is~~ that around 20% of these construction organization does not keep any records of the accidents. During this study, it was found that there were insufficient laws for the enforcement of safety management at the construction site. However, Jackson (2012) highlighted that "Federal Law No.8 of 1980" holds employers and employees responsible for health and safety breaches. Federal Law No. 3 of 1987 further elaborates the penalties for violation of laws. Federal laws have further delegated the development and enforcement of local regulations related to health and safety to individual emirates/states in UAE.

A further study by Al Kaabi and Hadipriono, (2003) identified the insufficient instruments in the law for the enforcement of safety management practices at construction sites. The studies of Shibani et al. (2012) related to H&S influence in the construction sector of UAE demonstrates that most of the construction companies lacked understanding of the OHS rules, practices and regulations. Other areas highlighted in the above studies are the lack of training elements, cultural barriers to link to the safety process and absence of accident reporting procedures. In 2012, the human rights report documented that even though there is some improvement in this sector, still there is an elevated level of safety issues

(HRW, 2012). As the construction sector is rapidly growing, the government has taken strict measurements in adopting safety regulations in each state.

Moreover, this has forced the government to adopt strategies that can build a robust workforce that fills the gaps across all industries in UAE. To this extent the government has given priority to OHS and has implemented standards for organisations to follow for managing and dealing with the OHS risk. Each authority will focus on developing and implementing regulations and codes that govern the construction practices in their terrains (HRW, 2012). In Dubai, this is controlled by the Dubai Municipality (DM) who governs the construction industry, and all its policies and codes of practices related to safety were revised in 2008. Another regulatory authority is the TRAKHEES which through its EHS management policy controls and regulates the environment, health and safety. Construction safety policies are documented in EHS version 2010, and organisations need to follow this. Another regulatory authority is the DTMFZA from Dubai Technology, and Media Free Zone (DMTFZA) which regulates the HSE practices through it revised 2008 regulation manual that protects the working condition of the workers in the construction industry (DTMFZA, 2008). It can be noted that all these standards are developed in consensus with the international standards of OHS regulations after conducting in-depth research on past incidents (OSHAD, 2017). The formulation and mandatory requirements of these entire standard initiated by the UAE government are focused on accomplishing the goal of a safe workplace environment for all parties.

OSHAD (Abu Dhabi Occupational Safety and Health Center) is arguably the only legislative requirement in UAE which prescribes a systems approach to manage H&S for entities/businesses operating in the emirates of Abu Dhabi. OSHAD was formed through a consultative committee directly reporting to the Executive Council, Abu Dhabi who engaged in discussions with all the local regulatory bodies and developed a comprehensive OHS management framework (OSHAD, 2017). Construction businesses in Abu Dhabi are regulated through the Department of Municipality Affairs (DMA), who is

accountable to OSHAD for the entities registered under them. However, the grey area is still the interpretation and weak enforcement of requirements on the construction site. Often, Construction companies complete a project with no requirements met and with no formal engagement with regulators. The projects which are in international media limelight are probably the only ones who gain some attention and enforcement from the local authorities (Jackson, 2012).

Nevertheless, it is worth noting that some companies mainly multinationals (MNCs) and companies with deep roots in the region understands the deficiency of the legal influence in this area. They take a more concerted systems approach, by building up robust management systems and programs to help manage their business in a cost-efficient way by minimizing losses related to injuries and ill-health.

2.12: Safety Management Systems

Management systems have been favourite research topics among safety professionals. Researchers have come up with various system models and factors that influence them in the respective business environment (Santos.et.al, 2018). Safety Culture and human behaviour theories in this context is another common field of research. A system thinking approach has been discussed in the literature which has extended from process safety to occupational health and safety (Stemna, 2018). Safety performances are studied and correlated directly with the changing system factors, rather than attributing to the human factors. Past literature has indicated that technological advancement in the field of safety had reduced the incident rates considerably (Yanga et al., 2018). Human factors are always discussed because of a complex nexus between management and system factors (Nordlof et al., 2017). It led to major disasters in the 1980s to create sufficient empirical evidence and formulated theories about process safety and further extended to occupational safety. Studies and theories around the past studies were more about predicting performances based on the system design and management factors (Fernández-Muñizet al., 2007).

In context to the definition of safety management systems, there is hardly any unanimity among organisations or agencies (Robson et al., 2007). However, the international management collaboration group of safety defined this as a series of organisations process that is focused on reducing the risk (Hamidi et al.). The International Civil Organization defined safety Management Systems as a logical approach that comprises systems, policies and procedures and an appropriate structure (ICAO, 2007). ILO defined SMS as a framework of networking components attentive to accomplish the objectives of occupational health and safety (ILO, 2014)

2.12.1: Elements of Safety Management Systems

Past research studies of Zohar (2000); Haber et al. (1990) all highlights that the elements of safety management systems vary from organisation to organisation. Hale et al. (1997) research studies were focused on case studies to derive associated elements with excellent safety performance in a high performing organisation. Through the analysis of good practices, the studies of McDonald (1994) derived elements of good safety management systems. Most of these past research studies related to safety management are carried out in a business environment, while most of it concerning psychology and sociology as noted by Gehman (2013). Even the development of textbook by (Hale et al., 1997) for Safety management systems do not cover any model or frameworks; the book only noted standards, practices and procedures for a functional safety management system. Based on the above researches it can have confirmed due to various standards and practices the definition of safety management systems have not reached a consensus. Choudhry et al. (2007) list out the benefits of management systems in the construction industry, as identified below: -

- Through the prevention and control of workplace hazards, reduction of workplace accidents and injuries can be encountered
- Extend of diminishing the risk
- Safety Management Systems controls workplace risk, and improve productivity and employee behaviour
- Damages to equipment and materials are reduced to a greater level

- Cost of insurance will be reduced
- Minimized legal actions and cost
- Reduce absence of employees
- Reduce accidents will save time

Choudhury et al. (2007) also point out the three main aspects of SMS which are elements of administrative management, technical and operational elements and cultural elements. The above has also been corroborated by Overseas Territories Aviation Circular (OTAR) defining a clear statement of the safety management process (OTAR, 2006). OSHA safety and health model demonstrate specific elements of a safety management system which comprise seven elements. OSHA safety management systems are the first tool that is widely accepted across the globe and most organisation employees this tool to improve the execution of safety practices. The elements of SMS according to OSHA include the following (OSHAD, 2017):

- Management commitment
- Accountability
- Employee participation
- Hazard Identification and control
- Incident / Accident Analysis
- Training and education
- Evaluation and Reviewing of the program

The research studies of Petersen (2005) argued nine elements should be considered in an SMS for deriving a better outcome of a safe working environment. These nine elements include the following

- The credibility of the management –measuring the management credibility by identifying the number of safety meeting or percentage of safety objectives the management has accomplished
- The performance level of the supervisor –a perception survey or

measuring meetings conducted by the supervisor

- Employee involvement – measurement can be through a survey or checking the attendance record of the employees who have attended the safety meetings.
- Employee training – perception survey is the best way to measure this attribute
- Employee attitude – This can be measured using the percentage of the employee participation in any safety observation.
- Communication – measuring the number of safety meeting conducted will derive this.
- Investigation procedures related to accidents – measurement should focus to identify the cause analysis of any accidents
- Hazard Control – quantity the number of incidents and identifying the cause of failure.
- Stress – Measuring the number of safety audits that have been carried out.

2.12.1: Management System Standard

A management system's essential focus is to identify and develop various management standards against which the system can operate, and these standards are essential inputs into the management system. This acts as a need for organisational improvement and performance (Bird & Germain, 1985). Every aspect of the system needs to have a determined performance criterion against which it can be gauged if a system must be reliable. For example - criteria for risk assessments, training, audits, emergency response, communication, job analysis etc. Every organisation is unique, and, therefore, the criteria that are created need to be with the active involvement of all stakeholders, creating a cross-functional group. The team should consist of all the various business functions, reps from employees and the supply chain companions. Specifications must be established to gauge the process tasks instead of just the outcomes (Fulwiler, 1993). Once the input, as well as

processes requirements, are developed and monitored, the end outcome will be the understanding of quality as well as the risk-free product.

There are different reference and guidance models available on management systems. They include the ISMEC system, OSHAS 18001, OSHA Voluntary Protection Program (VPP) etc. The ISMEC and OSHAS 18001 systems, in particular, have control circuits that integrate continuous improvement of the process. Thanks to these paintings, patterns and the elements can be developed to be used in the measurement of safety performance (Pradeep et al., 2018).

2.12.3: Efficiency of Safety Management Systems

Very few pieces of literature are available which discusses the necessary dimensions of system performance. One such study of Bottani et al. (2009) carried out an experiential study comparing safety performance levels of companies who have adopted the safety management systems and who have not adopted. The results of the studies show that there is a low level of performance level in non-adopted organisations. However, a major weakness of the study is that it concentrates on only five variables of safety management systems which include the objectives, risk management, communication, corrective actions and training. The major weakness of Bottani et al. (2009) studies is that it did not measure the management's involvement or commitment to safety standards. Research studies of Vinodkumar and Bhasi (2009) related to safety management systems efficiency also focused only on the limited parameters of safety management systems. The majority of these studies have not concentrated a complete system performance of safety management systems and also accordingly the results could not be compared as approved performance standards. In research performed by the Australian Transport safety Bureau (Thomas, 2012), recognise the performance of the safety management systems. The study results show that the safety management system enhances safety performance. However, the study shows lack of various safety attributes of high-risk areas (Thomas, 2012), All the above studies has somehow derived that

the safety management systems directly leads to better safety performance but Gallagher et al. (2003) argued that these outcomes are ambiguous and are not valid. Valid research till date is not available to gauge the influence of SMS on safety performance that includes all the elements of a safety culture.

To enable a system or strategy to deliver the desired outcomes, there should be an assurance that, the workplace is equipped with the necessary physical/engineering infrastructure and the resources. Along with the engineering arrangements, it is also essential to have the right leadership and directions to drive/use them (Hea et al., 2012). This is where the need for the right deployment and cooperation becomes essential among all the stakeholders. For example, doing an accident investigation just because the system requires them will not be useful unless it is done with some planning and commitment to identify the root causes systematically and accordingly action plans shall be developed which will be practically useful. Everybody is required to accept the management system and shall understand it's worth and have the right attitude (Marcus et al., 2014). Additionally, everyone requires the commitment to comply with the guidelines, identify and apply the most exceptional methods. To enable commitment from employees, the management must create the right work environment (Anastacio et al., 2018).

2.12.4: Measurement of Safety Performances

Performance measurement can be defined as reports on the results of a program, in particular, the progress towards pre-established objectives "(General Accounting of the United States, 1998). It measures the inputs, results and consequences of organisational objectives and goals. Measurement tools can assist organisations to measure the efficacy and success of their system, and the process is iterative and continuously improving (Aroceno et al., 2010). The process of measurement of performance is necessary because the management depends on the credibility of what it measures (Bottani et al., 2009). Whether it is the individual or part of a system that is ineffective or ineffective, correct or substituted. Evolving continuously, correcting and fixing the weakness can

help the systems improve, and positively achieve the organisation's objectives (Hamidi et al., 2012).

Some problems run into the job of performance measurement. On the outset, due to the measurement of performance, a loop of continuous changes is introduced in the organisation. Moreover, this would result in resistance and hesitance by the stakeholders. It is easier to advocate change than to make it work in an organisation (Eccles, 1991). Wrapping everyone in the process of measuring performance and provide individuals with opportunities to set goals and measure their performance, to some extent the resistance to change can be avoided. It is always a challenge to bring in and drive changes. There are no easy ways to do it (Eccles, 1991). As the business expands, the managers span increases and to monitor and manage hierarchically could pose challenges. Hence they become depended on the information gathered through monitoring strategies (Hayes, Wheelwright, and Clark, 1988). As and when the companies system matures, new means and technologies are brought in which assists in improved data collection and analysis (Hayes, Wheelwright, and Clark, 1988). Any problems encountered in implementing new technologies in performance measurement; robust performance management is required to be integrated into the management system. One significant disadvantage is individuals manipulating the performance monitoring measures to their benefit unless the system and process take care of this lacuna. A good example is when the manager decides to hide his performance figures out fear of retribution or to preserve the company records (Meyer, 2002). A consistent approach to performance measurement and implementing meaningful solutions to improve and not having a blame culture, this challenge can be to a great extent managed.

Irrespective of the type of performance metrics organisations use, whether it is profit per share, customer satisfaction etc., the ultimate goal of any organization must be to remain active and continue to be a profitable business. Therefore, it is essential to identify, measure and verify all the different aspects of the organisation accurately. Organizations must also consider the innovations and initiatives also as a performance measure (Eccles, 1991). In brief, the

performance measures could be quantified as monetary means as well the non-monetary means (Meyer, 2002).

2.14: Summary – Literature Review

Chapter 2 literature review aims to summarise the past literature related to safety management systems and has concluded with the conceptual framework of the research study. Keeping the framed objectives and hypothesis in the link the literature review has divided into twelve major areas starting with the definition, concept, elements of safety culture, leadership commitment and employee empowerment. Then it further reviewed the HSE training elements, the scope of the construction industry, UAE construction sector legislative frameworks governing OHS and finally reviewed the existing literature of Safety Management Systems. Most of the studies of the safety management system discussed in this section are different with various attributes. None of them discussed a comprehensive management system attributes that influences safety culture in construction industries.

Legislative requirements and style seem to be different in developing and developed nations. Some are more prescriptive, while others have only set broad expectations from entities. UAE has more of a goal setting style of legislation with enforcement has been decentralised to the local licensing authorities of businesses. However, except Singapore, none of the other countries had made it mandate to establish a safety management system in the construction sector. In addition to SMS, the literature as deliberated above, gathered all contributing and enabling elements of safety that can be framed to develop an effective management system. However, the past literature proved highlights a knowledge gap in identifying system factors that are particularly linked to safety culture development. Accordingly, the conceptual framework of this study has been developed.

Chapter 3: Research Methodologies

3.1: Introduction

The method employed in this study is intended to conduct a survey separately with the company operating corporate driven safety management systems and the other three companies which are operating a more localised system. This method helps the researchers to chalk out the benefits and impact factors of one with a corporate-driven and directed safety management system (SMS) and the rest without it. Additionally, interviews were carried out with four senior staff of the selected organisations which have validated the results obtained from the survey. The review of literature in the earlier chapter aided us in highlighting the knowledge gaps as well as assisted us in framing a suitable research style for this research. Saunders et al. (2011) created the research 'onion' to recognize the different stages of research that must proceed with the choice of appropriate methods. Accordingly, for this study to achieve the aims and objectives as indicated in the below illustration will start with the research Philosophy.

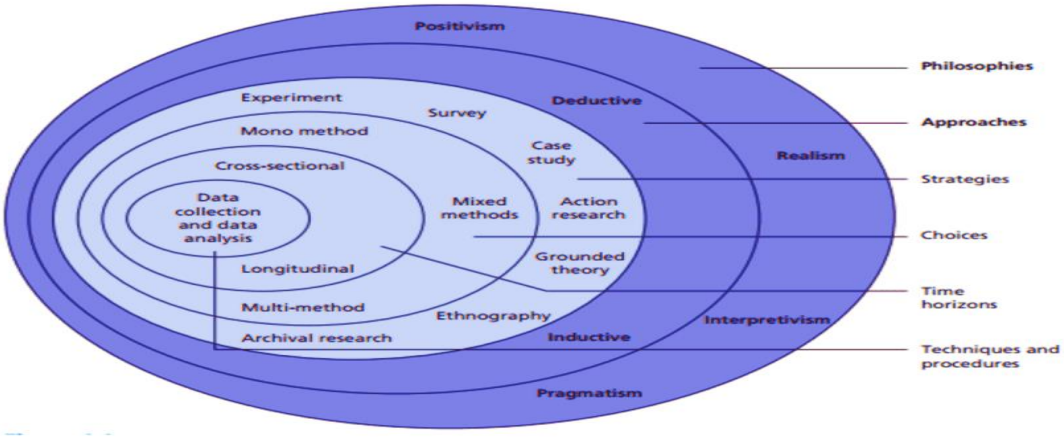


Figure 3.1: The Research Onion
Source: Saunders et al. (2012)

Since this study focusses on the framed objectives and hypothesis, it requires an intrepretivist style of data gathering using interviews and surveys covering different attributes. Interpretivism helps the researcher to link the findings of the secondary data analysis of the study to the information gathered about the perceptions of individuals and also what they understand. The information can be further analyzed and evaluated for a valid outcome (Bryman and Bell, 2011). The below flowchart illustrates the process:

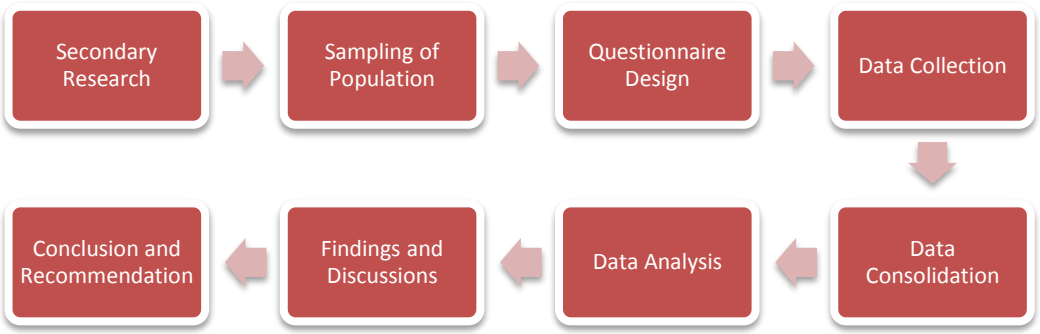


Figure 3.2: Research Method Process

Qualitative Vs Quantitative

The study aims, and objectives are achieved by exploring the various factors from an individual's point of view. Thus a blended technique of qualitative and quantitative is utilized. Hence the selection being deductive grounded theory is applicable, i.e. discovering the theory through various techniques of gathering data and analysis. To achieve the aims and objectives, the use of "How" question in Quantitative and "Why" question in qualitative is essential (Byrman and Bell, 2011; Flick, 2011).

Accordingly, we have selected a mix of both qualitative and quantitative methods. The Quantitative method is typically favoured for testing the hypothesis pertaining to positivism (Byrman as well as Bell, 2011). In Qualitative techniques, the subjective discovering and generation of concepts are derived and interpreted. The method chosen suits the objectives and hypothesis created for this study.

The Construction sector is a huge and well-recognised sector in UAE, and a variety of research studies are available with findings of various aspects related to construction and related to safety. However, the safety management systems concept is a relatively recent subject and lacks enough empirical evidence of its use and effectiveness. In the absence of these from the past researches and the presence of sound theoretical knowledge related to safety culture and management knowledge, the formation of the hypothesis is possible. It further assists to verify the research questions and objectives. Byrman (2012) recommend the interpretive approach combining quantitative and subjective methods for modern researches. For better and a more accurate interpretation triangulation is the best methodology supported by academicians. Through Triangulation methodology, we will be able to catch numbers in addition to content-based data that is presented in the form of charts and tables. There are three approaches to triangulation (Sekaran et al., 2016) which are methodological triangulation, data triangulation and time triangulation. In this research, the researcher will follow methodological triangulation in which the conclusions shall be drawn collectively from literature review, surveys and interviews. The quantitative methods in this study are intended to use a structured questionnaire employing a five-point Likert scale. The questionnaire is distributed either through emails or in person, and the responses are then collected and compiled. Qualitative analysis of this research will be by interviews with four senior decision makers from the selected four companies using open-ended questionnaire.

3.2: Questionnaire Design

A well-constructed questionnaire is the backbone of successful researches. For this research, the questionnaire has been framed to convert the qualitative text to numbers on a Likert scale of 5 points (Saunders et al., 2011). This has helped the respondents to select their opinion on the subject freely. The questionnaire is drafted in such a manner that each attribute is derived from the theoretical foundation accomplished from the literature source. This study involves a questionnaire for the quantitative survey and interview date for the qualitative

analysis. Accordingly, the research through the conceptual framework derived in this study includes nine attributes of safety management elements with five parameters for all the participants to respond. Participants are given the freedom to freely score their response on a 5-point Likert scale and this section measures the independent variables. It must be noted that the finalised attributes used in the questionnaire are reflected in most of the past studies in varying degrees (Anastacio et al., 2018. Coyle et al., 1995, Fernández-Muñiz et al., 2007, Yuling et al., 2018). Among them, Leadership, Management Commitment and Employee empowerment are identified as the most discussed ones.

The nine safety culture attributes chosen for this study are:

1. Organisational Leadership
2. Management Commitment
3. Employee Empowerment
4. Reward System
5. Reporting System
6. Risk Taking/Perception
7. Mutual Trust
8. Legal Environment
9. Compensation Environment

Five questions under each attribute were positively phrased to minimise the human error of judgement, and each question was framed to check the individual traits such as commitment, competence, credibility and confidence. To test the hypothesis, the dependency of the management system is established with the safety culture factors and vice-versa. The dependent variables are measured through 3 performance dimensions (HSE, 2013) of safety management systems distributed in 5 questions, which include:

1. Safety Management system capacity (identified resources, competence and control elements) – Measuring control & competence activities (02 questions)

2. Safety Management System compliance and effectiveness (KPIs broke down and understood) – Measuring control & communication activities (01 question)
3. Safety Management system 'Deployment' (consulted, coordinated and monitored) – Measuring control, communication and coordination activities (02 question).

These five parameters are measured through a survey with the manager level staff only. Information collected from the managerial level staff will help the study to obtain more valid and accurate information. Moreover, this strategy has given more accurate and valid results to this study. Moreover, regression within the two levels of the dependent and independent has validated the results. The questions develped for the interview focuses on the attributes explored in the survey questionnaire. This will help us to get a high-level response and actual factors from senior level management staff.

Organisational culture compatibility with the safety management system is measured through a survey with the managerial level (line management and above) staff as well as the complete sample. This will give a more relevant and valid result. Moreover, regression within the two levels of the dependent and independent variables will validate the results.

3.3: Survey Pilot Testing

The questionnaire is created to examine the relationships of various attributes discussed in the study aims and objectives of this study. The designed questionnaire is composed of multiple items. Validity and reliability assessment was confirmed using the best available literature (Churchill, 1979; Crowston, 1997).

Questionnaire development is done in stages. In the first stage, all available literature on the subject is referred, and factors with a reasonable degree of reliability and validity were chosen (Crowsten., 1997). Questions were slightly

reworded and modified to make it relevant to the construction industry, without losing the essence of questions.

In the second stage, five industry HSE experts were consulted to ensure the suitability of the survey instrument in the construction scenario. All valid feedbacks from the experts are then incorporated into the questionnaire. The language of the questionnaire was decided to be maintained as 'English', as the industry has people of different ethnicity and English is considered as the best language for communication.

Thirdly, to remove any content bugs, three academic experts (PhD) were asked to review the questionnaire. Following this, in the last step, the finalized questionnaire was shared with the construction industry and academic experts to undertake the survey and recommend improvement concerning the quality and clarity in the questions framed. The approximate time required to complete the survey was also assessed in this process. The comments received from the experts were limited to the length of the questions. Based on the feedback, the questions were compressed to make it simple, and straightforward 'positive' statements and a few questions were eliminated, which was ambiguous.

After finalizing the questionnaire, a pre-test is run using the Cronbach alpha to assess the constructs reliability (Cronbach, 1951). Accordingly, the survey questionnaire is sent to 30 respondents, and the Cronbach alpha of each construct is calculated. It is found that the Cronbach alpha for each construct is above 0.7 which indicated that the pre-testing requirements are met. The result is presented in Table 3.1. The response of these 30 selected respondents is also included in the final response set (Table 4.4):

Table 3.1: Pilot Testing - Reliability Assessment

SN	construct	Cronbach alpha
1	Organization leadership	0.92
2	Management commitment	0.89
3	Employees empowerment	0.84
4	Reward system	0.89

5	Reporting system	0.91
6	Risk reporting	0.97
7	Mutual trust	0.94
8	Legal environment	0.93
9	Compensation environment	0.93
10	Management system	0.95

3.4: Data Collection and Sampling Methods

The survey is targeted at two groups in the construction sector – the employees up to worker level and the senior executive management. Data are collected through perception survey questionnaires and personal interviews following a structured approach (Byrman and Bell, 2012). The way the questionnaires are designed and developed has a critical role in setting the direction of responses and related analysis. The questions are grouped into ten important aspects which were integrated to cover both safety culture aspects as well as a management system. Constructing such a questionnaire is targeted to derive the appropriate outcome of the research objectives.

Since the study is aimed at checking the influence of management systems on safety culture and vice-versa through perceptions of different levels of individuals, probability sampling method ia used as the method utilises a random selection of the selected population (Byrman, 2012). Accordingly, this research study has set a process to ensure that the sample selected from the construction companies has equal probabilities. The techniques employed in this study are a simple random sampling of selected population in the four construction companies and determining the number required from each population based on the probability. For example, if the company is having 100 Numbers of unskilled labours where we considered N=100 and out of which 20 are randomly picked from the probability of 1-5; 5-10……95-100. Through this, the research was able to attain the research objectives. Furthermore, conducting two different survey one with the company that

already established a safety management system and the other with three companies which do not have any safety management systems in place has helped the researcher to benchmark the benefits, influence and impacts of safety management systems. This helped in validating the study purpose by exploring the difference of safety management practices in these organisations.

The final questionnaire is sent to 310 permanent staffs and workers/ crews from the four companies. Eight (02 each) project sites are chosen as preferred by the respective company management to do the sampling. The questionnaires are e-mailed at the Managerial level, and the same is introduced in a personal meeting with the company senior management with the help of their Safety Director. The safety staffs of all the four companies encouraged the crews/workers to complete the questionnaires. The questions designed for the interview focussed on the attributes used in the quantitative analysis which helps the researcher to get a high-level response and the perspective of senior level management staff. In addition to the views expressed from the interviews, recorded performance data of all the companies were collected and compared. The below table 3.2 details the sample frame size:

Table 3.2: Sample Frame for Survey

Sample	Details	Sample Size	Analysis	Method
Company A	Employees	73	Quantitative Analysis	Survey directly or through emails
Company B, C, D	Employees	237	Quantitative Analysis	Survey directly or through emails

Company A, B, C, D	Senior Management	4	Qualitative Analysis	Direct Interview

The dependent variables are further surveyed through the Management staff from the above-selected population.

Interview Schedule - Qualitative Methods

Table 3.3: Sample Frame for Interview

Sample	Position	Date
Company A	CEO	10/11/2017
Company B	Director of Projects	22/11/2017
Company C	Engineering Director	26/11/0217
Company D	Safety Director	27/11/2017

For the survey methods employees are selected from skilled, unskilled to line management level from various nationalities segregating the influence of ethnicity and language, and for the interview four senior decision makers of the selected four companies have been nominated.

The criteria considered for selection of survey respondent are given below:

Construction Sector Employees:

- Employees from the selected sample population
- Respondents are representative samples from each group.
- Agreement and interest to participate in the study
- Electronically accessible
- Data will not be collected through any third-party sources

Senior Management Executive/Decision Makers

- Respondents to be from the selected companies

- Willingness to participate in the interview
- Conducting direct interview by researcher
- No third part will be employed to carry out the interview

This study uses cross-sectional data collection method, and the validity will not be affected significantly over a period. Whereas, in the longitudinal method, the data is collected over a period and results are analysed throughout that period (Cooper and Schindler, 2003).

3.5: Analysis of Data and Interpretation

The data collected is analysed in Ms Excel and SPSS latest version. Statistical Methods such as correlation and covariance matrix and factorial analysis is presented. Through the following statistical tools, data measurement is evaluated.

Descriptive statistics:	Mean, Standard deviation, minimum, maximum, range
Normality assessment:	Skewness, kurtosis,
Reliability assessment:	Cronbach alpha, corrected-item-to-total-correlation (**CITC**)
Validity assessment:	Confirmatory factor analysis, average variance extracted
Degree of implementation:	Mean, t-Test, ANOVA
Association assessment:	Covariance, Correlation, Regression

Since all the data are normal, parametric tools are employed to accomplish the research objectives and hypothesis. A detailed review and presentation of the empirical analysis are presented in Chapter 4.

3.6: Limitation of the Study

Following are the limitations to this study

- The research study is focused to be conducted only on the selected population and the selected organisation as identified and documented in this research report.
- The focus is construction sector safety aspects only. No other engineering/technical aspects of projects are considered.
- The study core focus is construction sector safety perceptions only. No other influences on construction safety performance are considered.
- The study has strictly followed and only investigated the framed aims and objectives that influence of safety management systems and its related safety cultural attributes.
- Data collection is carried out using survey and interview method only
- Validation of certain data collected from the web would be difficult.
- It is a known fact that minor errors are expected while coding of data due to possible biased responses.

Chapter 4: Data Analysis

4.1: Introduction

This Chapter discusses in detail the approach and outcome of the empirical analysis of data collected. The following table 4.1 outlines the data analysis methods employed for each research objective and hypothesis:

Table 4.1: Data Analysis Methodology

Objective 1:	• Descriptive statistics - mean scores and standard deviations. • Covariance and correlation analysis.
Objective 2:	• Correlation analysis of Management system and other cultural factors. • Compile the themes emerged from interview responses • Compute the KPIs
Objective 3:	• Mean test to understand the difference of perceptions among different demography. • t-Test for Skilled/Unskilled • ANOVA for language groups, Organisational levels, Ethnicity
Hypothesis 1:	• Independent t-Test for coy A & B, C and D (combined) • Regression analysis - Management System the Independent Factor and Safety Culture as a dependent factor.
Hypothesis 2:	• Regression analysis with Safety Culture as the Independent Factor and Management system as a dependent factor.

4.2: Sample Description

A detailed overview of the respondent's company, trade, language, ethnic origin, organisation level, gender, age group, job and overall experience is presented in this section. The study sample description is given in Table 4.2. It is imperative that satisfactory participation from the sample is critical to achieving research aims. Percentage wise distribution of different demographic groups classified in this study sample is shown from Figure 4.1 to Figure 4.8. Altogether 231 responses were received from the 310 that was issued to targeted companies, which was a credible response rate of 75%. Out of the received responses, company 'A' represents 29.4%, company 'B' - 25.1%, Company 'C' - 21.6% and company 'D' - 23.8%. Based on the responses it could be concluded that there has been an almost equal representation of data from all the four companies.

Table 4.2: Respondents Profile

Category	Respondent Group	Count (Nos)	Percent	Cumulative Percent
Company	A	68	29.4	29.4
	B	58	25.1	54.5
	C	50	21.6	76.2
	D	55	23.8	100.0
Trade	Not applicable	112	48.5	48.5
	Skilled	28	12.1	60.6
	Unskilled	91	39.4	100.0
Language	Arabic	27	11.7	11.7
	English	109	47.2	58.9
	Hindi/Urdu	82	35.5	94.4
	Others	13	5.6	100.0
Ethnic Origin	Arab others	43	18.6	18.6
	South Asians	124	53.7	72.3

	Westerners	13	5.6	77.9
	Others	50	21.6	99.6
	Arab UAE	1	.4	100.0
Organizatio n Level	Crew	119	51.5	51.5
	Admin staff	30	13.0	64.5
	Line Management	55	23.8	88.3
	Manager	19	8.2	96.5
	Sr Management	8	3.5	100.0
Gender	Male	213	92.2	92.2
	Female	18	7.8	7.8
Age Group	18-35 years	102	44.2	44.2
	36-50 years	115	49.8	93.9
	above 50 years	14	6.1	100.0
Overall Experience	<10 years	98	42.4	42.4
	11-20 years	110	47.6	90.0
	> 20 years	23	10.0	100.0

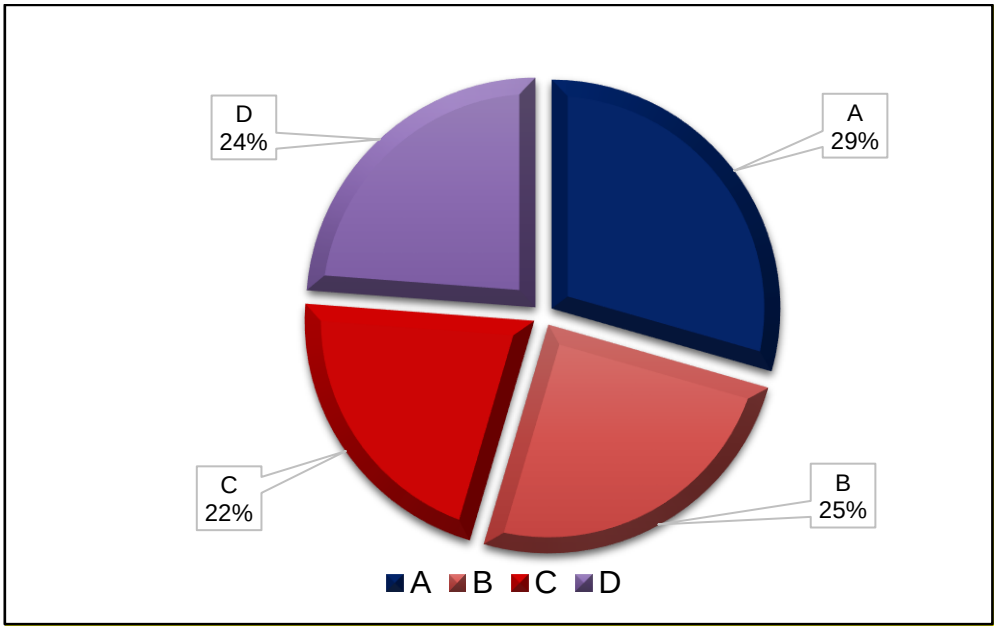


Figure 4.1: Organizations Profile

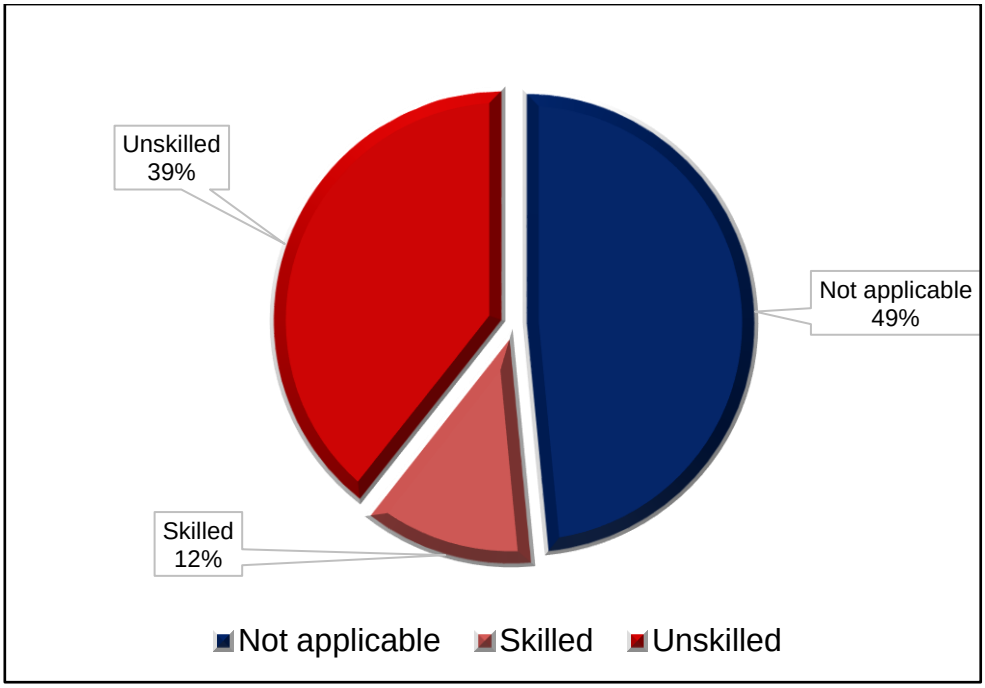


Figure 4.2. Skill Level

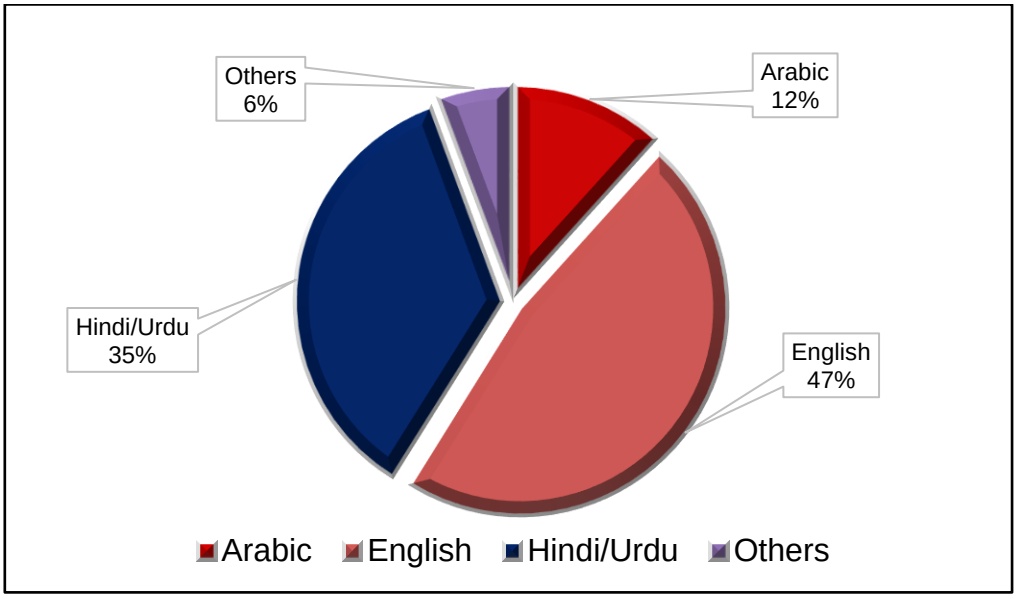


Figure 4.3. Language

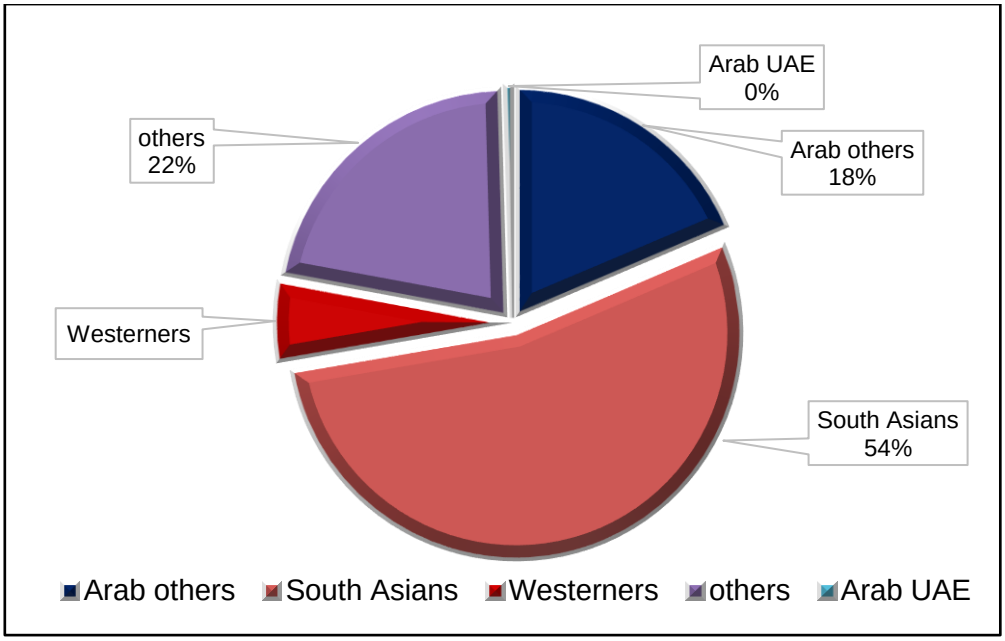


Figure 4.4. Ethnic Origin

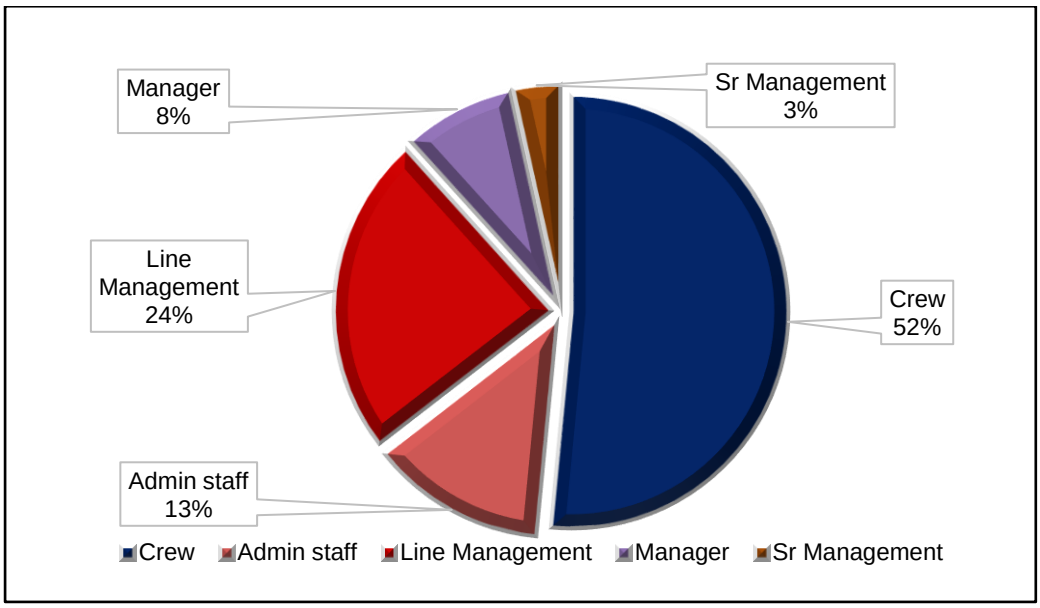


Figure 4.5. Organization Level

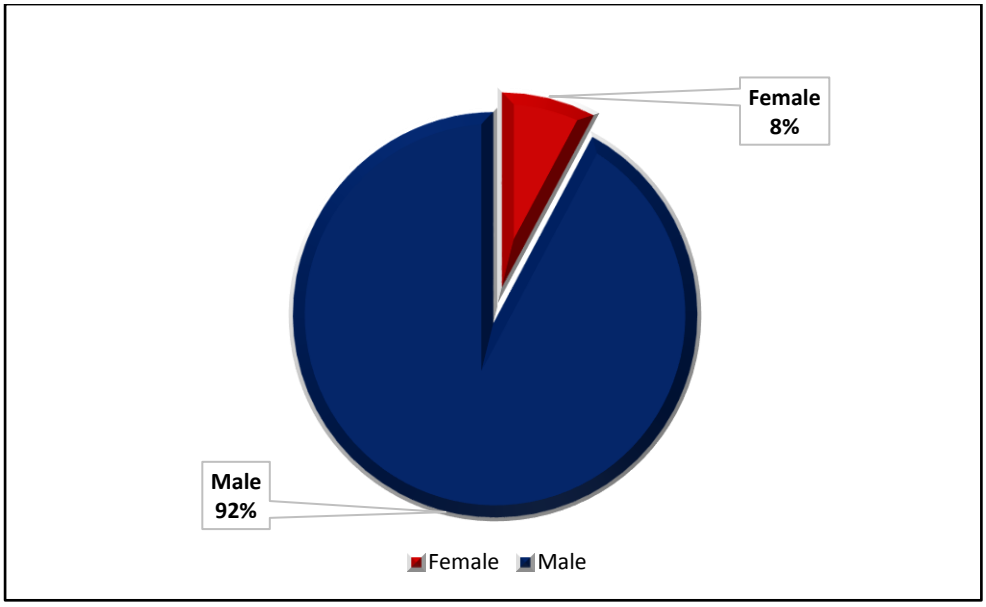


Figure 4.6: Gender

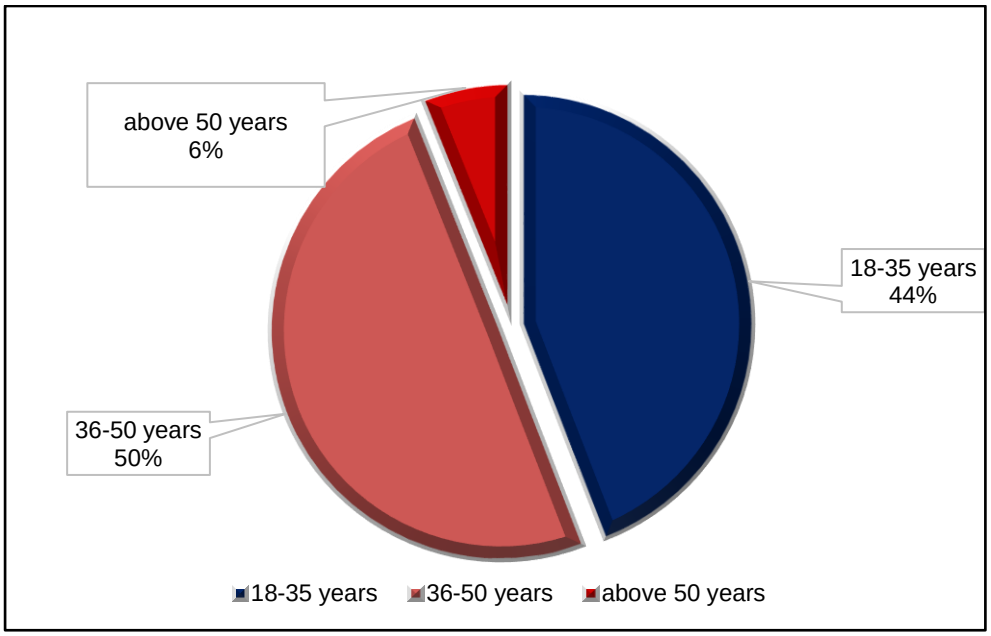


Figure 4.7: Age Groups

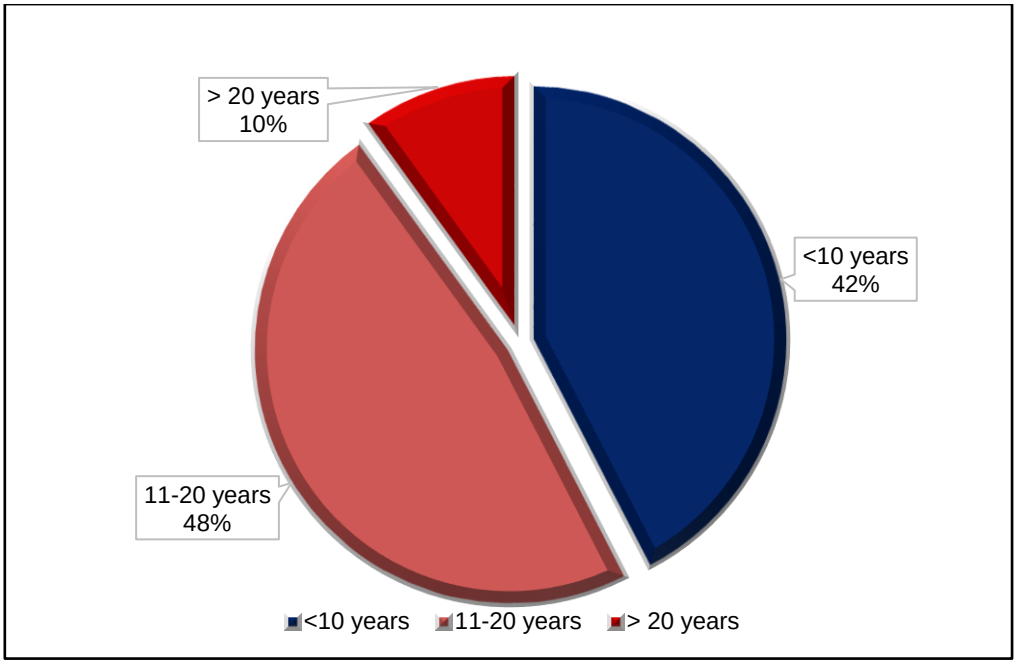


Figure 4.8: Overall Experience

4.3: Descriptive Statistics

The results indicate that the Construction Industry in the United Arab Emirates (UAE) has a fair perception on most of the safety attributes explored except for the influence of the legal environment and compensation environment. Mean values are above three which shows a good perception of the safety attributes. Skewness and Kurtosis values are within "**-1** to **+1**" and confirms that we can undertake parametric testing. Data normal distribution assumption is assessed before undertaking different proposed analytical (univariate or multivariate) tests. Frequency distributions, Kurtosis and Skewness values are critically assessed. Majority of Skewness and Kurtosis values of explored variables are within the suggested range of **"-1** to **+1**" as shown in Table 4.3.

Table 4.3: Descriptive Statistics

	N	Mean	Std. Deviation	Skewness	Kurtosis	Range	Minimum	Maximum
Dependent variables								
Q1	231	3.58	.960	-1.164	.837	4	1	5
Q2	231	3.39	1.006	-.533	-.622	4	1	5
Q3	231	3.44	.998	-.659	-.244	4	1	5
Q4	231	3.39	.939	-.883	.308	4	1	5
Q5	231	3.66	.855	-1.008	1.460	4	1	5
Q6	231	3.49	1.153	-.413	-.780	4	1	5
Q7	231	3.72	.971	-.848	.356	4	1	5
Q8	231	3.64	1.020	-.895	.315	4	1	5
Q9	231	3.68	.939	-1.282	1.642	4	1	5
Q10	231	3.72	.993	-1.266	1.471	4	1	5
Q11	231	3.41	.899	-.497	-.993	3	2	5
Q12	231	3.32	.909	-.388	-1.071	4	1	5
Q13	231	3.43	.929	-.298	-.957	3	2	5
Q14	231	3.41	.894	-.172	-.836	3	2	5
Q15	231	3.52	.922	-.456	-.778	3	2	5
Q16	231	3.11	1.080	-.635	-1.009	4	1	5
Q17	231	3.38	.956	-.787	-.370	4	1	5
Q18	231	3.36	.981	-.940	-.229	4	1	5
Q19	231	3.52	1.091	-.789	-.190	4	1	5
Q20	230	3.32	1.01634	-.665	-.561	4	1	5
Q21	231	3.39	1.089	-.701	-.478	4	1	5
Q22	231	3.42	1.009	-.625	-.386	4	1	5
Q23	231	3.49	.999	-.893	.090	4	1	5
Q24	231	3.37	1.025	-.763	-.421	4	1	5
Q25	231	3.38	1.096	-.482	-.825	4	1	5
Q26	231	3.47	1.083	-.611	-.404	4	1	5
Q27	231	3.46	1.037	-.644	-.420	4	1	5

Q28	231	3.33	1.105	-.447	-.845	4	1	5
Q29	231	3.56	1.077	-.878	-.043	4	1	5
Q30	231	3.39	1.110	-.808	-.276	4	1	5
Q31	231	3.52	1.038	-.830	.092	4	1	5
Q32	231	3.45	1.098	-.597	-.553	4	1	5
Q33	231	3.46	1.045	-.777	-.141	4	1	5
Q34	231	3.36	.981	-.856	-.180	4	1	5
Q35	231	3.25	1.215	-.302	-1.022	4	1	5
Q36	231	2.92	1.177	-.332	-1.240	4	1	5
Q37	231	2.92	1.192	-.284	-1.247	4	1	5
Q38	231	2.47	1.008	.592	-.699	4	1	5
Q39	231	2.79	1.174	-.117	-1.192	5	1	5
Q40	231	2.37	1.063	.449	-.887	4	1	5
Q41	231	2.39	1.053	.249	-1.132	3	1	4
Q42	231	2.48	.973	.439	-.335	4	1	5
Q43	231	2.32	.875	.503	-.378	3	1	4
Q44	231	2.36	.931	.257	-.767	3	1	4
Q45	231	2.01	.837	.470	-.401	3	1	4
Independent variable								
Q46	231	3.13	1.069	-.529	-.806	4	1	5
Q47	231	3.21	1.035	-.554	-.955	4	1	5
Q48	231	3.24	.987	-.685	-.652	4	1	5
Q49	231	3.24	.995	-.546	-.677	4	1	5
Q50	231	2.90	1.123	-.294	-1.152	4	1	5

4.4: Construct Items Analysis and Reliability

Reliability test via internal consistency assessment is carried out to assess the data suitability. Reliability can be defined as, "the degree of consistency of underlying theme by multiple measures". Internal consistency assessment comprises of a combination of indicative measures (Hair et al., 2010, p. 125). Two diagnostic measures are widely used to test the reliability. The first diagnostic measure is corrected-item-to-total-correlation (**CITC**). A CITC

threshold value is 0.50. Apart from this, inter-item-correlation assessment threshold is 0.30 (McCullum, Roznowski, Mar, & Reith, 1994).

Cronbach's coefficient alpha value is the second diagnostic measure to evaluate internal consistency (Cronbach, 1951). The Cronbach's alpha (α) is, "the ratio of the sum of the covariance's among the components of the linear combination (items), which estimates true variance, to the sum of all elements in the variance-covariance matrix of measures, which equals the observed variance". The 'alpha' threshold value is 0.7 (Nunnally & Bernstein, 1994, p. 265), though, 0.6 is also considered tolerable for exploratory studies (MacCallum et al., 1994). CITC and α coefficient values are given in Table 4.4.

Table 4.4: Constructs Reliability Assessment

Constructs and items		CITC	α
Dependent constructs			
Organisational Leadership			***0.835***
1	Senior managers set self-example by and demonstrate right safety attitude.	.712	
2	Safe practices are actively promoted by senior managers consistently throughout the organisation.	.609	
3	Senior managers provide adequate resources	.530	
4	Senior managers include safety consideration in their decision making.	.692	
5	Senior managers attend safety meetings/briefings.	.649	
Management Commitment and Involvement			***0.815***
6	All safety critical activity has direct involvement of line managers.	.577	
7	Safety seminars, talks and training have involvement of line managers.	.569	
8	My manager well understands the safety risks in my job	.660	
9	Safety issues are regularly explained to me by my manager	.703	
10	My manager has a positive attitude towards safety.	.535	
Employee Empowerment			***0.890***
11	I understand my role in improving the safety of my job	.796	
12	I am allowed to take decisions on safety.	.687	
13	I can introduce safety improvements to my job.	.661	
14	My job safety is my responsibility	.799	

15	I am proud of my company's safety performance.	.720	
Reward System			***0.872***
16	Good safety behaviour is rewarded and appreciated by management.	.542	
17	Unsafe employees are punished for their behaviour.	.646	
18	Company has a formal procedure to measure employee safety behaviours.	.815	
19	Management is consistent in the evaluation of safe and unsafe behaviours.	.768	
20	Management is consistent in rewarding and punishing safe and unsafe behaviours.	.747	
Reporting System			***0.891***
21	Company promotes free and open reporting of safety observations.	.542	
22	We have a written reporting system which is implemented.	.646	
23	I am free to report any good or bad issues related to safety.	.815	
24	Company promotes learning from incidents, and unsafe observations reported.	.768	
25	I am given feedback on safety issues reported by me.	.747	
Risk Taking and Risk Perception			***0.934***
26	I will not start my job without understanding the risks.	.909	
27	I can stop others who are behaving unsafely.	.879	
28	I understand the hazards'/risks involved in my job.	.794	
29	I am capable of preventing risks in my job.	.861	
30	Company does not permit anyone to take risks to finish the job.	.685	
Mutual Trust			***0.865***
31	Trusting each other is very important to work together.	.738	

32	I can freely discuss any issues with my line manager.	.728	
33	My supervisor is very fair with me when I report a safety issue or an incident.	.673	
34	Departments exchange information on safety freely among them.	.628	
35	We need to improve trust between employees and supervisors.	.674	
Legal Environment			***0.887***
36	I understand my legal responsibilities related to Health and Safety at Work	.721	
37	Management has no tolerance on legal violations.	.851	
38	Local authority inspectors come to site for visit and advice.	.652	
39	Legal authorities will personally prosecute me for safety violations.	.824	
40	It is easy to understand and implement the technical requirements/safety codes in the regulations	.592	
Compensation Environment			***0.931***
41	I am aware of my entitled compensation for workplace injuries	.849	
42	Injured employees are paid compensation as per the existing laws	.842	
43	I am aware of the process of claiming compensation for my injuries/ill-health due to work	.862	
44	I am satisfied with my employer's commitment to injury/ill-health compensation	.861	
45	Insurance companies are very strict and influence HSE improvements in the company.	.690	
Independent Construct			
Management System			**0*.852***
1	Our director has provided a framework for setting and reviewing OHS objectives, and they are communicated throughout the organization.	.726	

2	Our Management System provides the necessary tools to understand all the stakeholder's requirements and help us objectively measure the performance and consistently improve.	.678	
3	We have a committed and formal program to report issues and reward employees for improvement suggestions.	.729	
4	We have a cross-functional team involving all stakeholders including employees for developing control procedures.	.684	
5	Our risk control programs and procedures are easy to use and identify our HSE responsibilities and accountabilities.	.524	

4.5: Constructs Validity

The next logical step after assessing the reliability of constructs is to assess the validity of the construct (Churchill; 1979, p. 66). To assess unidimensionality and convergent validity, confirmatory factor analysis (CFA) is performed. Bagozzi and Phillips (1982, p. 468) mention that "construct validity is the extent to which an observation measures the concept it is intended to measure". Hair et al. (2010, p. 94) discuss validity as "extent to which a measure, or set of measures, correctly represents the concept of study - the degree to which it is free from any systematic or nonrandom error". Nunnally and Bernstein (1994), suggests that the best way to evaluate the validity of a construct is to perform factor analysis (CFA). For this study, CFA is carried out on both dependent and independent constructs. All CFA is done using the "principal components extraction method with varimax rotation" (Atanasova, 2007) to establish uni-dimensionality. Items meeting the cut-off criteria of item loading of minimum and 0.5 are considered of practical significance. Secondly, Kaiser-Meyer-Olkin (KMO) (knkasnnfkjn & Kaiser, 1970) and Bartlett's test is performed for all constructs. A minimum value of 0.5 is considered appropriate for factor analysis. In Bartlett's test, the significant value represents that variables are not the identity matrix and their inter-correlations are different from zero. Bartlett's "Sphericity Test Chi-Square Statistics" for each factor should be significant at $p < 0.05$. Percent variance of each construct should be at least more than 50%. Results for each construct CFA are given in Table 4.5.

Table 4.5: Constructs Validity Results

Constructs and items		Factor Loadings	Variance (%)
Dependent constructs			
Organisational Leadership	**KMOs = 0.850, Bartlett's Chi square = 417.09 at p<0.01**		
1	Senior managers set self-example by and demonstrate right safety attitude.	.836	***60.799***
2	Safe practices are actively promoted by senior managers consistently throughout the organization.	.759	
3	Senior managers provide adequate resources	.684	
4	Senior managers include safety consideration in their decision making.	.821	
5	Senior managers attend safety meetings/briefings.	.789	
Management Commitment and Involvement	**KMOs = 0.830, Bartlett's Chi square = 369.13 at p<0.01**		
6	All safety critical activity has direct involvement of line managers.	.738	***58.12***
7	Safety seminars, talks and training have involvement of line managers.	.727	
8	The safety risks in my job are well understood by my manager	.806	
9	Safety issues are regularly explained to me by my manager	.833	
10	My manager has a positive attitude towards safety.	.700	
Employee Empowerment	**KMOs = 0.871, Bartlett's Chi square = 631.68 at p<0.01**		

11	I understand my role in improving the safety of my job	.879	***69.66***
12	I am allowed to take decisions on safety.	.801	
13	I can introduce safety improvements to my job.	.778	
14	My job safety is my responsibility	.882	
15	I am proud of my company's safety performance.	.827	
Reward System	**KMOs = 0.870, Bartlett's Chi square = 599.03 at p<0.01**		
16	Good safety behaviour is rewarded and appreciated by management.	.678	***67.06***
17	Unsafe employees are punished for their behaviour.	.780	
18	Company has a formal procedure to measure employee safety behaviours.	.897	
19	Management is consistent in the evaluation of safe and unsafe behaviours.	.866	
20	Management is consistent in rewarding and punishing safe and unsafe behaviours.	.853	
Reporting System	**KMOs = 0.869, Bartlett's Chi square = 652.08 at p<0.01**		
21	Company promotes free and open reporting of safety observations.	.885	***69.93***
22	We have a written reporting system which is implemented.	.881	
23	I am free to report any good or bad issues related to safety.	.807	
24	Company promotes learning from incidents, and unsafe observations reported.	.830	
25	I am given feedback on safety issues reported by me.	.772	
Risk Taking and Risk Perception	**KMOs = 0.882, Bartlett's Chi square = 1071.11 at p<0.01**		

26	I will not start my job without understanding the risks.	.949	***79.51***
27	I can stop others who are behaving unsafely.	.929	
28	I understand the hazards'/risks involved in my job.	.871	
29	I am capable of preventing risks in my job.	.916	
30	Company does not permit anyone to take risks to finish the job.	.784	
Mutual Trust	**KMOs = 0.857, Bartlett's Chi square = 509.91 at p<0.01**		
31	Trusting each other is very important to work together.	.843	***65.20***
32	I can freely discuss any issues with my line manager.	.838	
33	My supervisor is very fair with me when I report a safety issue or an incident.	.799	
34	Departments exchange information on safety freely among them.	.758	
35	We need to improve trust between employees and supervisors.	.797	
Legal Environment	**KMOs = 0.818, Bartlett's Chi square = 712.50 at p<0.01**		
36	I understand my legal responsibilities related to Health and Safety at Work	.828	***69.47***
37	Management has no tolerance on legal violations.	.916	
38	Local authority inspectors come to site for visit and advice.	.772	
39	I will be personally prosecuted by legal authorities for safety violations.	.901	
40	It is easy to understand and implement the technical requirements/safety codes in the regulations	.720	
Compensation Environment	**KMOs = 0.895, Bartlett's Chi square = 966.62 at p<0.01**		

41	I am aware of my entitled compensation for workplace injuries	.908	***78.73***
42	Injured employees are paid compensation as per the existing laws	.902	
43	I am aware of the process of claiming compensation for my injuries/ill-health due to work	.916	
44	I am satisfied with my employer's commitment to injury/ill-health compensation	.917	
45	Insurance companies are very strict and influence HSE improvements in the company.	.788	
Independent Construct			
Management System	**KMOs = 0.852, Bartlett's Chi square = 492.07 at p<0.01**		
1	Our director has provided a framework for setting and reviewing OHS objectives, and they are communicated throughout the organization.	.843	**63.64**
2	Our Management System provides the necessary tools to understand all the stakeholder's requirements and help us objectively measure the performance and consistently improve.	.813	
3	We have a committed and formal program to report issues and reward employees for improvement suggestions.	.845	
4	We have a cross-functional team involving all stakeholders including employees in developing control procedures.	.806	
5	Our risk control programs and procedures are easy to use and identify our HSE responsibilities and accountabilities.	.669	

4.6: Composite Scales

After assessing the single item reliability and constructs validity it is imperative to transform constructs items into single composite variables. This study unfolds the relationship between safety culture and management system. All the ten constructs are converted to composite scales by taking their average. A composite scale "is formed by combining several individual variables into a single composite measure". As an example, four items of organisational leadership (Q1, Q2, Q3, Q4, and Q5) are added first and then divided by the number of questions, i.e., five. The result represents the complete organisational leadership. The benefits of composite measures are; the error of measurement is reduced, and one single value can represent the multidimensional concept. Below table (4.6), shows the composite scale scores for all the four companies:

Table 4.6: Composite Scores

Company		N	Mean	Std. Deviation
A	Compensation Environment	68	3.685	.1458
	Employee Empowerment	68	4.012	.1342
	Legal Environment	68	3.032	.1273
	Management Commitment	68	3.900	.1588
	Management Systems	68	3.89	.153
	Mutual Trust	68	3.844	.1729
	Organisational Leadership	68	3.85	.177
	Reporting System	68	3.759	.1788
	Reward Systems	68	3.76	.175
	Risk Taking/ Risk Perception	68	3.850	.1193
	Overall		**3.758**	**0.15**
B	Compensation Environment	58	2.234	.8420
	Employee Empowerment	58	3.207	.7445
	Legal Environment	58	2.603	.9489
	Management Commitment	58	3.593	.8452
	Management Systems	58	2.92	.786
	Mutual Trust	58	3.414	.8809
	Organisational Leadership	58	3.33	.791

	Reporting System	58	3.355	.8754
	Reward Systems	58	3.22	.842
	Risk Taking/ Risk Perception	58	3.407	1.0045
C	Compensation Environment	50	2.064	.8801
	Employee Empowerment	50	3.440	.6047
	Legal Environment	50	2.484	1.0247
	Management Commitment	50	3.488	.7991
	Management Systems	50	2.71	.777
	Mutual Trust	50	3.112	.9251
	Organisational Leadership	50	3.40	.711
	Reporting System	50	3.196	.9420
	Reward Systems	50	3.09	.893
	Risk Taking/ Risk Perception	50	3.228	1.0435
D	Compensation Environment	55	2.149	.8293
	Employee Empowerment	55	2.884	.7198
	Legal Environment	55	2.571	1.0572
	Management Commitment	55	3.545	.7398
	Management Systems	55	2.86	.742
	Mutual Trust	55	3.076	.8899
	Organisational Leadership	55	3.30	.834
	Reporting System	55	3.196	1.0107
	Reward Systems	55	3.14	.936
	Risk Taking/ Risk Perception	55	3.153	.9645
	Overall		**3.00**	**0.86**

4.7: Covariance and Correlation

Covariance shows the direction of the association between two factors whereas; correlation indicates direction as well as relationship strength between any two variables. All the covariances are positive and indicate a positive relationship between all variables used in this study. All the correlations are positive and significant at $p < 0.01$. Covariance and correlation of the composite variables results are presented in Table 4.8 and Table 4.9. Mean, and standard deviation of composite factors are also presented in Table 4.9.

Mean of all constructs, except legal environment (2.69) and compensation environment (2.31), are above three which indicates a substantially good understanding and application of safety attributes in construction companies of Abu Dhabi. Management commitment 3.64 and reward system mean 3.33 are being implemented from maximum to minimum level. Similarly, the management system with mean 3.15 indicates that its well received and accepted in the sampled companies. Among the individual factors, the strongest positive correlation is seen between risk taking attitude and reporting system (0.906 at $p<0.01$). The matrix of correlation is shown in Figure 4.9.

Table 4.7: Direction of Relationship between Variables

	Orgldr	Mgmtcmt	Emppow	Rewsys	Reportingsys	Risktap	Mutrust	Legenvmt	Compenvmt	Mgmtsys
Orgldr	.547									
Mgmtcmt	.430	.596								
Emppow	.117	.082	.576							
Rewsys	.461	.371	.147	.696						
Reportingsys	.532	.483	.134	.630	.774					
Risktap	.571	.539	.146	.657	.769	.931				
Mutrust	.504	.488	.129	.542	.630	.726	.758			
Legenvmt	.333	.263	.135	.383	.406	.456	.339	.873		
Compenvmt	.177	.147	.176	.237	.217	.228	.216	.413	.686	
Mgmtsys	.395	.296	.232	.481	.501	.548	.484	.436	.294	.684

Key

Orgldr	Mgmtcmt	Emppow	Rewsys	Reportingsys	Risktap	Mutrust	Legenvmt	Compenvmt	Mgmtsys
Organisational leadership	Management commitment	Employees empowerment	Reward system	Reporting system	Risk taking and risk perception	Mutual trust	Legal environment	Compensation environment	Management system

Table 4.8: Strength of Relationship between Variables

	Mean	Std Dev	Orgldr	Mgmtcmt	Emppow	Rewsys	Reportingsys	Risktap	Mutrust	Legenvmt	Compenvmt	Mgmtsys
Orgldr	**3.49**	**.740**	1.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	0.00
Mgmtcmt	**3.64**	**.771**	.754***	1.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	0.00
Emppow	**3.41**	**.758**	.208***	.140***	1.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	0.00
Rewsys	**3.33**	**.834**	.746***	.576***	.233***	1.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	0.00
Reportingsys	**3.40**	**.879**	.818***	.711***	.200***	.859***	1.00	*0.00*	*0.00*	*0.00*	*0.00*	0.00
Risktap	**3.43**	**.964**	.800***	.723***	.199***	.817***	.906***	1.00	*0.00*	*0.00*	*0.00*	0.00
Mutrust	**3.39**	**.870**	.783***	.727***	.196***	.746***	.823***	.864***	1.00	*0.00*	*0.00*	0.00
Legenvmt	**2.69**	**.934**	.483***	.365***	.191***	.491***	.494***	.506***	.417***	1.00	*0.00*	0.00
Compenvmt	**2.31**	**.828**	.289***	.231***	.280***	.343***	.297***	.285***	.299***	.534***	1.00	0.00
Mgmtsys	**3.15**	**.827**	.646***	.463***	.370***	.697***	.688***	.686***	.672***	.564***	.428***	1.00

***. p < 0.01 level (2-tailed)".
" ** p < 0.05 level (2-tailed)".

“ *. p < 0.1 level (2-tailed)”.

Key

Orgldr	**Mgmtcmt**	**Emppow**	**Rewsys**	**Reportingsys**	**Risktap**	**Mutrust**	**Legenvmt**	**Compenvmt**	**Mgmtsys**
Organisational leadership	Management commitment	Employees empowerment	Reward system	Reporting system	Risk taking and risk perception	Mutual trust	Legal environment	Compensation environment	Management system

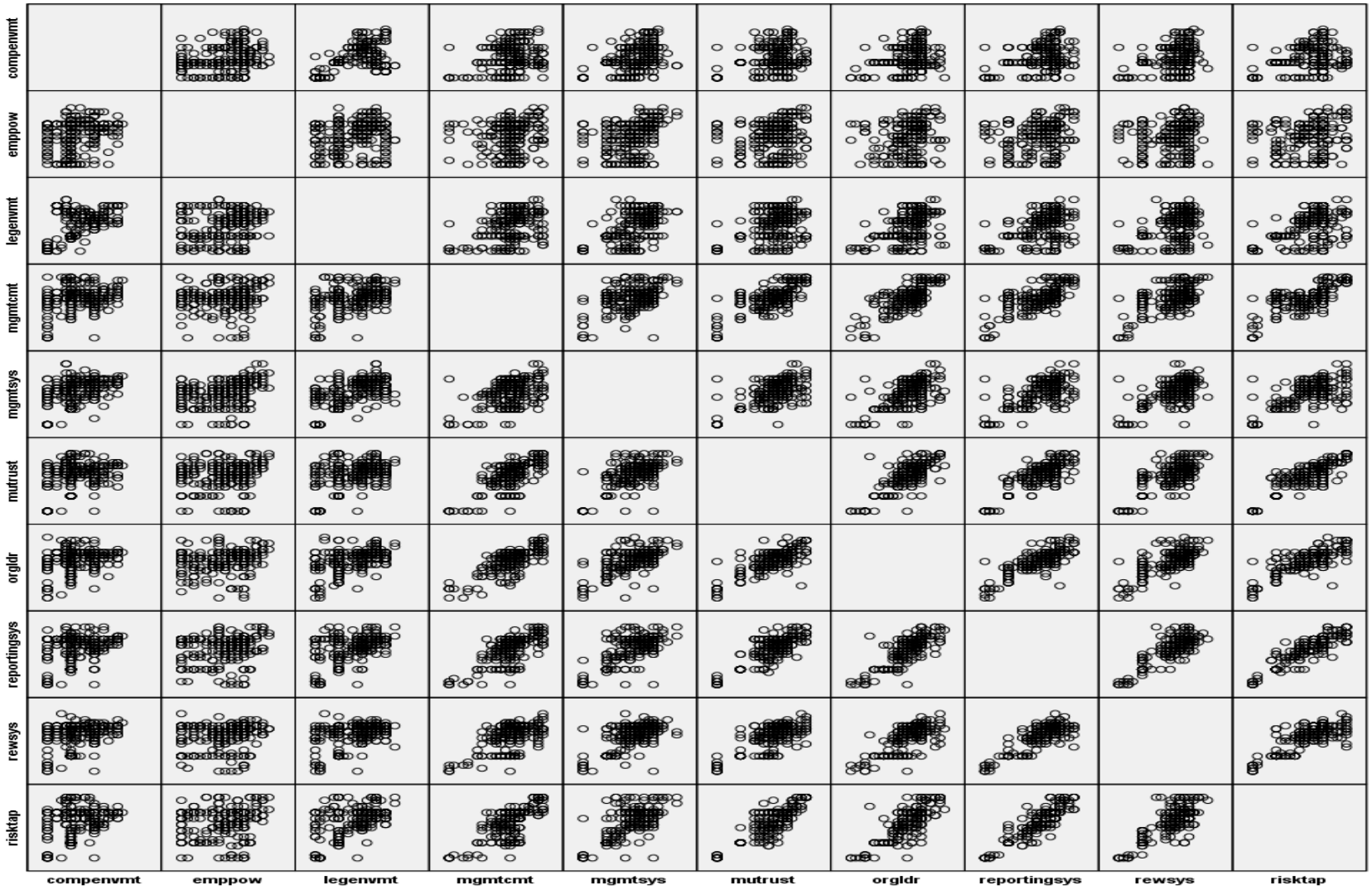


Figure 4.9: Correlation Matrix- Scatter Plot

4.8: Mean Test

Mean test is performed to understand the difference between safety culture and management system understanding among different groups and categories of people, as identified in the survey questionnaire (part 1). Independent t-Test is performed on where there are two variables/categories of a sample like skilled and unskilled respondents. Analysis of Variance (ANOVA) method is used where the respondent's category is more than two, like organization level.

4.9: t-Test between Organization A and Organizations B, C, D

A t-test is performed to assess the difference in safety culture and management system understanding between organizations having a corporate driven formal safety system (Organization A) and organizations which operate a more local informal system (Organization B, C, D). Results show that there is some noticeable variation in the level of understandings and perceptions between Organisation A and rest of them (B, C, D) as shown by the t-values and p-values. The p-values are higher than 0.01, which shows that there is a significant difference on the explored variables between Organization A and Organization B, C, D. It means that respondents from company 'A' perceives and understands the safety culture and system attribute quite differently from other company respondents. Results are presented in Appendix E.

4.9.1: t-Test between Skilled and Unskilled

Similarly, the t-test is performed to assess the difference between safety culture and management system understanding between skilled and unskilled respondents. Results indicate that no difference is observed between the level of understanding of skilled and unskilled respondents as shown by the t-values and p-values except for in organization leadership where the p-values are higher than 0.05. There is no significant difference in any of the variable between

skilled and unskilled. It means that irrespective of their trade skills, everyone perceives safety culture and system attributes in the same manner. Results are shown in Appendix F.

4.10: ANOVA Results

ANOVA test is performed to assess the mean difference between safety culture and management system understanding among demographic variables where there are more than two respondent categories. The underlying hypothesis is that no difference exists in the perception of safety culture and management system understanding among respondents. Whereas, another hypothesis suggests that at least one respondent category is different from others. To test the hypothesis, ANOVA is performed for the following demographic variables.

a. Language
b. Ethnic groups
c. Age groups
d. Skills/trade
e. Organization level
f. Overall experience

4.10.1: ANOVA Results – Language

ANOVA results for respondents grouped as per their language skills are presented in Table 4.9. The mean difference on safety culture and management system among groups is assessed, and results show no difference in the perceptions among the respondents on most of the explored culture and system attributes, except in organisational leadership and compensation environment. F value indicates the degree of variation among the group's responses. A high F value indicates that the difference in perception among the group is not by chance and hence rejects the null hypothesis. No noticeable difference in perception among the other variables can be seen from the results. The analysis report is attached in Appendix H (a).

Table 4.9: Variation in Perception – Language Groups

SN	Varibles	F Value	Degree of Freedom (df)	Significance (p)
1	Organisational Leadership	3.49	3, 227	0.016
2	Compensation Environment	3.84	3, 227	0.01

4.10.2: ANOVA Results - Ethnic origin

ANOVA results for respondent categorised on ethnic origin are presented in Table 4.10. The mean difference in perceptions of safety culture and management system among groups is assessed. The results show that there are no differences in the perceptions among the respondents on most of the explored attributes, except compensation environment. No noticeable difference in perception among the other variables can be seen from the results. The analysis report is attached in Appendix H (b).

Table 4.10: Variation in Perception - Ethnic groups

SN	Explored Attributes	F Value	Degree of Freedom (df)	Significance (p)
1	Compensation Environment	3.01	4, 226	0.019

4.10.3: ANOVA Results – Age Group

ANOVA results for respondents grouped as per their age are presented in Table 4.11. The mean difference in perceptions of safety culture and management system among groups is assessed. The results indicate significant differences in

perceptions about the culture attributes among the different age group. No noticeable difference is observed in the other management system aspects. The legal environment is the only attribute, where there seems to be no noticeable difference in perceptions among the different age groups. The analysis report is attached in Appendix H (c).

Table 4.11: Variation in Perception - Age groups

SN	Explored Attributes	F Value	Degree of Freedom (df)	Significance (p)
1	Organisational leadership	5.58	2, 228	0.004
2	Management Commitment	4.27	2, 228	0.015
3	Reporting System	6.46	2, 228	0.002
4	Risk Taking and Perception	4.10	2, 228	0.018
5	Mutual Trust	8.10	2, 228	0.00
6	Compensation Environment	6.97	2, 228	0.001

4.10.4: ANOVA Results - Organization Level

ANOVA results for respondents grouped as per their positions/job levels are presented in Table 4.12. The mean difference in perceptions of safety culture and management system among groups is assessed. The results indicate a significant difference among the group on all the explored attributes except the legal environment. The legal environment is the only attribute, where there seems to be no noticeable difference in perceptions among the different age groups. The analysis report is attached in Appendix H (d).

Table 4.12: Variation in Perception – Organisational Levels

SN	Explored Attributes	F Value	Degree of Freedom (df)	Significance (p)
1	Organisational leadership	5.87	4, 226	0.000
2	Management Commitment	5.29	4, 226	0.000
3	Employee Empowerment	3.38	4, 226	0.01
4	Reward System	3.93	4, 226	0.004
5	Reporting System	2.60	4, 226	0.037
6	Risk taking and Perception	3.04	4, 226	0.018
7	Mutual Trust	5.95	4, 226	0.00
8	Compensation Environment	10.76	4, 226	0.00
9	Management System	2.61	4, 226	0.03

4.10.5: ANOVA Results - Overall Experience

ANOVA results for respondents grouped as per the number of years of experience are presented in Table 4.13. The mean difference in perceptions of safety culture and management system among groups is assessed. The results indicate that there is a significant difference among the group on all the explored attributes. F values are high for all the explored factor, indicating the differences in perceptions existing between the different groups. The analysis report is attached in Appendix H (e).

Table 4.13: Variation in Perception - Overall Experience

SN	Explored Attributes	F Value	Degree of Freedom (df)	Significance (p)
1	Organisational leadership	7.77	4, 226	0.001
2	Management Commitment	7.64	4, 226	0.001
3	Employee Empowerment	3.49	4, 226	0.03
4	Reward System	3.65	4, 226	0.027
5	Reporting System	7.47	4, 226	0.001
6	Risk taking and Perception	5.03	0.007	0.018
7	Mutual Trust	9.93	4, 226	0.000
8	Compensation Environment	8.15	4, 226	0.000
9	Management System	3.75	4, 226	0.03
10	Legal Environment	4.16	4, 226	0.02

4.11: Regression results

Regression is performed to study the association between safety culture and management system. To test the hypothesis formulated for this study, the regression is performed in two stages. For the first hypothesis, the management system factors were the independent variable and safety culture elements as the dependent variable. For the second hypothesis, 'Safety Culture' factors were the Independent variable and management system as dependent. For the second hypothesis, two tests were carried out with different samples. The first test was performed with the complete sample size. For the second test, the sample was grouped into two categories, i.e., crew and administration staff in one group and

line managers, managers and senior managers in another group. Then, regression is performed only for the manager's group.

Safety Culture Dependence on Management System

Regression results with the full sample are presented from Table 4.14 to Table 4.15. Model results are also illustrated in Figure 4.10. Results indicate that management system activities significantly explain variance in safety culture with an R^2 value of 0.43 (43.8%) and adjusted R^2 of 0.435 (43.5%). Moreover, F value is also significant at F=69.438 (df 5, 215) at p<0.00. The five questions in the Management System factors were framed to test the performance measurement dimensions. Results (Table 4.16) indicate that management system dimensions like leadership t=3.687 at p=0.00, competence/resources t=2.345 at p=0.02, compliances t=2.189 at p=0.03, consultation/coordination t=2.486 at p=0.01 and ownership/control t=6.677 at p=0.00 positively significantly contribute at $p<0.05$ towards safety culture development. The scatter plot between regression residuals and predicted values is shown in Figure 4.13. The graphs do not indicate any abnormality in the residual distributions. Regression residual coefficients distribution Histogram and P-P plots are shown in Figure 4.11 and Figure 4.12. Scatter plot between regression residuals and predicted values is shown in Figure 4.13. The graphs and illustrations do not indicate any abnormality in the residual distributions.

Table 4.14: MS effect on SC: Model Summary

Model	**R**	**R^2**	**Adjusted R^2**	**Std. Error of the Estimate**	**Durbin-Watson**
1	.662a	.438	.435	.5680	1.446
a. Predictors: (Constant), Management System					
b. Outcome: Safety Culture					

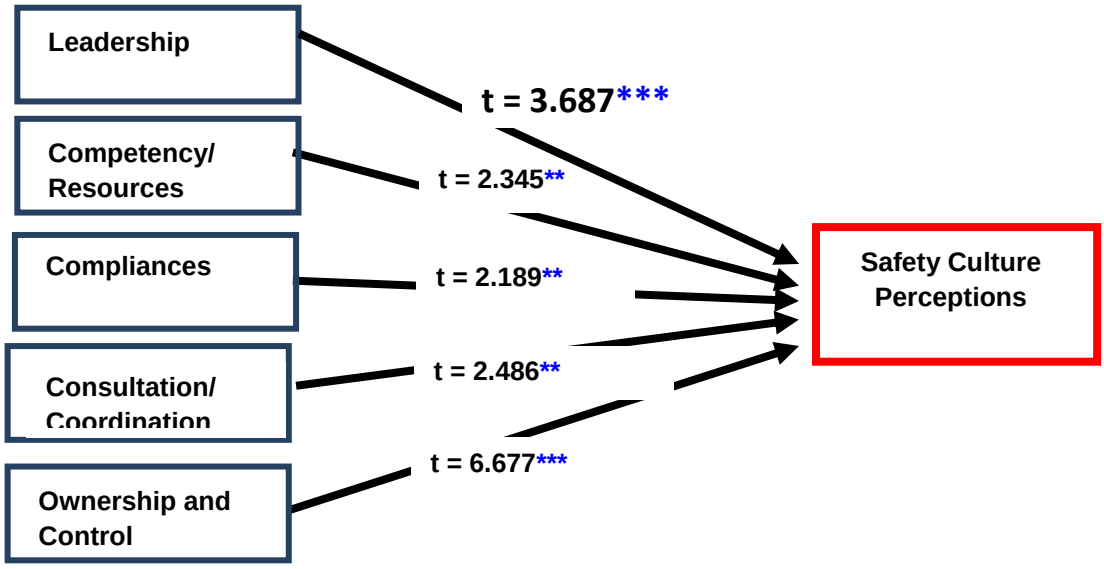
Model	**Unstandardized Coefficients**		**Standardized Coefficients**
	B	Std. Error	Beta
(Constant)	1.349	.147	
Management System	.605	.045	0.662

Table 4.15: Analysis of Variance (ANOVA)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	58.407	5	11.681	69.438	.000[b]
	Residual	36.169	215	.168		
	Total	94.575	220			
a. Outcome: Safety Culture						
b. Predictors: (Constant), Management System						

Table 4.15: Causal Relationship between MS and SC

Model		Unstandardized Coefficient		Std Coeff	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Predictors)	1.399	.105		13.264	.000	1.191	1.607
	Leadership	.126	.034	.213	3.687	.000	.058	.193
	Resources	.093	.040	.148	2.345	.020	.015	.171
	Compliances	.087	.040	.137	2.189	.030	.009	.166
	Coordination	.097	.039	.159	2.486	.014	.020	.174
	Control	.196	.029	.337	6.677	.000	.138	.254
a. Outcome: Safety Culture								



***. p < 0.01 level (2-tailed)".
" ** p < 0.05 level (2-tailed)".
" *. p < 0.1 level (2-tailed)".

Figure 4.10: Causal Linkage – Full Sample Size

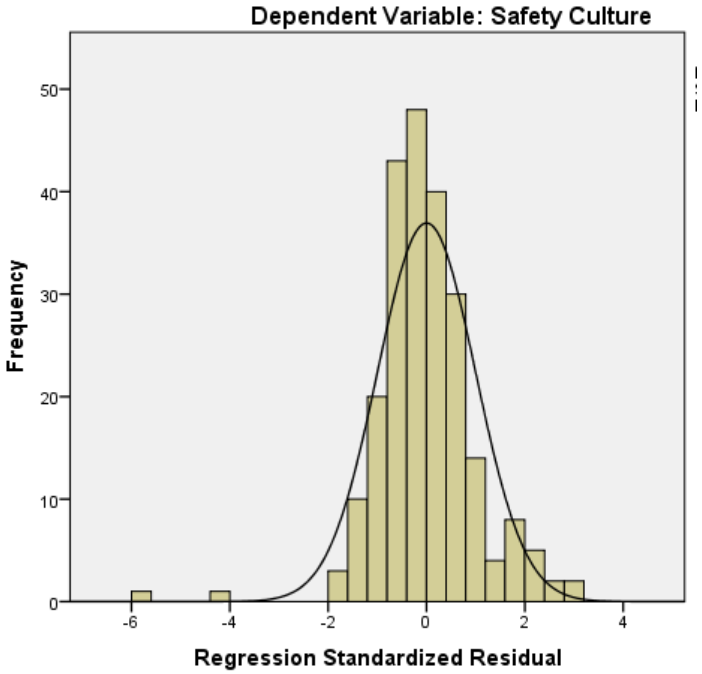


Figure 4.11: Residuals Histogram – MS effect on SC

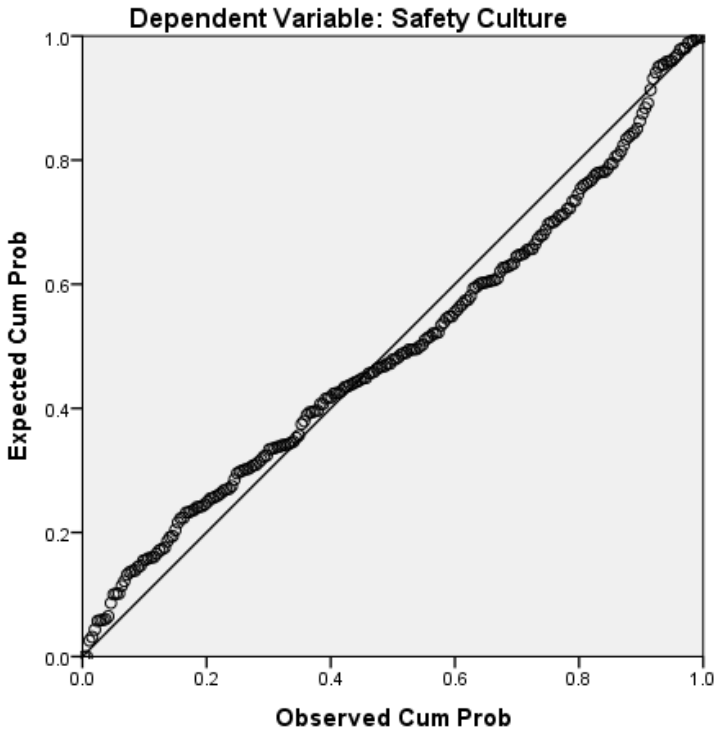


Figure 4.12: Probability Plots – MS to SC

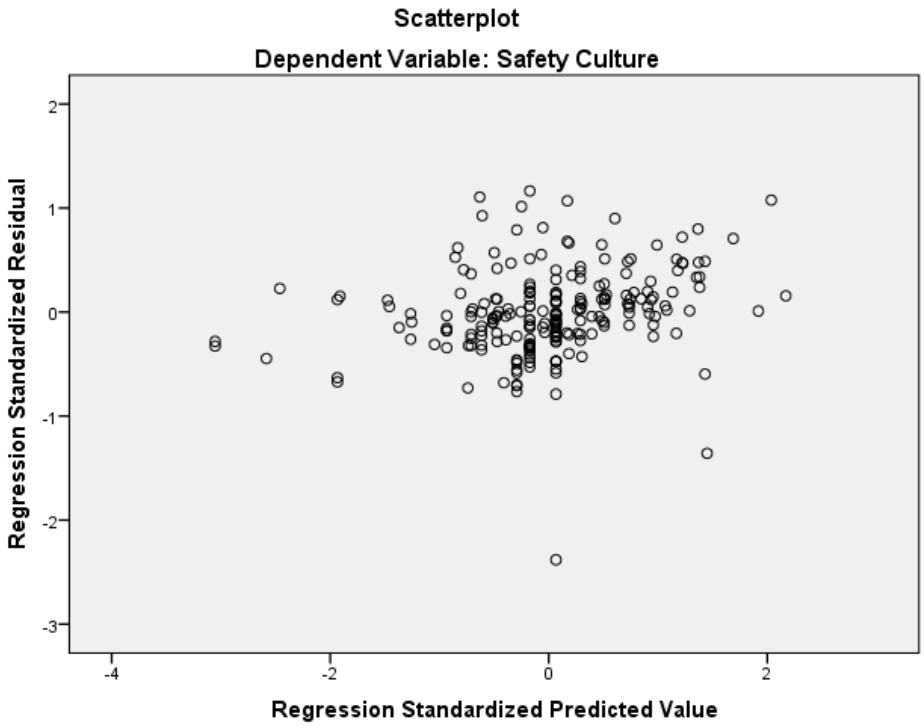


Figure 4.13: Scatter Plot – MS to SC

Regression analyses were carried out separately for companies with a certified corporate driven safety system and companies without it. The results obtained through the regression performed, helped to assess the difference on safety culture and management systems influences in organisations having well-established corporate driven safety systems (Organization A) and organisation operating a localised informal safety systems (Organizations B, C and D). The t-test is performed to assess the difference on safety culture, and management system perceptions between organisations Organization A and organisations Organization B, C, and D. Results indicate that differences in perceptions among Organisation A and the rest are significant which is shown by the t-values and p-values. All the p-values are less than 0.05, and there is a significant difference in all of the variable explored between Organization A and Organization B, C, D.

Table 4.17: Analysis of Variances in the SC Factors

Companies	Model		Sum of Squares	df	Mean Square	F	Sig.
A	1	Regression	2.030	1	2.030	6.872	.011b
		Residual	19.499	66	.295		
		Total	21.529	67			
BCD	1	Regression	41.024	1	41.024	122.830	.000b
		Residual	53.773	161	.334		
		Total	94.798	162			

a. Dependent Variable: Safety Cultural Factors

b. Predictors: (Constant), Management System

ANOVA results indicate the significance (p-value) less than 0.05 in all the four companies, and hence the variation in safety culture is significantly explained by the changes in the management system.

Table 4.18: MS to SC – Company Wise

Companies	Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Durbin-Watson
A	1	.307a	.094	.081	.5435	1.640
BCD	1	.658a	.433	.429	.5779	1.404

a. Predictor: Management System
b. Dependent/ Outcome: Safety Culture

From the model summary above (Table 4.18), it can be seen that the management system factors can explain 42.98% of variations in the safety culture for company B, C and D. At the same time, only 8% of variations in Safety Culture can be explained by the management system of Coy A. t-test results for company 'A' ($t=2.622$ at $p<0.05$) and a combined sample of Companies B, C, D ($t=11.08$ at $p<0.000$) indicates a good positive causal relationship between the management system and safety culture.

Table 4.19: Causal linkage – MS to SC Company Wise

Companies	Model		Unstandardized Coefficients		Std Coefficient	t	Sig.	95.0% Confidence Interval for B	
			B	Std. Error	Beta			Lower	Upper
A	1	(Constant)	1.730	.734		2.356	.021	.264	3.196
		MS	.493	.188	.307	2.622	.011	.118	.869
BCD	1	(Constant)	1.231	.173		7.097	.000	.888	1.573
		MS	.654	.059	.658	11.08	.000	.538	.771

a. Dependent Variable: Safety Cultural Factors

Management System Dependency on Safety Culture

Regression results with the full sample are presented from Table 4.20 to 4.22. Model results are also presented in Figure 4.14. The results indicate that safety culture elements significantly explain variance in management system with an R^2 value of 0.64 (64%) and adjusted R^2 of 0.632 (63.2%). Moreover, F value is also significant at $F=44.89$ (df 9, 221) at $p<0.00$. Results (Table 4.22) indicate that sub-elements of safety culture like employee's empowerment $t=4.16$ at

p=0.00, reward system t=2.18 at p=0.03, mutual trust t=3.18 at p=0.02 and legal environment t=3.66 at p=0.00 positively and significantly contribute at $p<0.05$ in the management system, whereas, organisational leadership marginally contribute t=1.68 at p=0.093 in management system at p<0.1. However, management commitment negatively contributes t = -2.279 at p=0.006 in management system at p<0.05. Regression residual coefficients distribution Histogram and P-P plots are shown in Figure 4.15 and Figure 4.16. Moreover, scatter plot between regression residuals and predicted values is shown in Figure 4.17. All the graphs do not indicate any abnormality of the residual distributions.

Table 4.20: SC effect on MS: Model Summary (Full Sample)

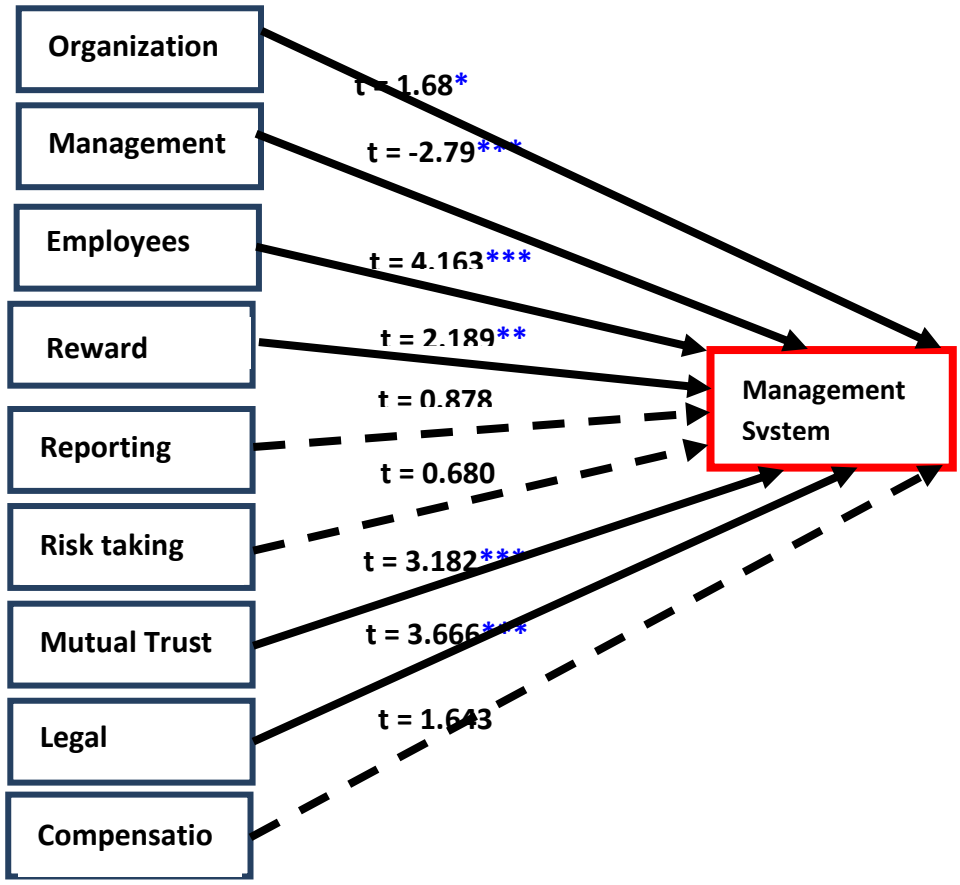
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Durbin-Watson
1	.804[a]	.646	.632	.502	1.477
a. Predictors: (Constant), compenvmt, mgmtcmt, emppow, legenvmt, rewsys, mutrust, orgldr, risktap, reportingsys					
b. Outcome: management system					

Table 4.21: Analysis of Variance (ANOVA)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	101.714	9	11.302	44.890	.000[b]
	Residual	55.639	221	.252		
	Total	157.353	230			
a. Outcome: management system						
b. Predictors: (Constant), compenvmt, mgmtcmt, emppow, legenvmt, rewsys, mutrust, orgldr, risktap, reportingsys						

Table 4.22: Path Coefficients

Model		Unstandardized Coefficients		Std Coefficient	t	Sig.	95.0% Confidence Interval for B	
		B	**Error**	**Beta**			**L/Bound**	**U/Bound**
1	(Constant)	-.007	.216		-.033	.974	-.434	.419
	Orgldr	.153	.091	.137	**1.687**	**.093**	-.026	.331
	mgmtcmt	-.201	.072	-.187	**-2.797**	**.006**	-.342	-.059
	Emppow	.192	.046	.176	**4.163**	**.000**	.101	.282
	Rewsys	.181	.083	.183	**2.189**	**.030**	.018	.344
	reportingsys	.094	.107	.100	.878	.381	-.117	.305
	Risktap	.066	.097	.077	.680	.497	-.125	.256
	Mutrust	.262	.082	.276	**3.182**	**.002**	.100	.424
	legenvmt	.174	.048	.197	**3.666**	**.000**	.081	.268
	compenvmt	.081	.049	.081	1.643	.102	-.016	.178
a. Dependent Variable: mgmtsys								



***. p < 0.01 level (2-tailed)".
" ** p < 0.05 level (2-tailed)".
" *. p < 0.1 level (2-tailed)".

Figure 4.14: Causal Linkage – Full Sample Size

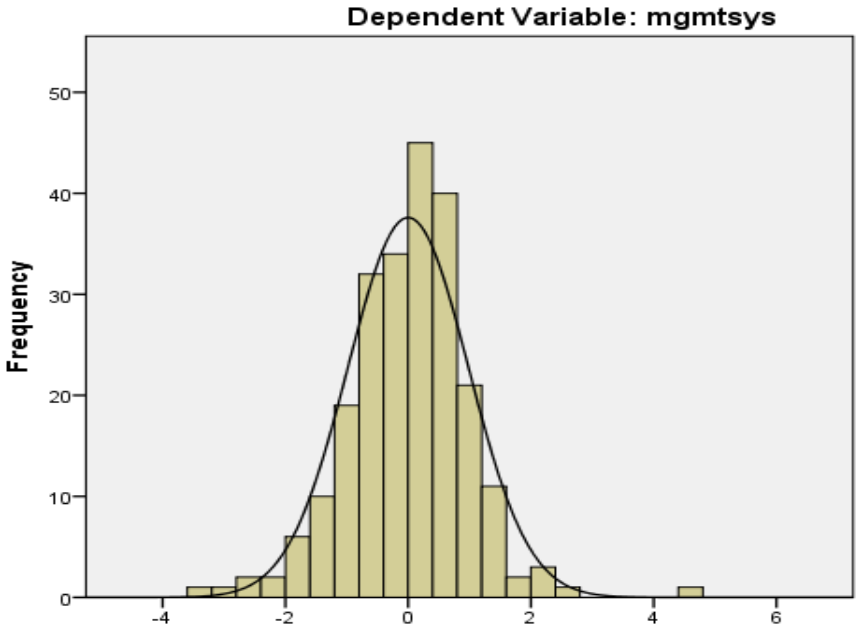


Figure 4.15: Residuals Histogram – SC effect on MS (Full Sample)

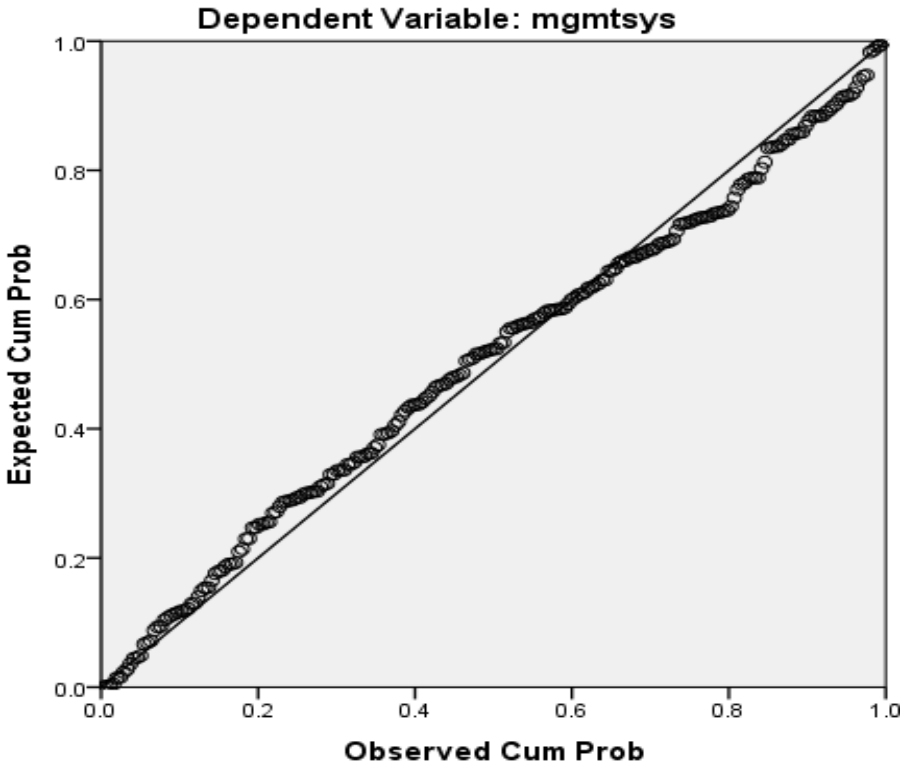


Figure 4.16: Probability Plots – SC to MS (Full Sample)

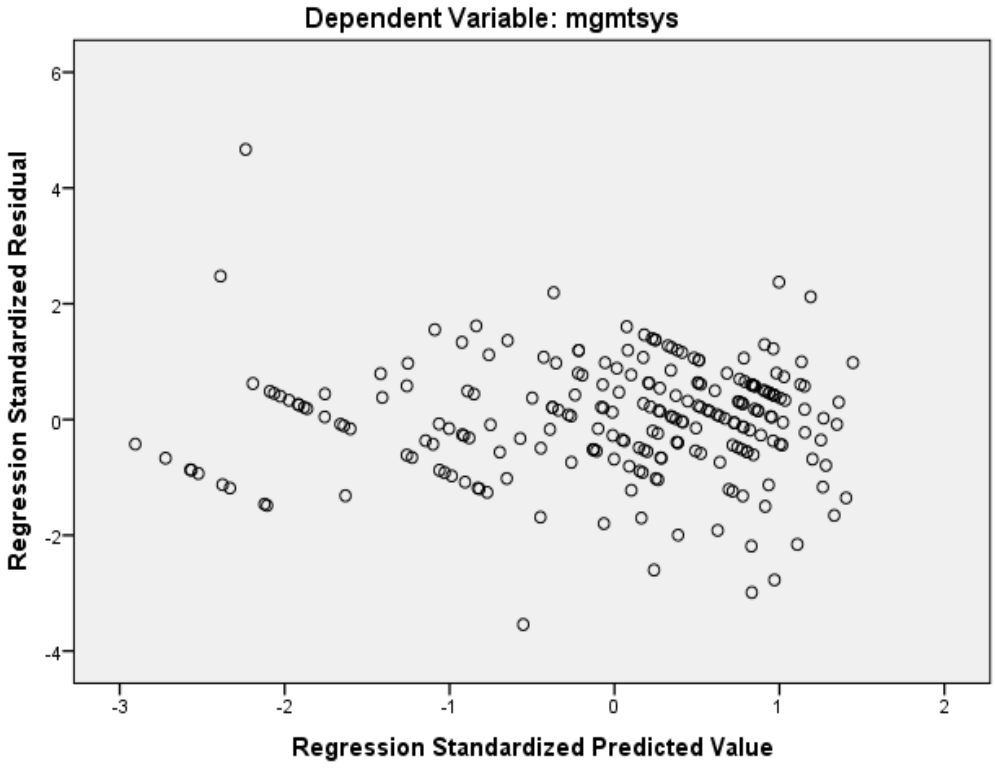


Figure 4.17: Scatter Plot – SC to MS (Full Sample)

Similarly, Regression results for managers are presented from Table 4.23 to Table 4.25. Results are also presented in Figure 4.18. Results indicate that safety culture elements significantly explain the changes in management system with an R^2 value of 0.61 (61%) and adjusted R2 of 0.57 (57%). F value is also significant at F=12.92 (df 9, 72) at p<0.00. Results (Table 4.25) indicate that among the sub-elements of safety culture only employee's empowerment (t=3.86) and legal environment (t=2.46) significantly contribute (*p<0.05)* to the changes in the management system. Regression residual coefficients distribution Histogram and P-P plots are shown in Figure 4.19 and Figure 4.20. The scatter plot between regression residuals and predicted values are shown in Figure 4.21. The graphs and illustrate do not indicate any abnormality in the residual distributions.

Table 4.23: SC effect on MS: Model Summary (Managers)

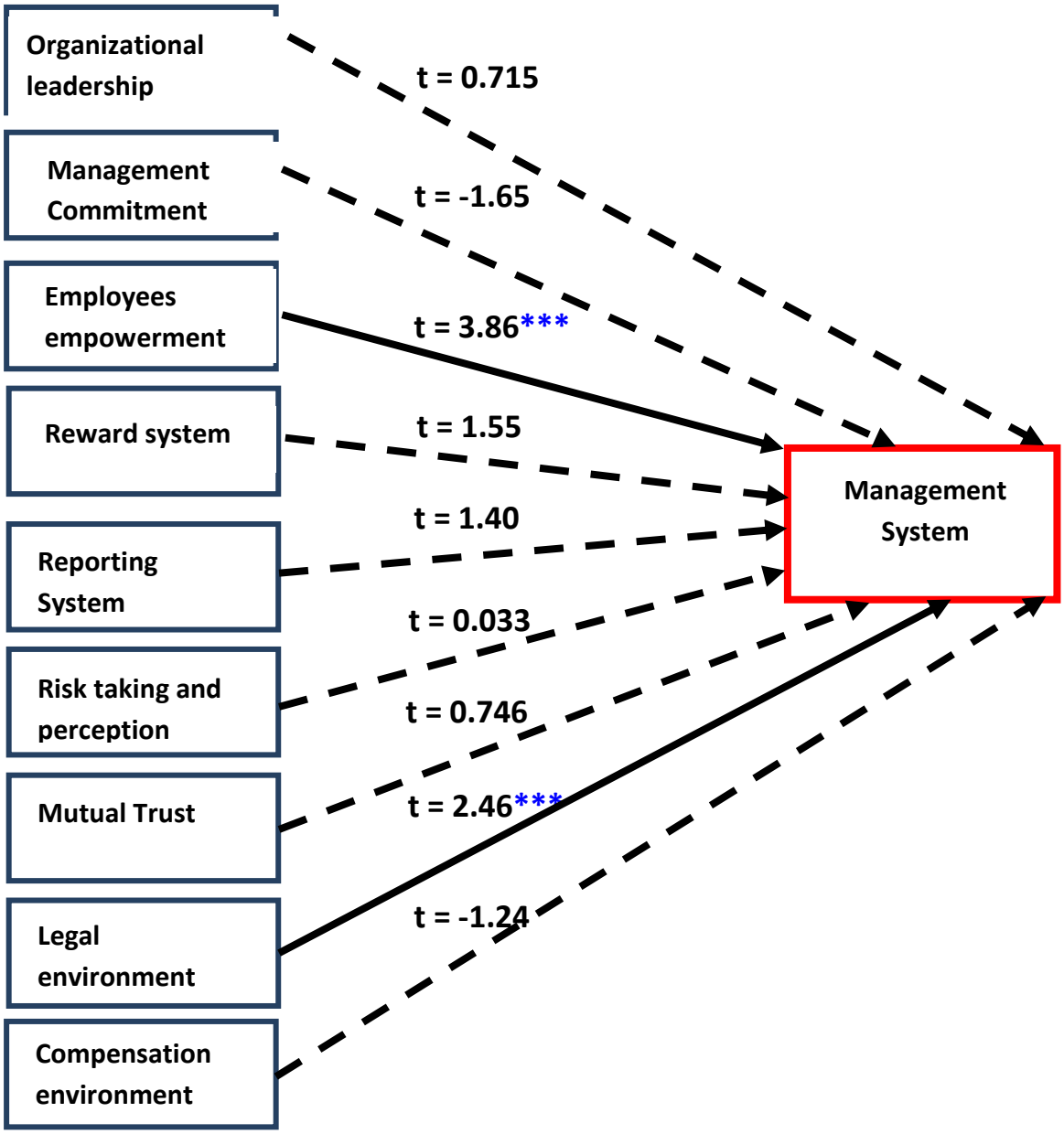
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Durbin-Watson
1	.786[a]	.618	.570	.574	1.302
a. Predictors: (Constant), compenvmt, emppow, mgmtcmt, legenvmt, rewsys, orgldr, mutrust, risktap, reportingsys					
b. Outcomes: management system					

Table 4.24: Analysis of Variance (Managers)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	38.302	9	4.256	12.919	.000[b]
	Residual	23.718	72	.329		
	Total	62.020	81			
a. Outcomes: management system						
b. Predictors: (Constant), compenvmt, emppow, mgmtcmt, legenvmt, rewsys, orgldr, mutrust, risktap, reportingsys						

Table 4.25: Path Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-.423	.554		-.763	.448	-1.527	.682
	orgldr	.171	.239	.142	.715	.477	-.305	.646
	mgmtcmt	-.332	.201	-.313	-1.650	.103	-.733	.069
	emppow	.427	.111	.307	**3.864**	**.000**	.207	.648
	rewsys	.233	.150	.246	1.555	.124	-.066	.531
	reportingsys	.310	.221	.314	1.405	.164	-.130	.751
	risktap	.006	.183	.007	.033	.973	-.358	.371
	mutrust	.164	.220	.149	.746	.458	-.274	.602
	legenvmt	.238	.097	.252	**2.461**	**.016**	.045	.431
	compenvmt	-.122	.099	-.126	-1.241	.219	-.319	.074
a. Outcome: management system								



***. p < 0.01 level (2-tailed)".
" ** p < 0.05 level (2-tailed)".
" *. p < 0.1 level (2-tailed)".

Figure 4.18: Causal Linkage SC to MS – Managers

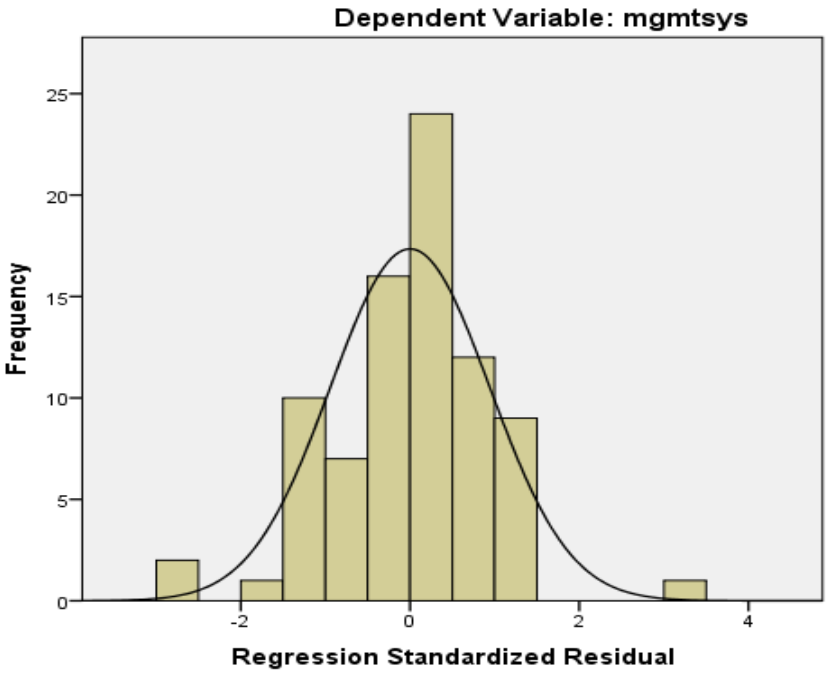


Figure 4.19: Residuals Histogram – SC effect on MS (Managers)

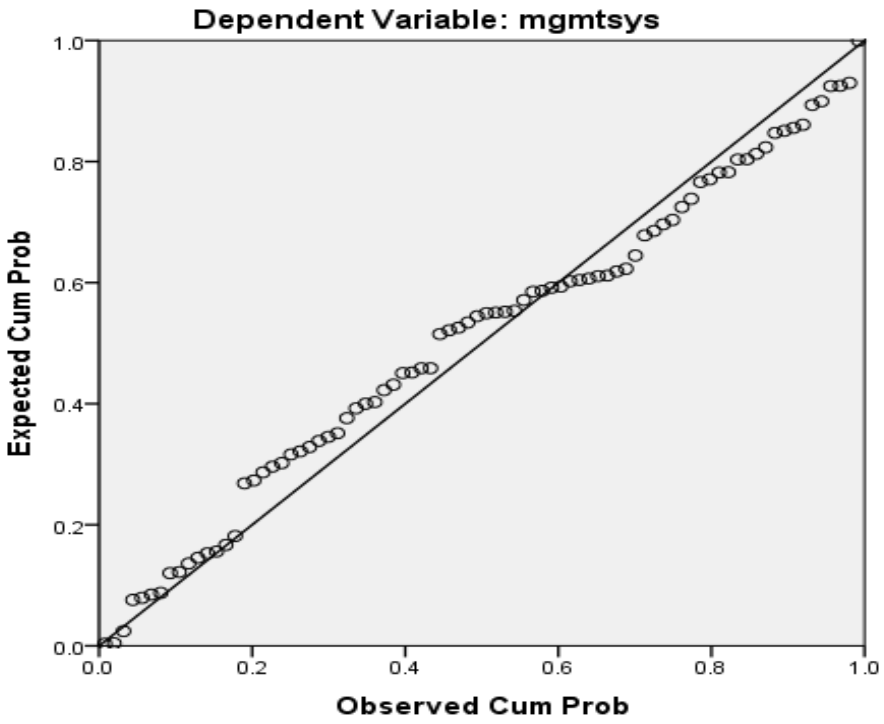


Figure 4.20: Probability Plots – SC to MS (Managers)

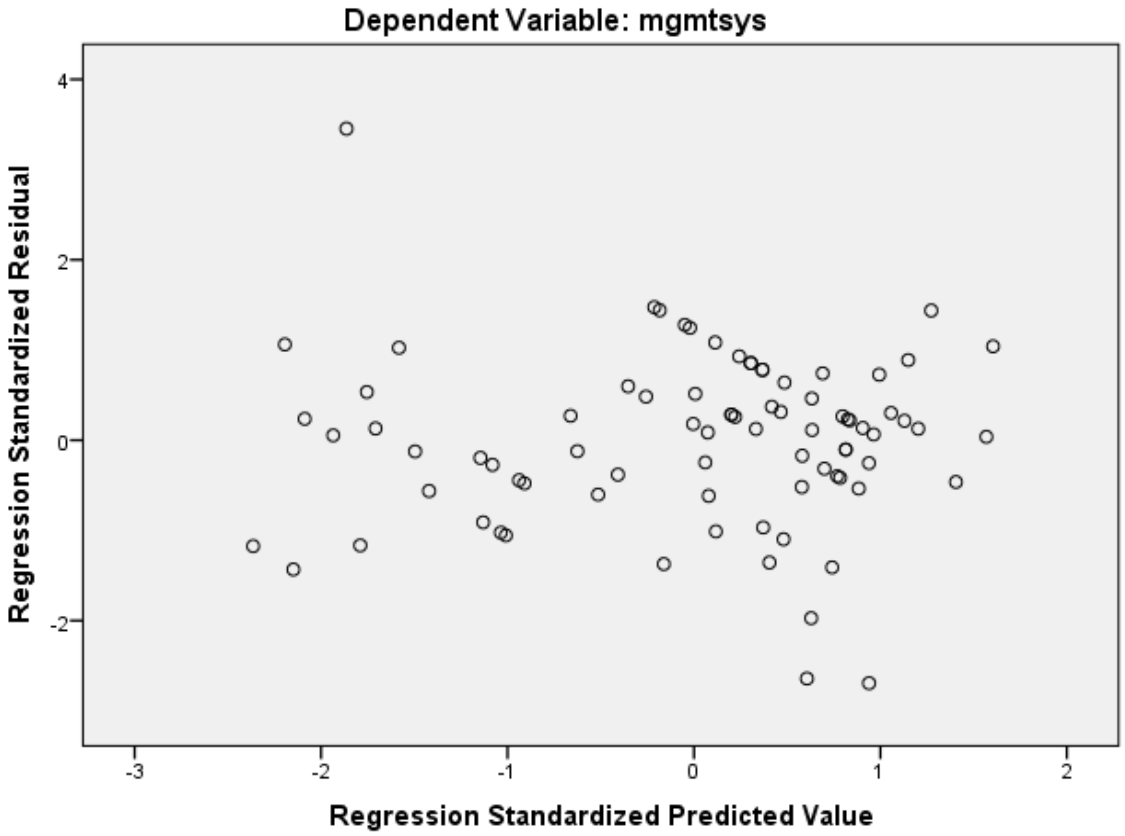


Figure 4.21: Scatter Plot – SC to MS (Managers)

4.12: Qualitative Analysis: Interview Responses

Interviews with key senior management staffs revealed a reasonable understanding of safety culture and management system attributes. There has been an almost unanimous view about applying a more local and flexible system model compared to a regimented/mechanistic off-site driven system like what is being operated by Company 'A'. The respondents from company 'A' raised concerns about lack of adaptability and bureaucratic hassles in introducing innovations into the system. He opined that too much time and effort is wasted in the documentation and feedback. The representative of Company 'D' mentioned the difficulty in interpreting/understanding the mandated standards and codes that need to be applied. All responded seems to agree that system performance outcomes must be carefully recorded, collected and interpreted. There is an increased concern expressed by all respondents that it is challenging

to ascertain the skills of workers before they are mobilised to the country and the respective projects. A representative at Company 'C' raised concerns regarding the ownership of line supervision. There is a growing perception in the company that safety activities are the responsibility of safety staffs, while construction supervisors must be more focused mostly on increasing production. On questions related to human factors and their role, none of the respondents was able to explain the behavioural issues of workers that could be linked to the management. A respondent from Company 'A' mentioned that robust systems are important to carry out smooth businesses. However, a respondent from Company 'B' opined that availability of a system or procedures does not automatically solve the problem, as often due to the site constraints and requirements, the procedures are by-passed.

Appendix D shows the themes developed based on the interviews conducted with the four companies. The results shown in Appendix E support the responses obtained through the quantitative analysis. Through the interview, the research was able to obtain the three years key performance indicator records of each company and was able to do a correlation to validate the focused study

4.13: Leading and Lagging Indicators

Key performance indicators are grouped into leading (pro-active) and lagging (reactive) indicators and they are shown in Table 4.26. Data collected from all the four companies cover a period of three years from 2013-14 to 2015-16. Frequency rates are calculated by dividing them with the total man-hours worked and calculated for one million man-hours (FR = (No of Indicators/Total Man-hours for the year) x 1,00,00,00).

Leading Indicator scores are presented in Figure 4.22, and the results indicate that Company 'A', compared to rest, is more focused and committed to measuring performance pro-actively. Company The system objectives of Company 'A' are set, driven and monitored by the corporate head office. This has enabled them in directing their resources in measuring it proactively. Whereas the leading performance indicators of the other three companies (B, C

and D)do not match up to the level that can be seen in Company ‘A’. However, they do have a pro-active measurement process which is reflected in their KPI scores (Appendix B).

The KPI scores of Companies A, B, C and D are given in Appendix C and the illustrations provided in Figure 4.22 & 4.23 below. The scores are calculated as frequency rate per one million man-hours worked. Score on near miss indicator shows that company ‘A’ meticulously follows a robust near miss reporting process. Results also indicate that due to the non-existence of well driven HSE system in organizations B, C and D the number of loss cases (first aid and medical treatment cases) is on the higher side as compared to the organization ‘A’.

Table 4.26. Key Performance Indicators

SN	Lagging Indicators	Leading Indicators
1	Lost Time Injuries (LTIs)	HSE Training (Excl Induction)
2	Medical Treatment Cases (MTCs)	HSE Inspection
3	First Aid Cases	HSE Audit (Internal/External)
4	Near Misses	HSE Meeting
5	Property Damages	HSE-MS Review
6	Work Stoppages	HSE Management Walkthrough
7	Legal Notices (FR)	HSE Campaign/Promotions
8	-	Task Risk Assessment
9	-	Safety Suggestions
10	-	Health Surveillance

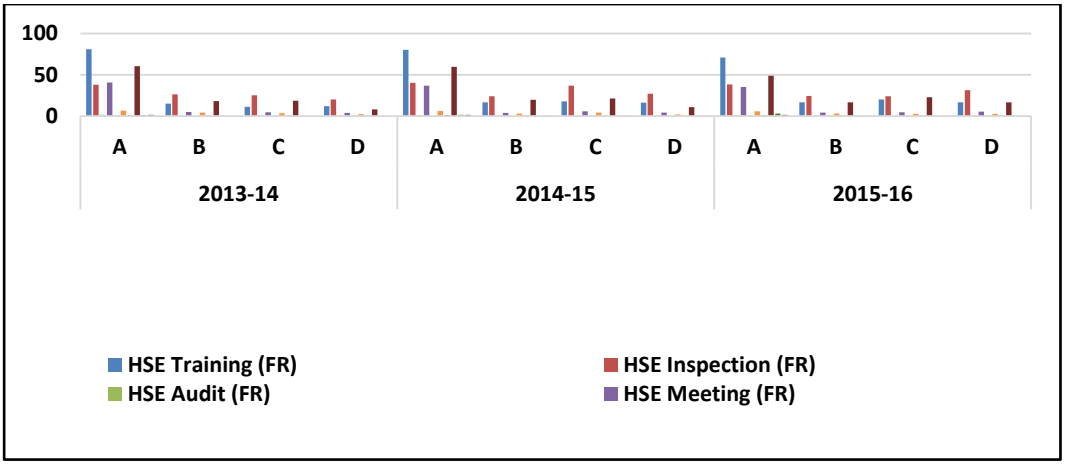


Figure 4.22: Leading Indicators Frequency Rates – Company Wise

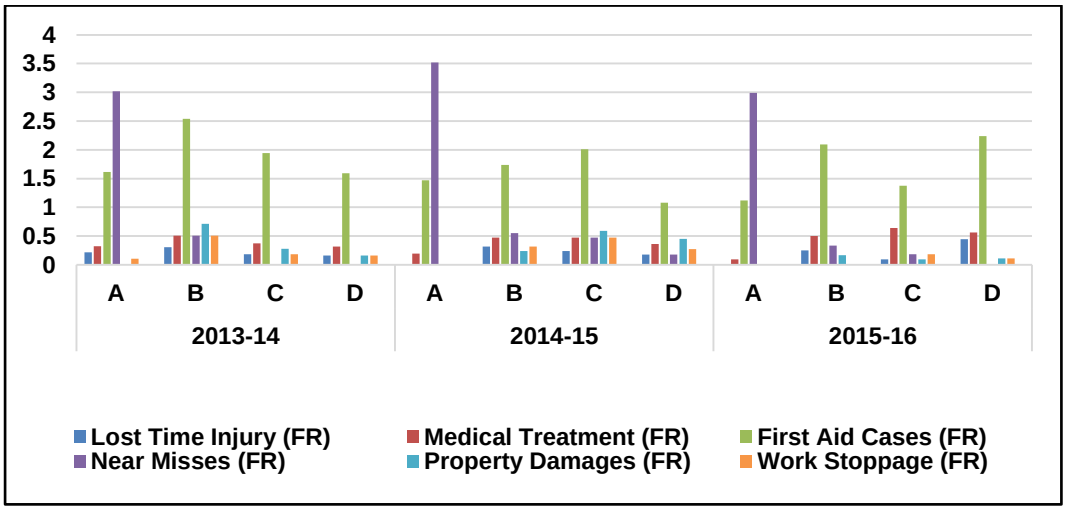


Figure 4.23: Lagging Indicators Frequency Rates – Company Wise

Correlation table between leading and lagging scores are shown in Appendix G. There is no apparent relationship established among the lagging indicators. Most of them are negatively correlated to each other, which show that they are independent of each other. Interesting to note is that the legal notices recorded by the companies were zero for the period measures. Medical treatment cases have a negative association with all the leading indicators. As the companies measure, their system proactively the loss cases/injuries are decreasing, which is a good indicator. Near miss has a positive and strong correlation with all the leading indicators. Companies who are focussed more on measuring the system inputs are equally focussing on the near miss cases to learn lessons from it

before a loss occurs. This is evident by the negative correlation of near-miss with other lagging indicators such as lost time and medical treatment cases. Similarly, lost time injury, property damages and work stoppages have a negative correlation with leading indicators which shows that if companies focus on system performance proactively, then they tend to have fewer negative outcomes.

All the leading indicators are positively correlated. It shows that HSE meetings, training, audits, reviews, campaigns, management commitment, safety suggestions, health surveillance and task risk assessment are working closely as inputs to the system and are interconnected, feeding back to each other.

4.14: Conclusion

This Chapter covered the data description and presentation of study results. Descriptive statistics describe the collected data after characterizing and distributing it among the respondent categories. The data is then empirically measured for its reliability, validity and unidimensionality. Covariance and correlation matrix are presented. Mean tests like t-test and ANOVA are performed to measure the degree of implementation of safety culture and management system across different groups. Regression analysis is run to estimate the impact of safety culture on management system and vice-versa in construction companies of UAE. Results tend to show the influences of independent factors vary significantly among Company ‘A’ and the rest of the three (B,C,and D). The interviews support the results obtained by the gathered data and analysis. It is further validated by analyzing the performance indicators and their correlations in all four companies. The analysis validates that, due to the lack of a directed formal system in organizations B, C and D, the number of first aid and medical treatment cases is higher compared to organization A.

Chapter 5: Findings and Discussion

This chapter discusses the interpretations from the findings obtained through the secondary and primary analysis of safety culture and management system attributes to accomplish the research objectives and hypothesis.

5.1: General

Out of the questionnaires that were sent out to a target audience of 310, a response was received from 231 which formed a credible response rate of 75%. From the total responses, Company 'A' represented 29.4%, company B - 25.1%, Company C - 21.6%, and company D - 23.8%. Based on the responses it was inferred that there had been an almost equal representation of data from all the four companies. Pronovost et al. (2005) suggest that a response rate of at least 60% is deemed enough to qualify the findings to some acceptable levels.

The statistical analysis in this study makes a parametric approach by assuming and defining properties of the population distribution whose data is drawn for analysis. Violation of these assumptions will have significant impact on the conclusion and interpretation of results (Saleh Z et al. 2012). To validate the assumption, testing normality of data distribution is done. Test of normality is important for a parametric research to confirm that the means across the sample don't deviate drastically from the overall mean (Saleh Z et al. 2012). To check for the data received to be normally distributed the Kurtosis and Skewness tests were carried out. The results indicate that most of the values lie between -1 to + 1 which confirmed the data to be 'normally' distributed. Hair et al. (2010, p. 36) suggest that data to be considered as normally distributed shall have Skewness Values within "**-1** to **+1**". Majority of the values of explored variables were within the suggested threshold values. However, few values are marginally violating the criteria. Hair et al. (2010, p. 72) elucidated the relationship

between the size of the sample and normality as, "larger sample sizes reduce observations, and especially, if, the sample size is less than 30 or so, significant departures from normality can have a substantial impact on the results. For sample sizes of 200 or more, however, these same effects may be negligible". The sample size of this study was 231 and therefore few values departing from normality will not have significant impact on the conclusions.

5.2: Objective No. 1:

To critically analyse the current safety culture and practices of Construction companies in Abu Dhabi.

From the results obtained, it could be said that the sampled population has a reasonable level of safety perception. There is a marginal yet significant difference in the perception was observed in Company 'A' viz-a-viz the rest of the three companies B, C and D . The mean score of Company 'A' is greater (>3) and standard deviations lower (<1) than rest of the three companies (Table 4.6). All the explored factors, including legal and compensation environment, had a higher score in all the four companies which suggests that there is a good safety culture perception in the sampled construction companies of Abu Dhabi (UAE).

While excluding the legal and compensation environment, Company 'A' results show a high degree of perception score for employee empowerment and a low score in the perception of the reporting system. This could be one of the reasons why in Company 'A', the reporting system perception was low. Having a directed and a rigid reporting system makes it more difficult to implement (Pradeep et al.,2018). User-friendliness and flexibility of any documented system are critical for its effective use (Arocena et al., 2010). Company B, C, and D scored high in the perception of management commitment, while perceived poorly about the management system.

To some extent, we could argue that the system does not directly correlate to the commitment of the management. This relationship is required to be further

explored. The average responses among the respondent from the three companies who operate a more local and informal system seem to be close to each other. However, the perception scores of Company 'A' scores are comparatively higher compared than the rest, particularly in the Management system, Employee empowerment as well as in its Organisational Leadership. A company that drives a structured and organized approach in defining formal means to engage and empower employees seems to be performing better in the individual perception scale (Alazza et al., 2015). However, it needs to be established whether there is any causal relationship between the management system and employee empowerment. The lowest factor that emerged from the study is the compensation environment for all four companies. None of the companies seemed to believe that compensating for injuries have been a driving force in management's safety decisions.

Results (Table 4.6) indicate that the respondents of Company 'A' have a more coherent view (SD 0.15) about the explored ten factors compared to the other three companies (SD 0.86). The lowest difference in perception among Company 'A' and the other three company respondent is Management commitment, and the most different perception is the Employee Empowerment. All the four companies perceived management commitment as an underpinning factor, and there is no significant difference in their perceptions about it. Whereas, employee engagement and empowerment seem to be better in Company 'A' compared to the rest. Since Company 'A' operates a more directed and formal program for employee engagement and empowerment, the respondents are more aware, competent and confident about it. The relation between employee empowerment and management commitment are amply discussed in previous literature. HSE (2013) in their research report stresses the fact that all employee participation activities are based on the demonstrated management commitment. Modeling of appropriate behaviors by managers and other leaders contributes primarily to creating and supporting a good culture of dialogue (HSE, 2007).

Moreover, good dialogue cultures will invariably influence better workforce participation. There is a definite need for management direction and a formal and systematic approach for participatory programs, set at the highest organisational level (Nielsen, 2014). Enthusiasm and involvement from the management in the direction of participatory programs is critical to achieving their objectives (Biggins & Farr 1988a). The below radar plot illustrates the mean of the ten explored attributes (Figure 5.1) to give a visual representation of the perception difference between the four companies. While the perception scores of B, C and D tend to lie close to each other, the perception score of Company 'A' is significantly higher particularly in the Management system, Employee empowerment as well as Organisational Leadership.

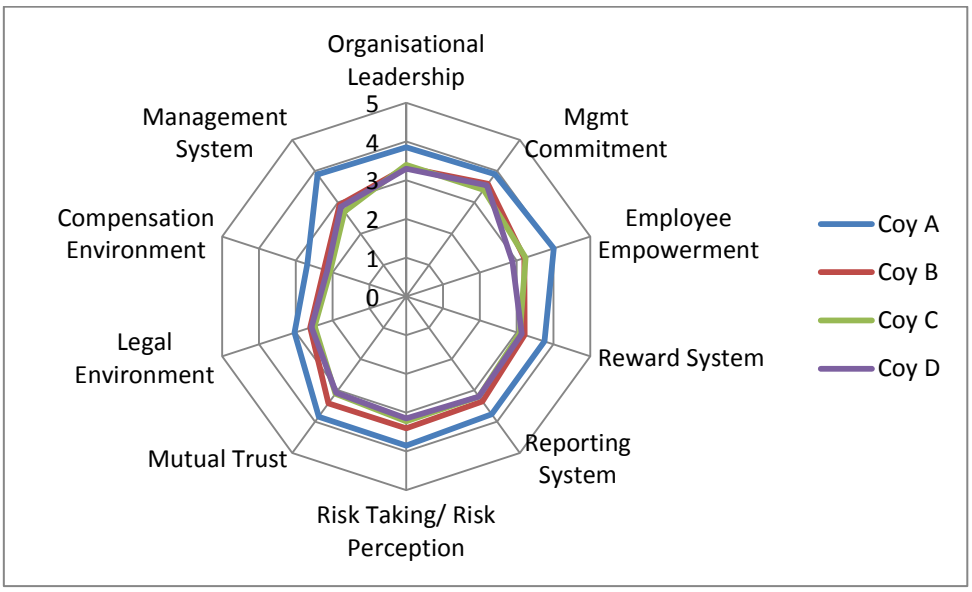


Figure 5.1: Radar Plot of Mean Score (Full Sample)

Standard deviations in the responses of all the four companies indicate a lower value for Company 'A' compared to rest of the other three companies. Results (Table 4.6) show that the respondents of Company 'A' have a more coherent view (SD 0.15) about the explored ten factors, compared to the other three companies (SD 0.86). The below radar plot illustrates the degree of differences in responses from all the four companies, which indicates how respondents view the different factors.

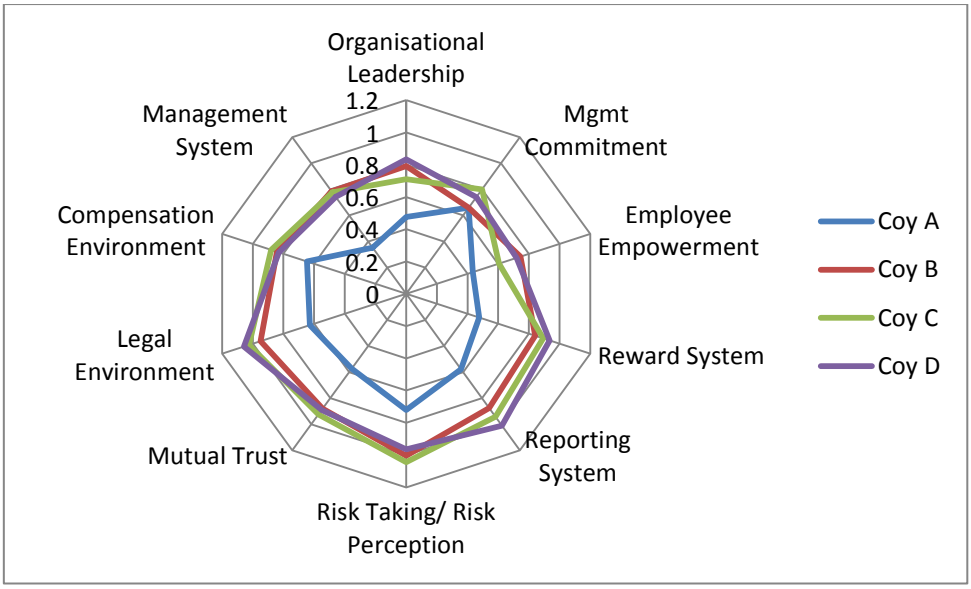


Figure 5.2: Radar Plot of Standard Deviations (full sample)

The strength of association between variables

The strength of association among the variables was measured through covariance and correlation analysis. All the variables are positively correlated, and most them are strongly correlated. This is an indication that all the factors are interlinked and together contribute to the overall safety perception. The strongest positive correlation (Table 4.8) was seen between risk perception and reporting system (0.906 at $p<0.01$) which have a direct influence on how safety issues are highlighted and reported. When individuals realise the significance of safety-related practices, they tend to be more motivated and committed to reporting unsafe conditions and practices (Saari, 1990). Awareness leads to commitment which ultimately helps individual to take right actions (Saari, 1990). It was possible to further validate in the study when the performance data was analysed that showed that increased training and employee engagement, improve the near-miss reporting in the workplace. Other very strong positive correlations were between Organisational leadership and reporting system/risk-taking attitudes (Table 4.7, value of 0.818 and 0.800 at $p<0.01$). Leadership at all levels significantly contributes to positive behaviors in the workplace. Setting self-example and encouraging others to report and to work safely is by

far the best way to motivate the downlines (Latham et al.,1994). It is evident that encouraging employees to report unsafe practices through tangible returns using incentives or rewards motivates them significantly. However, the reward system must be carefully designed and consistently applied. If not, employees lose trust in the reward system and, to some extent, shy away from reporting (Benn et al.,2009). The results indicate the companies reporting system and reward system /mutual trust are strongly and positively correlated (Table 4.8, value of 0.858 and 0.823 at $p<0.01$). Employees tend to under-report or ignore reporting an incident or injury due to reasons not limited to the fear of reprimand. If there are no actions taken or no feedback provided to the employee once an injury is reported, they tend to lose the trust in the system (Benn et al.,2009). Slowly, this will degenerate into a poor reporting culture. The study results, confirms this relationship between reporting and mutual trust. A common linked factor is rewarding employees for good behaviours, including reporting an untoward incident. Reward programs if not carefully and formally developed and implemented, the employees tend to lose confidence in the management's intention (Biggins & Farr 1988a). The overall correlation between the nine factors and the management system is positive and strong, which could be argued that having a strong perception of systems is connected to how people perceive safety practices in their organization.

However, a weak correlation is observed between the employee empowerment factor and the management system which could essentially imply that an organisation where employees take ownership and influence safety activities, do not depend on a written management system. Therefore, engaging employees and empowering them is essential for any organisation to create a paradigm shift in their safety culture (Pradeep et al.,2018).

Causal Relationship

Regression analysis was done to study the effect of various factors external to the organisation such as legal and compensation environment on the management system. Results conclude that there is no significant influence of the legal environment on a management system for all companies. Legislations

have always been a significant contributor to the way a companies culture evolves (Jackson,2012). It sets out the minimum expectations, and compliance is ensured through robust enforcement actions. The studies of Al Kaabi (2003), highlights the weakness of the UAE OHS laws and requirements as it is based on a fragmented framework and is ineffectively spread, due to the varying requirements in different emirates and local authorities within them. However, compliance with legal requirements alone cannot improve the safety perceptions and cultures (Jackson, 2012). A collective approach involving all the stakeholders cemented by the mutual trust is essential, along with the right competence and attitudes of all individuals involved (Abbas et al., 2018). Engaging employees in performing safety activities is a great way to improve people commitment and awareness. There is no better learning than doing it ourselves. As evident from the study results, employee empowerment and engagement are a significant predictor of better culture perception.

Safety standards and guidance help in a way to deal with safety problems without strong safety engineering knowledge and background. However, there are no off-the-shelf standards and solutions available for all the site issues and problems it faces Employees themselves are often best suited to find solutions to specific work problems (Alazzaz, 2015). The overall results indicate the perceptions of safety culture in UAE construction companies and prove that it is consistent with similar studies done previously (for ex: - Zohar, 2000; Flin et al., 2003). It is evident that due to a decentralised enforcement environment, the influence of legal requirements on the company's safety culture and management systems are low. Companies seem to be not encouraged to adopt a management system approach, as the focus has been limited to compliances to local and federal requirements.

In general, this study and the survey results show a reasonable level of consensus among the respondents. Most of the responses in the questionnaires were inclined towards a positive safety culture perception. It is possible that such a response is due to a common belief or stereotypes shared among the workforce regarding safety. The overall results indicate the safety culture in UAE construction companies and prove, , that it is consistent with similar

studies done previously (for ex: - Zohar, 1980; Flin et al., 1996). Helmreich et al. (2006) have reported the same from their survey on airline industries. It is also possible that since most of the statements were positive, it did not measure the individual differences well enough.

5.3: Objective No. 2

To examine and quantify the effectiveness of the Management System in promoting and improving safety culture.

Overall scores of perception on management system indicate a positive trend with an overall mean score of the complete sample is 3.09. However, there are differences between the perceptions of respondents of Company 'A' and the rest of the three companies. Company 'A' is having a much higher perception, Mean 3.7 compared to a combined mean for B, C, and D at 3.0 (Table 4.6). The result also indicates that there is no unanimity and consistency in the perception of management systems in companies B, C, D (SD 0.76), while Company 'A' has a unanimous view about management system (SD 0.35), which is expected as Company 'A' employs a corporate-driven, directed and formal system. However, that alone does not show the robustness of the systems. One of the reasons for the differences in perception among the three companies could be because of the way they understand the need and use of a system. Robson et al. (2007) argued that there is no unanimity among organisations or agencies in defining management systems. Company 'A' has a directed and formal approach to develop and roll out their system, ensuring that employees are aware and are competent to understand the importance of it. The results confirm that the respondents of Company 'A' are more confident about their management system compared to the rest.

The results indicate that employee empowerment is more significant in the companies that have a formal system to engage employees through participation initiatives like committees and forums, compared to companies which do not

have a formal process. Empowerment of people is referred to as, both a style and attitude of management (Broadbent, 2004). Empowering employees increases ownership where they feel the responsibility as well as accountability for their decisions. It makes sure that employees and the management together are involved in the decision-making process. This will help the manager plan, monitor and lead whereas the employees do their best work as an individual and as a team (Cohen et al. (1977).

The strength of association between variables

Through correlation and covariance analysis, the nature and strength of the relationship were established between the management system and rest of the nine factors and the result indicates a positive correlation among almost all the variables except for legal and compensation environment. The strongest positive correlation is with the reward system, and the weakest relation is with the legal environment. Most of the countries have legislative expectations about health and safety practices. However, except for Singapore, none of the other countries has a legal requirement demanding construction companies to have a formal management system (Kamardeen, 2009). As discussed earlier, it will not be enough to have legal requirements in place, but the enforcement of it is critical for its effectiveness (Mortimer et al.,1990). Having a formal management system is not a legal requirement in UAE. However, the emirate of Abu Dhabi has enacted some guidelines on it through the setting up of OSHAD and its directive instruments. However, it demands self-regulation from the business sector regulatory authorities to enforce it on their entities (Jackson, 2012). This could be one reason for the weak correlation between the system and legal requirement, as explored from this study. The other positive correlations with management system were organisational leadership, reporting system, risk-taking/perception, and mutual trust. The correlation with management commitment and employee empowerment were positive but not as strong as the rest with 0.082 and 0.140 at $p < 0.01$ level (Table 4.8 & 4.9). The results for all the four companies show a weak correlation between the system and 'employee empowerment'. A system's success depends on people who are

driving it (Bottani et al., 2009). Despite having a high capacity system, if it is not well deployed by getting the employees involved, it will become ineffective (Cotton, 1993). The results conclude that the employee empowerment perceptions are not linked to how the system is being perceived. However, individually all the four companies have a positive perception about employee empowerment, while management system is perceived poorly by company B, C, and D compared to A. An argument arises here that one does not need a management system to have a strongly empowered employee and committed management. The difference in the perception and the unanimity of responses in Company 'A' compared to the rest shows that a company with a formal management system perceives better about the safety cultural aspects compared to the rest.

Individual questions (Q46, Q47, Q48, Q49, Q50) on management system factors were targeted to measure the leadership/commitment, competence, compliance/credibility and confidence (consultation & control) among individual respondents. The results show that Company 'A' fares higher in all the parameters compared to the rest three. A company with a more formal and directed system approach, tend to appreciate the various safety attributes. There is no significant difference in the overall perception score, though Company 'A' scored slightly higher in all aspects. Therefore, it can be confirmed that safety culture perception has multiple dimensions and the overall perception is a complex product of all individual factors combined (Beatriz et al., 2012). A clear difference in the coherence in the perceptions of the respondent was observed among Company 'A' and the rest of the three companies. While in Company 'A' the respondents had a standard deviation of 0.153 on management factors and 0.47 on rest of the factors. Companies B, C and D had a score of 0.86 on management system factors and 0.85 in rest of the factors (Table 4.6). This gives a clear indication that there is more unanimity in the response of the company with a formal directed system compared to others.

The findings from the survey were backed up through the personal interviews done with the senior management representatives of all the four companies. The

representative at Company ‘A’ mentioned that the programs in their management system are implemented not just for compliance purposes, but they make use of it to solve the daily safety problems on site. He also mentioned that employees waste a significant productive time in reporting and following the documentation required. At times it becomes too laborious to implement them, and people tend to take shortcuts. Company B, C, and D responded by saying that their system is more site-specific and follow the entire requirement as per the contract. They suggested that keeping the uniqueness of project in mind, having a system which is not designed to suit them will not be successful. In the latter case, they can quickly adapt and change the system as per the situation. At the same time respondents of. Company ‘A’ raised a concern about the difficulty in changing/adapting the system to suit the project or site requirements once it is implemented. Multiple levels of approvals and authorisations are often required to bring in any modification to their system, which is an essential drawback.

System Performance Outcomes

Safety performance indicators were computed as ‘lagging’ and ‘leading,’ and a comparison was sought to check the strength of the relationship between the two. Lagging indicators represents the outcomes of the safety system and practices while leading indicators represent the inputs to the system to achieve the desired outcomes, which is no losses/failures (Grabowski et al., 2007). The former indicates the failure of the system and the latter indicates the success. Correlation between leading and lagging variables (Appendix G) shows weak correlation amongst themselves except that of ‘Property damages’ and ‘Work stoppage’ (0.904 at $p < 0.01$ level). No strong correlations are seen between injuries (LTI, FA, and MTC) with ‘work stoppage’ (0.426, 0.452 and 0.422 at p,0.01). This indicates that injuries in the workplace do not necessitate formal work stoppages. This is also a reflection of a weak legal enforcement environment in UAE. The statistics obtained from all the four companies indicates no legal enforcement notices were received in the previous three years of their operation. However, a strong negative correlation can be seen between ‘near-miss reports’ and rest of the lagging indicators. This could be a significant

advantage of near-miss reporting. As near miss reports increase, the opportunity for loss incidents decreases. Improvement in safety is achieved in organizations by acknowledging their weaknesses, and willing to adapt based on the lessons learned through the investigation of non-injury incidents before a more serious accident occurs (Eiff, 1999).

All leading indicators show strong positive correlation amongst each other. The strongest is between HSE meeting and Management System Review (0.999 at $p < 0.01$ – Ref Appendix G). Hale et al., (2010) mention that employee engagement and consultation forums provide enormous opportunity for continuously and continually evaluate and improve the management system performance. The study also indicates that the more formal consultations/engagements are held with stakeholders, the more active the system reviews will be. The near-miss indicator has a positive association with most of the leading indicators. Similarly, lost time injury, property damages, and work stoppages have a negative correlation with leading indicators which shows that if firms are investing much on leading indicators, then they have less lost time injuries, property damages, and work stoppages.

All the leading variables are strongly correlated with each other. It shows that HSE meetings, training, audits, reviews, campaigns, management commitment, safety suggestions, health surveillance, and task risk assessment are working closely as a management system and are highly interlinked and activity on one leading indicator is strongly associated with other leading indicators. It is evident from the study that the companies which are focusing more on leading indicators have a decline in their lagging indicator over a period. The companies that are focusing on the failures or lagging indicators do not have a clear trend of improvement in their performance. As discussed by Bird and Germain (1985), if the company focuses on the inputs and processes of the management system eighty per cent of the losses can be prevented. The failure indicators might reflect just the random fluctuations in the workplace (Dial, 1992).

From the results indicated by comparing the leading and lagging indicators for all the four companies, Company ‘A’ showed significant interest in measuring

its leading indicators and a focus on the system inputs. Rest of the three companies seems to be more focused on measuring their losses compared to the inputs/leading indicators. Score on near miss lagging indicator shows that firm A follows a robust near miss reporting mechanism. Results could also argue that due to a lack of awareness about the need and use of systems in organizations B, C and D, lagging indicators (except near-miss) are more compared to A. A formal approach to designing and developing a management system will enable the organisation to focus on the right inputs to help the system achieve its goals (Kamardeen, 2009).

Causal Relationship

Regression analysis was performed to study cause and effect relationship between the management system and safety culture. For this part, regression is performed with complete sample size. The significant independent variable, which is the management systems, provides a framework of activities that are more important in improving the safety culture of construction companies in UAE. The results obtained through the regression indicate that management systems significantly explain differences in safety culture perceptions as the significant p-value is less than alpha 0.05 (Table 4.15). Therefore, there is an increased possibility that the management system causes the variation in the safety cultural factors.

The coefficient of determination (R^2) is usually used to measure the comparative explanatory power of independent variables (Cohen, 1992) statistically. The adjusted R^2 value shows the amount of variation in the safety culture that is caused by the variation in Management system. From the model summary (Table 4.14), the management system factors explain 43.8% of variations in the safety culture. According to Hair et al., (2012) a high R^2 value of 75% (0.75) will be deemed significant for studies related to 'pure science' field. A value as low as 10% is usually accepted in the field of arts, humanities, and social sciences as the attitudes and perceptions of human cannot be accurately predicted (Falk et al., 1992). Therefore, a low R^2 value is often not a problem for studies measuring human perceptions and behaviors. The significance of

these values is important while we compare different data samples, to determine the explanatory power of their predictors. Higher the R^2 value, greater will be the explanatory power. From the results (Table 4.14) of this study with an R^2 value of less than 50%, it is clear that the management system alone is not a decisive predictor of safety culture outcomes. More than half of the influences on culture in construction companies are associated with other internal and external factors. These influences need not be limited to job factors, but it could be more to do with the environment in which the job is carried out; the absence of specific requirements to comply to and competencies of people who are performing the work.

The path coefficient (Beta of 0.662) shows that for a one-unit change in the management system the culture increases by 0.662 on average without considering any other factors (Table 4.15). While examining the individual questions on management system factors which were targeted to measure the 'Capacity,' 'Compliance' and 'Deployment' among individual respondent, it could be seen that Company 'A' which has a management system fares higher in all the parameters compared to others. A clear difference in the coherence and perceptions of the respondent was observed among Company 'A' and the rest of the three companies.

A past study by Bottani et al., (2009) directed an empirical study comparing safety performance levels of companies who have adopted the safety management systems with those who have not. The results of the studies show that there is a low level of performance level in non-adopted firms. However, there was a major weakness of Bottani et al., (2009) study, which was is that it did not measure the management involvement or commitment to safety standards. The Australian Transportation Safety Bureau conducted a study in 2012, to identify the efficiency of safety management systems. The study results show that the safety management system enhances safety performance. However, the study shows lack of various safety attributes of high-risk areas (Thomas, 2012), While all the above studies have somehow derived that the safety management systems directly influences safety performance outputs, Gallagher et al., (2003) argued that these outputs are ambiguous and are not

valid. As such valid research to date is not available to assess the effect of safety management systems on safety performance that includes all the elements of a safety culture.

5.4: Objective No. 3

To establish the differences in safety culture/perception among people with different demography (ethnicity, language, education and skills).

Through the primary analysis, the study has analysed the variations in perceptions among different groups (organizations, gender, education, the skill of workers, language, ethnic groups, age groups, skills/trade, organization level, overall experience). Independent t-Test is performed where the demographic category of respondents are grouped into two categories, like language which is grouped as English and non-English speaking. Analysis of Variance (ANOVA) test was done where there are more than two groups of respondents, like the organization level. The underlying hypothesis is that there is no difference in understanding among respondents regarding the explored safety perception factors. Results are discussed below according to the different demography:

Language: The mean difference on safety culture and management system among groups shows no difference in perceptions on safety culture and management system, except organisational leadership and compensation environment (Table 4.9). This indicates a varying degree of perception related to how they understand the leadership factors internally and the perception of injury compensation. The differences could be to some extent attributed to interpreting questions differently due to linguistic differences. Mode and selection of language are critical in a successful communication process (Verner et al., 2005). While selecting the language for questionnaires, due consideration was given to the fact that the majority of the crews/workers are non-english speaking. Since it was difficult to create questionnaires in multiple languages, English was chosen as the most preferred language among the respondents. Piloting the questionnaire helped in finalising the questions more simply and understandably. Moreover, support of safety supervision team was sought to

explain the meaning of each question framed during the mass safety briefing sessions. So, the likelihood of misinterpretation of questions and responding incorrectly can be considered negligible or within the tolerance level.

Skill level: t-test is performed to assess the difference in safety perceptions between skilled and unskilled respondents. Results (Appendix F) indicate that there is no difference in perceptions which is shown by the t-values and p-values. One of the challenges in the construction industry is the high turnover and unavoidable mix of people with different skill and competency levels (Al-Humaide et al., 2010). The sample selected for the study had a good mix of skilled (carpenters, electricians, steel fixers, masons etc.) and non-skilled workers (labours, helpers etc.). A skilled employee will have to undergo legally mandated, as well as internal training programs which shall cover the safe operating practices (HSE, 2007). Besides that, the company management focuses and monitors skilled workers more than the unskilled ones, as the former is considered more productive compared to the latter. There is a possibility in industries that the temporary and non-skilled workers are omitted from the internal competency development programs and hence are more likely to contribute to human failures (Al-Humaide et al., 2010). However, the study findings do not suggest or validate this observation. One of the respondents from the interview commented about the difficulty in ensuring the competency of crews/workers before they are mobilized to the country and respective projects. There are no legally mandated skill certifications for the construction industry. The UAE law requires that all employees must be competent to perform their tasks with no prescription on how this should be achieved. Therefore, irrespective of the skill level of the worker/employee, there is very little difference or change in approach towards aligning them with the company's safety culture and practices.

Organization Level: ANOVA test is performed to understand the difference in safety perception among the different organization levels as identified in part 1 of the questionnaire. Except for the perceptions of the legal environment, all other explored attributes are perceived differently by different employee groups (Table 4.12 & Appendix H-d). From the mean scores, it is seen that the

management group perceive the safety attributes and practices more positively compared to crews and support staffs. Safety culture to a considerable extent is influenced by the broader organizational culture (Anastacio et al., 2018), which is driven primarily by the management team. During the interview, a question was asked about the stakeholders of the management system in their respective companies. Except for one company, the rest seem to suggest that it is the managers at all levels who are the stakeholders of their safety system. Therefore, it is natural that manager level respondents affirm about the safety perception questions posed at them. The largest stakeholder in any organizations safety systems is the workers themselves who outnumber the management team in terms of direct beneficiaries (Biggins et al., 1991). If a company does not involve the employee in developing and sustaining the system, lower level employees may not take ownership and may even perceive the system differently from the manager categories. The study results endorse this fact that construction companies typically have a mechanistic style of management, and the perceptions about safety practices depend on how they are positioned and involved in developing and sustaining it. Interestingly, irrespective of the level of employment, all respondent seems to perceive, almost unanimously, that the legal influences on safety practices are low.

Ethnic Origin: To explore the differences in perception among people from the different geographic origin, ANOVA test was done. Results (Table 4.10 & Appendix H-b) indicated no difference in how people perceive safety, irrespective of their domicile, except the influence of compensation environment. To achieve the organisation's goals and objective, it is imperative to have a system where everyone in the organization understands, accept and work towards achieving it (Anastacio et al., 2018). Matured organisation invest much focus on orienting and aligning people's attitude and perception the way the organisation would want it (Anastacio et al., 2018). The study endorses the fact that the sampled construction companies are matured companies and have a clear approach is aligning individual goals to organizational goals; hence there is no statistically significant difference in how they perceive safety. For the success of Organizations, it is vital to create level playing by defining the

expectations and requirements of every individual without considering their cultural and social background (Pradeep et al., 2018). People from different origins and social backgrounds have different expectations when it comes to how they will be treated or compensated when they are injured (Oswald et al., 2018). This largely depends upon what they have seen and experienced in their respective countries before coming to UAE. The difference in perception about compensation environment among the different ethnic groups could be because of this reason. This also highlights the influence of the broader social expectations on H&S perceptions.

Overall Experience: Study sought also to explore the difference in perception among respondents grouped by the years of experience they have in the industry. ANOVA test results (Table 4.13 & Appendix H-e) suggest a significant difference in their perception. Respondents who have more years of experience tend to perceive safety more positively than the rest. It could be argued that as individuals experience matures in an organization, the perceptions, and beliefs changes (Bisom-Rapp et al., 2011). To some extent, this could be attributed to peer pressure and an improved understanding of the culture concept. Organizations require acknowledging and making use of this opportunity by tasking experienced people to be mentors of 'younger' staff and new joiners of the company.

Therefore, results confirm that except for the differences in overall years of experience and the positions they hold in their organization, no other factors influence the perceptions of respondents regarding the safety culture and system attributes. A commonly emerged difference among the groups was the difference in perception about the compensation environment existing in the companies.

5.5: Hypothesis 1

"Companies with a Certified Corporate driven Safety Management System in place have a more positive safety culture than companies who are deficient in it."

In all the four sampled companies, the respondents seem to have a reasonably good perception of their safety culture and respective management systems. However, as discussed earlier there seems to be a significant difference in how a company with a formal directed management system perceives, compared to the rest. The results indicate that Company 'A' is having a much higher perception, Mean 3.8, compared to a combined mean of B, C, D at 3.0 (Table 4.6). For the success of a system, it is vital that all stakeholders understand and value the dynamics of the system and apply them to their individual processes (Pradeep et al., 2018). A company which has a formal approach towards developing and implementing a management system will ensure that the system is rolled out carefully so that everyone understands their role in its success. If individuals do not understand the advantage of a systems approach, it is very likely that they may perceive it to be cumbersome and a time-waster (Lv, 2014). Safety culture is a product of the individual as well as group perceptions and motivations. Hence, it is imperative that all stakeholders understand and value the safety processes, collectively. The results (Table 4.6) of this study indicate that there is no unanimity in the perception of companies (B, C & D) without a formal directed management system (SD 0.86), as compared to the respondents from Company 'A' (0.15) which has one. This study demonstrates variations in perceptions about the management system. The mean score on management system perception of Company 'A' is higher (3.89) than the combined mean of the other companies (Table 4.6). One reason for this trend could be because the respondents of Company 'A' are more aware and competent to understand the importance of the management system, and they perceive it with more confidence compared to the rest. Surprisingly, in Company 'A', the respondents seem to vary mainly in the perceptions of 'risk-taking attitudes,' while the least difference is in how they view the 'management systems' and its relevance to safety culture. A similar trend could not be established in the other three companies, as there is no trend or unanimity in their responses.

Regression analyses and t-test have been carried out for companies with a certified/formal corporate driven safety system and companies without it (Table 4.17 – 4.18). The test is performed to assess the difference on safety culture and

management systems between organisations having corporately driven and directed safety systems (Organization A) and organisation having a local site-based safety system (Organizations B, C, and D). Results show the difference in perception of Organization A and Organization B, C, D as shown by the t-values and p-values (Appendix E). All the p-values are less than 0.05, with a significant difference on all the variable between Organization A and Organization B, C, D. ANOVA results indicate the significance (p-value) less than 0.05 (Table 4.17) in all the four companies, and hence the variation in safety culture is significantly explained by the changes in the management system.

A management system is necessarily a tool that helps an organisation achieve its business objective (Beatriz et al., 2017). It sets out goals, expectations, resources, and means to achieve them. From the results (Table 4.17), it can be seen that the management system explains 42.98% of variations in the safety culture for company B, C and D. At the same time, only 8% of variations in Safety Culture could be explained by management system of company 'A'. An inference could be drawn here that, having a more controlled and rigid/regimented management system loses 'ownership' by its people who are implementing them (Pradeep et al., 2018). They could perceive it more restrictive and a hinderance in their smooth functioning. Simultaneously, they lose trust and dependency on systems to carry out their daily functions safely.

The results (Table 4.18) from this study indicate that for every unit change in a regimented/formal management system of Company 'A', the culture changes by 0.307 on an average. While, in company B, C, D the influenced changes are noticeably high (beta is 0.658) with a significant degree of confidence ($p<0.05$).

Regression analysis shows that the Safety Culture of the company with a more local and site-based management system (B, C, D) seem to be more influenced than the company that employes an off-site driven system. The reason could be attributed to the flexibility and freedom in companies to adapt as they can change and modify the system based on the specific project needs. However, a directed/mechanistic system forces people to implement the procedures without

giving any due consideration of individual requirements, competencies and the context. Among the different management system performance dimensions, deployment factor seems to be influencing the safety culture more than the capability and compliance. This confirms the fact that it is not about the capability and content of the management system that promotes a safety culture, but how it has been developed, consulted, communicated, monitored and implemented makes the difference in safety culture (Pradeep et al., 2018). The results (Table 5.1) show that the benchmarked company 'A' has a higher capacity compared to the rest, and lower compliance and deployment.

Table 5.1: Regression Analysis Summary for MS Dimensions

Coy	Capability				Compliance				Deployment			
	R^2	b	t	p	R^2	b	t	p	R^2	b	t	p
A	.030	.172	1.41	.161	.04	.21	1.8	.076	.10	.31	2.72	.008
BCD	.364	.603	9.59	.000	.36	.60	9.57	.000	.52	.72	13.2	.000

The management system does help in creating processes to manage issues, but do not help in leading people (Pradeep et al., 2018). Probably the most challenging part is not the development of the system, but how it is rolled out and communicated to all the stakeholders and this is confirmed from the study findings.

The difference in management system perceptions was also observed from the interview responses. When the question was asked about the significance they give to their management system, the representative of Company 'A' responded that the programs in their management system are implemented not just for compliance purposes, but they make use of it to solve the daily safety problems on site. Company B, C, and D responded by stating that their system is more tuned to their site requirements and follows the contract terms. They suggested that keeping the uniqueness of project in mind, having a system which is not designed will not be successful.

The critical aspects of performance measurement were explored by asking questions to the interviewees on their awareness along with the areas of improvement and challenges that they believe they face in their performance management system. However, one of the interviewees of company 'C' suggested that this system was reactionary. Williams (2002) discusses the need for stakeholder engagement to enable accountability, confidence, and commitment in the process. An interviewee from Company 'A' commented that the system they use is already framed and finalised at the beginning of the project. Staffing, resource planning and mobilisation happens at a later stage and is often forced to change as per the site requirement. The involvement of the site team is minimal in drafting the construction safety management plan in all the sampled companies. An effective performance-based management system requires having an integrated approach involving the entire stakeholders (internal and external) in its conceptualisation, development, implementation and continuous improvement (Pradeep et al., 2018). Together with a committed and competent leadership and workforce engagement/participation the management system can be implemented effectively achieving OHS goals and objectives and reduced accidents & injury rates.

The interview results suggest that in 'Company 'A'', clear direction is set by the senior leadership with regards to the expectations of each business unit. This is then cascaded down to project level for further build up and implementation. While in company B, C and D, the expectations are defined locally at the project level, and compliance to the legal and contractual obligations are primarily considered, and their approach is more site risk-based than rule-based. The interview response also suggested the need for involvement of all the stakeholders in setting the performance targets and monitoring them. This helps in a collective bargaining approach with increased accountability, competence and commitment towards achieving the performance measures (Zhu, 2001). The interviewees suggested opportunities for improvement including the presentation of data in a different way, more incentives and definition of departmental objectives. These Suggestions can help increase employee responsibility and participation in the safety management system. The

respondent of Company ‘A’ expressed his confidence in their systems, as the objectives and performance measures are set with active consultations with the stakeholders and are continuously monitored by all levels of management. When asked about the effectiveness of their safety systems, the respondents of ‘B’, ‘C’ and ‘D’ affirmed hesitantly. This could be because of an inadequate understanding of a systems approach, suggesting a need for change. Quite interestingly company ‘A’ responded the increased paperwork as a weakness of their performance management process, which triggers a need to simplify the process. At the same time company ‘B’, ‘C, and ‘D’ seemed to suggest that the employees are not fully aware of the need and method of reporting and they felt a pressing need to have a structured performance management system. Therefore, there is better ownership regarding compliance in companies with a formal/directed management system compared to rest. However, the primary data analysis does not reflect any direct influence of a manager’s perception of how the safety culture and system is perceived collectively.

While comparing the performance data collected from all the four companies, Company ‘A’ seemed to be more focused on measuring the system inputs which in turn have reduced their losses throughout three years (Appendix C). Whereas, organisation B, C, and D were having less focus on measuring the process inputs/leading indicators despite having a fair understanding of HSE system. Therefore, it is evident from the study that the companies which are focusing more on system inputs have a decline in their losses over a period while those focusing on the failures or lagging indicators do not have a clear trend of improvement in their performance. Measuring leading indicators (system performance) is more proactive and can help in preventing losses before it happens. As discussed by Bird and Germain (1985), if the company focuses on the inputs and processes of the management system eighty per cent of the losses can be prevented. The failure indicators might reflect the random fluctuations in the workplace (Dial, 1992).

The study results show that there are many factors interlinked together, which defines the proficiency and effectiveness of a management system. HSE management system provides information on what to do, when to do and most

importantly how to do (Beatriz et al., 2017). For this system to work, all the stakeholders who are involved must understand and should be competent to use those (Abbas et al., 2018). Every individual in the organization should recognise and appreciate the hazards and risks existing in their workplace, accept the company policies, comprehend its significance and should possess the appropriate attitude (Pinto et al., 2018). All stakeholders must commit to comply with the rules and apply the best practices (Hasse et al., 2017). For a system to be effective, the necessary engineering and management infrastructure is critical, along with the desired behaviour and attitude of individuals (Chan et al., 2013). These lack of resources and complicated reporting process were highlighted during the interview by the interviewee at Company 'A'.

When all the above aspects are linked together with a mechanism of self-evaluation and continuous improvement in the work environment, an Ideal Culture is created. The factors that critically define the culture of the organization are the acceptance and commitment of the entire stakeholders involved (Kent, 2014). Management systems are often limited to documentation developed and tracked without gaining the confidence and commitment of all the stakeholders (Arocena et al., 2010). People associate management system as 'paperwork' without realizing the fact that paper works are only to communicate, track and analyses information. While the system is living and breathing, where every processes and sub-processes within the system is driven by individuals who are influenced by the different complexities in the workplace, conflicting demands/ changes and varying degree of behaviors. Since individuals drive it at all levels, their commitment and competence are essential for the system to deliver results (Robson et al., 2007). The significance of management commitment and employee engagement is highlighted throughout the results of this study.

5.6: Hypothesis 2

"A positive safety culture influences the development and implementation of an effective Safety Management System."

In order to test the hypothesis, a cause and effect relationship was explored between the management system and the safety culture factors. Regression analysis was performed where safety culture factors were considered as the predictors and management system as the outcome. Regression was carried out in two steps. In the first step, regression was performed with complete sample size while in the second regression was performed only for management group respondents. For the second step organisation level, demographic variables were then divided into two groups, i.e., crew and administration staff in one group and line managers, managers and senior managers into another. Then regression was performed only for managers group.

The results for the complete sample indicate that safety culture factors significantly explain the difference in management system with a determination level of 64% (R square value of 0.64), which shows that safety cultural factors define more than 60% of differences in the management system (Table 4.19). Moreover, F value is also significant at F=44.89 (df 9, 221) at p<0.00, and confirms variables within the group are jointly significant (Table 4.21). Statistical significance of variables and its impact on management system was measured through t-test results. Results (Table 4.22) indicate that sub-elements of safety culture like employee's empowerment t=4.16 at p=0.00, reward system t=2.18 at p=0.03, mutual trust t=3.18 at p=0.02 and legal environment t=3.66 at p=0.00 positively significantly contribute at $p<0.05$ in the management system. Whereas, organisational leadership marginally contribute t=1.68 at p=0.093 in management system at p<0.1. However, management commitment negatively contributes t = -2.279 at p=0.006 in management system at p<0.05 (Table 4.22).

Similarly, Regression results (Table 4.23) done for 'Manager' groups indicate that safety culture elements significantly explain variance in management

system with a determination level of 61% (R square value of 0.61). Moreover, F value is also significant at F=12.92 (df 9, 72) at p<0.00 (Table 4.24). Results (Table 4.25) indicate that among the safety culture factors only employee's empowerment t=3.86 at p=0.00 and legal environment t=2.46 at p=0.16 positively influence the perceptions on the management system at p<0.05 (Table4.25).

The results highlight that the safety culture elements significantly explain the changes that occur in a management system of respective companies. Safety Culture attributes like employee's empowerment reward system, mutual trust, and the legal environment positively influence the management system performance. Whereas, organisational leadership only marginally contribute to the difference in system perceptions. The results also indicate that there is no direct positive correlation between the commitment of management and the systems. Companies that are high performing with strong management involvement have a more flexible approach and quickly adapt to the specific day to day requirements (Pradeep et al., 2018). Most of the past literature suggests that the existence of a leadership commitment to participatory initiatives is an essential prerequisite (Daniel, 2015) for improving the safety of the workforce. The effectiveness of worker involvement is based on the specific assurance by the management (Boden et al., 1984). Modeling of appropriate behaviors by managers and other leaders contributes primarily to creating and supporting a good culture of dialogue (HSE, 2007).

An important factor in acquiring the commitment of management is that they have a vital role in licensing any change or recommendation which may develop from employee engagement campaigns (Locke et al., 1994). The commitment of the management must also be expressed by earmarking specific resources to carry out the tasks and engagement of employees (Rahimi, 1995). Failing to involve workers in establishing agendas and objectives of health and safety could diminish the value of participatory initiatives. Providing a useful environment has proven to be a reliable way to promote the creative thinking and progress of the team (W

einstein, 1998). Monitoring assistance is a great way to strengthen the real commitment of superiors and recognise that the work environment is at the top of organisational priorities (Penzer 1990).

Employee empowerment has been responded as significantly contributing factor by both the group of respondents, management commitment has been jointly expressed as negatively contributing. Managers being the owners of respective systems and procedure are more likely to perceive the importance of it, and the results confirm that. Management commitment, on the other hand, is seen as directly related and influenced by the type of systems that are being employed. A system that is forced to comply and aimed to control seems to work negatively on the perceptions. A system must encourage ownership than control. More the control less will be the motivation and commitment towards safety aspects.

Guldenmund (2000) identifies management systems as just one of the most frequently occurring safety climate/performance factors. Coyle et al., (1995) comments that no comprehensive all-inclusive factors exist to measure safety climate. However, some others (e.g., Glendon et al., 2001; Flin et al., 2000) suggests that there could be at least one factor that could be relevant and commonly applied in most of the industries and cultures. This could be seen in this study also where all the four companies perceive similarly in most of the other nine factors while differently about management system and vary significantly in the degree of differences amongst themselves in their perception. Another vital factor in promoting a safety culture is the ability of organisations to learn from adverse events (Benn et al., 2009). This process of reporting and responding to unsafe conditions in a workplace is achieved by an effective feedback system which depends heavily on communications based on mutual trust (Sexton et al., 2006a). Comparing the results of Company ‘A’ with the rest, we can infer that companies who have a formal management system have a more robust mechanism to track and escalate reports and issues and the performances.

Chapter 6: Conclusions & Recommendations

6.1: Conclusion

To complete this study past literature reflecting the framed objectives and hypothesis were reviewed and different factors related to safety culture and management systems were explored. Emirate of Abu Dhabi in the United Arab Emirates (UAE) has a regulatory framework with defined legal instruments and to some extent prescriptive requirements. However, the enforcement has been decentralised and self-regulated by the sector regulatory authorities who are often seen as weak in enforcing it. Therefore, different construction companies have a different approach to the requirements, and often a safety management system becomes an initiative purely driven internally. The past literature reveals that there exists a knowledge gap regarding identifying a comprehensive list of factors that promote an effective safety management system and resultant safety performance and culture. To this context, the literature shows that there is little research/study undertaken about safety management system in UAE and there are not enough data to support its influence in safety performance. Accordingly, the research has adopted a combination of a quantitative and qualitative study using survey instruments and interview as the methods to shed some light on the research gap related to the safety management system, its understanding, and implementation in the UAE construction sector.

Management commitment has been unanimously considered as the key binding aspect among all the attributes explored for creating a positive safety culture. Companies who participated in the study have a view that employee engagement is critical to the evolution of safety practices, irrespective of the type of management system or level of management commitment. This shows that the employees feel more accountable and responsible for their safety as well as that of others.

The respondents of all the four sampled companies seem to indicate that legal and compensation environment do not contribute to how they perceive safety culture. This highlights the limitation of UAE's H&S legislation in bringing about visible changes in the safety practices of construction companies. The performance indicators also reflect the fact that there is no formal or informal intervention by the local authorities, and therefore no significant contribution on improving the safety conditions. From the results, it will be prudent to understand that a formal management system helps consistency in understanding the various safety issues and to perceive these factors in a unanimous way. Companies with a formal and rigid management system have a poor risk-taking attitude despite perceiving the system as a good contributor to safety practices.

It can be concluded from the study that management systems significantly influence the safety culture. Similarly, the overall safety culture and perception is critical to the success of management systems. It could be said that even though the management system influences the safety culture, it cannot be attributed as the most significant factor. Nevertheless, the construction companies in UAE significantly value the importance of management systems and use them to improve their organisational activities that promote safety culture. A system which is more localised and adapted to the requirements and expectations of a specific project seemed to be better implemented. Companies those are mechanically implementing an off-site designed/developed system often risks inefficiency as the people, who are responsible for driving it, would be expected to comply to the system irrespective of whether they understand the terms of references or agree with it. This leads to a drop in perception levels and beliefs and their trust in the system, which would further lead to undesirable behaviors. The common association of hidden culture and visible behavior often leads to culture change activities through management systems. They help in creating "just culture" by changing the accountability framework or trying to improve connection and trust by mandating that managers must adopt a situational leadership style. While these approaches will influence culture, it is often not in the way intended because they are applied as interventions rather

than organic improvements (David et al., 2018). Systems must have the capacity to deal with the changes and adapt to the environment. The failure to consider the inevitable forced situational compromises/deviations from the system further compounds the adverse outcomes (David et al., 2018).

The capability and compliances to system requirements have a significant influence in improving the organisational activities. However, if it tends to control and restrict people to innovate and adapt as per situations, people would start losing confidence in the system. Which then exposes the individual to 'human failures', be it a mistake or a violation. The studies on behaviors have highlighted that values/attitudes influence 20% of it and the rest 80% is due to the situation (David et al., 2018). The study concludes that more than the capacity and compliance, it is the deployment of the system by collective engagement of all stakeholders that will ensure better performance. The study concludes from its findings that high caliber management system may not always perform the way it is expected. The most important aspect of the system is the consideration given and allowance for its dynamicity. It needs to be user-friendly and should have the acceptance of all the stakeholders. Mere capacity and compliance to the system, do not necessarily improve the safety perceptions individually and the safety culture collectively.

Often, organisations prefer a more flexible system which collectively engages everyone where the focus is not just compliance but ownership also. It is essential for organisations not just to select a ready-made blueprint for their management system, but they also need to make a more customised system that suits the specific project site conditions and stakeholder requirements. Once it is developed the primary task is over, and the next logical step is to ensure that all involved in implementing the system is made aware of the importance and significance of the system. Together with a robust mechanism of continuously and continually monitoring the system performance, it can significantly contribute to more positive safety culture and performance. Use of Information technology, by means of online training and monitoring, helps in reducing a lot of effort and burden while deploying the system.

The study confirms that a formal management system will encourage the demonstration of leadership and will empower employees in making safety decisions. At the same time, management ownership on their respective system is more important than merely following and being compliant to the system requirements. Managers perceive differently in organisations depending on how they are engaged and involved in developing the safety systems and are held accountable for the same. A rigid/inflexible system could lead to poor commitment/involvement of people who are expected to lead and steer the system. It could to some extent mean that a formal written system is not necessarily required to demonstrate management commitment.

The macro environment of safety culture significantly affects the management system perception and its performance. However, no single detrimental component//aspect improves the performance of the management system and promote safety culture. The reliability of the system depends on the individual component reliability. The performance of these individual components heavily relies on the changing internal and external influences on the organization. One such influence is the management system itself, as indicated in the study. Company with a more formal approach to management system tends to have a better perception of the importance and influence on performance. It is however noted that the system has its changing influences, which to a reasonable extent promotes safety culture. The key factor in such systems is the change management and its ability to engage all stakeholders. The system helps in objectively measuring the performance and consistently improve. This essentially establishes the fact that bespoke safety management systems/programs have increased ownership than a directed/rigid off-site driven management system. The influence of safety culture is more on management system effectiveness compared to the influence of system on safety culture. Though both positively contribute to each other, a cause and effect relationship does exist between them especially in case of the culture on the system than the system on culture. This confirms the earlier theories that a good culture/environment is necessary for any engineered or administered systems to be implemented effectively. From the study, it is also evident that a good safety

performance, concerning reduced losses, need not directly reflect the safety culture. However, it is a fair method of measuring the success of system interventions.

6.1.1 Theoretical Contributions of the Study

Findings from this study support the theories established in the past literature, that the broader cultural and behavioural factors influence the effectiveness of a formal safety management system in construction industries. However, the study also discovers that the reliability and effectiveness of individual factors are neither necessary nor sufficient to promote safety culture and performance. This contradicts the past research findings and the standard belief that there is a strong correlation between reliability of management systems and safety performance. This study confirms the correlation, however, discusses it to be weak and often indirect.

Management commitment has always been associated with strong system development. However, in this study management commitment was seen inversely correlated to the management system. Unlike the common belief, drawing clear expectations and requirements from the management team on their involvement in safety initiatives are not sufficient to promote a positive culture. There is a need for direct involvement of specific managers who are expected to implement them at their respective workplaces. If not, the system and its expectations maybe viewed as bureaucratic and burdensome. Therefore, it would be fair to suggest that even if there is a strong management commitment or employee engagement, the organization could have a poor safety culture and performance. Employee engagement is considered another key aspect of improved safety culture, and the findings in this study have supported the same. However, study findings also show that improved employee engagement practices alone do not determine the variation and improvements in the safety culture. Similarly, the legal environment and compensation culture are not directly and positively correlated to the safety culture. However, they all individually have a positive and direct influence on safety culture.

Safety is considered a system property (Jahn, 2016). The study supports this and adapts the reliability science applied to engineered systems and to management systems too. The systems dynamics takes into consideration the complex interaction of various elements, one complementing and supporting the other. Failure of one component need not fail the entire system. Therefore, the overall effectiveness of the management system element does not rely on any single safety culture factor. It is rather a complex system where there is a dynamic interaction between various elements configured non-linearly. One failure does not trigger the failure of others. It will also be prudent to mention that measuring a system by its output/failure data may be grossly inadequate, as the system may continue to work safely, despite weakness and drawbacks in the individual elements. However, a point will be reached where there is no scope for improvement unless there is a failure and lessons are learned from it and will be only a matter of time, when all the weaknesses in the individual component align, leading to system failure (Reason, 1990). Due to its varied influences, it will be difficult to say that a system has reached a statistically stable state and can go on performing with minimum interventions. It can be said that the desired safety outcomes are achieved only by improving the reliability of individual system elements as well as the overall safety culture. This will require improving individual competencies and perceptions and collectively working towards an interdependent and adaptive system with a focus on continuous improvement. However, as seen from the study findings safety performance may not solely rely on management systems and safety culture. There could be many other variables which cannot be configured into the management system and relied upon, as some of them could be external to the organisation and larger individual psycho-social factors.

There is a need for a holistic approach and focus on the various interconnected system elements, which works unit. Instead of focusing on individual components, it is important to look at its influences and interactions on the overall system. Therefore, a robust and high capacity safety management system alone will not provide direct solutions to safety problems on site. It is critical that a more conducive ecosystem be created for any human-made

systems to originate, grow and sustain. Availability of resources and user-friendly technology is critical in such ecosystems. In other words, a safe workplace must exist, and safety shall be integrated into all decisions made by the company leadership including the decision to bid for the project. The system that will take shape will entirely depend on the leadership and the context of the project/business. Instead of a set of prescriptive rules in the management system, the system must have a risk-based approach.

It would be prudent to say that the management system and safety culture are two different properties of a high performing organization. A reliable system can be unsafe, and a safe system can be unreliable. Reliability is improved if it is designed, developed and deployed by all the stakeholders who are responsible for implementing it. Having a management system oriented towards the specific need of the project will provide the required tool to practice and implement safety programs in the workplace. This enables maturing the organisation from a supervisory rule-based safety culture to a self-conscious and interdependent team culture, where there is a cohesive perception about safety and takes more ownership of own safety as well as of others. However, a functional safety management system is not just a pile of documents or just another initiative from the higher management. It requires the involvement of all stakeholders at every stage of its conceptualisation, development, and implementation though, the commitment, competence, and coordination among the stakeholder are critical to its success.

Another theory that emerges from the findings is using loss statistics as a performance measurement criterion. The results of the study suggest that the outcomes of the system need not be always due to the robustness of the system that's been employed and not merely be by chance. From the data in this study, the reactive indicators could be seen improving, despite the proactive indicators declining and hence could say that the actual performance is determined by factors not limited by the systems employed. Therefore, though there exists a good correlation, a cause and effect relationship cannot be established between system and culture. However, only by measuring the specific system inputs one can be confident to some degree about the safety maturity of the organisation.

An analogy could be drawn about a well performing sophisticated piece of equipment, which is consistently operating well without any glitches. However, this does not guarantee that it will continue to operate well in the future unless there a regular inspection and maintenance are undertaken. Notwithstanding that, the people who are involved in the whole life cycle of that piece of equipment must be aware, competent and have the right attitude towards the use and maintenance of it. Every individual involved in the life cycle of that piece of equipment is critical to its success. This concept is very much relevant to management systems, as we discovered from the findings.

6.1.2 Practical Contributions of the Study

From the findings of this study, UAE construction companies will be able to understand that Safety management is not different from any other management activity and needs to be valued equally. It requires challenging visions and goals to pursue and committed leadership to set the ball rolling and sustain it. The management's intent is therefore critical, based on which the rest of the system gets built (Bird & Germain, 1985). The study will help companies understand the need for focusing on improving and aligning the safety management system in line with expectations of all the stakeholders. A cross-functional team must be entrusted in revising the management system with more active participation from the employees. It is said that an organisation's safety is a lot like the weather (Guldenmund, 2007). It is omnipresent in the organisation and surrounds everybody and dictates the mood and affects the performance. It is also said that everybody talks about the weather but cannot do anything about it. Safety culture is similar- it is easy to talk about it but difficult to influence. However, unlike the weather, it is not impossible to change the safety culture as they are a manifestation of human actions and perceptions.

The study helps the construction companies in UAE to understand the need for a careful selection of a management system model that suits their specific project requirement. The need for having a formal approach to demonstrate visible leadership, management commitment, and employee engagement is

highlighted. This study helps the organisation to have better clarity on the concept and dynamics of safety culture change and its relevance to the management system. Effecting cultural change is not easy and an instant process. It requires persistent and patient efforts by everyone in the organisation, especially the senior management as they say that it is easy to roll a stone down that to roll it up. To bring in safety culture change, the first step is to understand the present level of perceptions within the organisation. By focusing on and improving the eight key factors listed in this study and other studies will help in making a decisive difference in the safety culture of any organisation.

From the findings in this study and as identified in some of the past literature, organizations will be able to acknowledge that a formal safety management system alone cannot determine the safety maturity of the organisation. The broader cultural and behavioral factors influence it. However, having a robust management system in place will provide the required tool to practice and implement safety programs in the workplace, thereby slowly maturing the organisation from a supervisory rule-based safety culture to a self-conscious and interdependent team culture, where every individual similarly perceives safety is taking care of themselves and others (DuPont, 1991). However, good safety management is not just a set of documents or just another initiative from the head office. It requires the involvement of all stakeholders at every stage of its conceptualisation, development, and implementation. The commitment, competence, and coordination among the stakeholder are critical for its success.

6.2: Recommendations

Though this study finding could not establish a cause-and-effect relationship between safety culture and management system, it has highlighted the influences of both on each other. Validating with the past researches on the topic, it could be fairly judged that a robust and reliable system is one of the important components to building safety culture for an organisation. To assist

the management in improving the safety culture and practices in UAE construction companies, the following recommendations are provided.

Selecting a Management System Model

Like all management systems, health and safety also have a few management system models available to adapt. Typical of which is OHSAS 18001, published by International Standards Organization (ISO) and is purely voluntary to adopt. The challenge with a ready to use blueprint is that there will be more bureaucracy and documentation that burdens the user. Better safety culture is typically misunderstood as more paperwork, which is incorrect. The management system framework focus must be in the context of the organisation which essentially means that the system shall be built based on the project environment and the need of all the stakeholders involved. Two projects could have completely different looking systems while the fundamental principles of the 'PDCA' do not change.

Other fundamental focus areas are to reinforce workforce engagement and management commitment further. These have been discussed as a requirement under OHSAS 18001, but ISO 45001 gives more importance to it.

Use of Technology

Once a management system frame is conceived and adopted, with all the processes studied, documented and rolled out, the most time-consuming phase is over and now, to keep the system live and moving. Critical safety activities happen during the operational stage which is not limited to monitoring and reporting, but also actively providing solutions to problems and to continuously improving the system. By using technology in this area, it can be argued that more than 50% of the time can be saved. This saved time can then be further invested in behavioral change and motivational programs. Which will, in turn, give rise to a much productive workforce and a positive feedback loop is evolved, one benefit triggering the other.

Technological solutions like online reporting and training are much user-friendly at present times than in the past. This will help in a faster and a real-time reporting to quick and easy escalations for safety improvements. As identified from the current study, some of the managers are concerned with the way the performance data are presented and communicated. The technology can solve this problem with having an interface where the user could explore the data in whatever different ways that appeal to them to make a complete sense of it.

Safety Leadership

As evident from the current study result, there is a disconnect between the perception of safety leadership and the safety management system. All the previous literature has also outlined the need for a demonstrated leadership to attain a positive safety culture. Therefore, it is necessary to expand the safety management system to safety leadership at all levels. The challenge is on how to visibly demonstrate the leadership which cannot be limited to 'walk-throughs', which is a good indicator as is evident from the current study. A management walk that ends with no follow-up and actions would be a waste of time, and this is where technology can assist. An online reporting by the leadership of the project at an agreed timeframe and frequency will help the managers themselves to be on top of safety affairs. It will encourage and help them to objectively look at the safety performance in their areas of responsibility. It helps to reduce the time wasted in the walk by clearly understanding the areas to focus and solutions required.

Like the way the social media has broadened our daily interactions in our social life, the technologies on safety reporting will expand the leaders and managers interactions within their ecosystem. Live video streaming of safety walk-throughs, campaigns and final team chats can help in making safety communications more exciting and productive. The system should have an agreed, documented process of performance appraisal of employees in leadership roles where completed safety activities shall be a key criterion.

Employee Engagement

The most significant challenge in achieving a continuously evolving organic safety management system and technology is the people themselves, who are expected to drive them throughout its life cycle. People being a social entity, requires active engagement through proper communication routes and demonstrated leadership.

Engaging people and empowering them will always be the most critical aspect of a safety management system. Shifting the focus of management from 'controlling' to 'empowering' should be considered. As an organisation is a social entity, with lots of unique formal and informal group actively 'affecting' each other within and off work, encouraging and motivating people to behave safely needs to be always the top of agenda for management. From the current study, it can be concluded that the engagement of employees and management commitment are two key factors that promote a thriving safety culture. One of the ways in which the employee engagement can be improved is to have a formal behavioral based management program, and such a program need also be developed and driven by the same people who are being targeted. The HSE department could track, monitor and give people some points for their demonstrated safe behaviors, and bring them up in the company's safety leader board.

Reporting System

It has always been a challenge to deal with the massive safety data collected every day and recording them for further communication. It is critical that key issues do not get hidden under 'not-so-critical' issues due to the poor presentation and communication of data. It is unproductive to force people to read lengthy memos and safety inspection reports as it risks the inattention to details by the stakeholders. Therefore, it is essential that safety information and reports must be made more exciting and engaging for people. This is where technology can help.

Technology like online and real-time reporting applications can help the communication processes to improve. What's more interesting about technology is that it will help in 'standardising' and improve consistency. Combined with an administrator and user control interfaces, the process can be 'sustained' and changes can be adequately managed. This is more relevant for a construction business from a corporate leadership perspective, as it would be challenging for the head office to keep a track and to monitor the performance and device meaningful solutions if the reporting and data communication is decentralised and not shared.

Improving Safety Perceptions & Attitudes

The traditional method of improving attitudes is through various training activities. However, this could be a challenge in a construction environment as time and resources are a significant constraint. This is where online training helps, where the training matrix developed based on the competency requirements of the role being handled is converted in various lesson plans which are progressively and continuously mandated for every individual to undergo and complete. Each course may be restricted to 15 to 20 mins maximum with visual presentations. Irrespective of the level of employees, it must be mandated. For construction crews, hard skill training could be focused and for anyone with supervision role must have soft skill training too. Depending on the duration and scale of the project, the programs could be customised. An active administrator will be required, which HSE department is ideally able to offer. An inventory of trained and competent employees must be made available on the company intranet and management could consider facilitating inter-department/project mobility. This could be efficiently achieved by having a competency management system integrated with the HSE Management System.

Improved Safety Attitude by Role Play

There is ample evidence about line management's influence on the health and safety behaviors of the crews working under them. Often on a construction site, there are significant numbers of line management staffs (chargehand, foreman,

supervisor, site engineer, etc.) who are often limited to construction activities. HSE staffs undertake all the associated safety activities by having a mechanism in which every month, line management staff could be deputed to the HSE department, reporting to HSE Manager and perform safety activities such as inspections, audits, inductions, samplings, and surveys. This will enhance their safety perceptions and attitudes by consistently practicing, observing and correcting safety issues themselves. Even if one-line management staff could be rotated/deputed to perform safety functions in a year, a total of twelve competent people would emerge, which would then directly influence the workers under them.

Performance Measurement

As observed from the current study and recorded in some of the previous literature, most of the management look for solutions to a problem after it has occurred. Management reviews mostly restrict themselves to the analysis of previous incident and loss statistics. However, this study has evidenced that measuring successes of the system inputs and processes contribute positively by reducing the losses to the company. The KPIs set to start at the corporate level must amply include all leading indicators and give less stress to lagging indicators. However, the critical challenge here is to manage the enormous database, which is often subjected to human error.

Use of mobile and desktop applications to measure performance continuously and in real-time before something goes wrong seems critical to ensure that the objectivity and focuses are maintained. Further, having just the raw data in numbers does not add any value to the business either. It is all about analysing the data and interpreting them for useful solutions for improvement. A formal integrated ‘performance management system’, considering all the management activity at the input and the process stages of the various system activities are essential in measuring the performance successfully. As explained above, this could be a data-intensive and laborious process which consumes a significant management time. The problem can be solved by using technology to our

advantage, which helps in automatic analysis and, to some extent, eases the interpretation of the result.

However, as discussed in the introduction of the report, there is a limit to technology in improving safety issues. It is heavily reliant on the people who are driving the system. Their engagement, competence, and commitment are essential for its success. Therefore, companies must focus a lot on training employees in using these systems and use of technologies. Following the analogy of the bath-tub curve in discussion hardware failures, the same could apply in a management system as well. A lot of care and leadership should be invested in the 'early stages' to avoid the 'early failures', and the effort needs to be consistent by close supervision and management to help the system sustain and extend its useful life. During this stage, it will be important to have timely reviews and change management to be put in place and prevent the total failure of the system.

Legislative changes

The UAE regulatory bodies require focusing on bringing in more comprehensive legislation covering all the emirates of the country which will address specific day-to-day construction hazards. Regulations must consider prescriptive requirements to have a management system specifically designed for the construction industry. Enforcement must extend to the local authorities with inspectors appointed who have sufficient competency and authority to initiate actions. There is also a need to have clear criminal and other punitive laws for violating companies, and this information requires to be well communicated to all the licensed entities operating in the country.

6.3: Way Forward

This study was focused and limited to the aims and objectives set out in Chapter 1 of this report, and therefore, it does not explore all the influences on Safety maturity of an organisation. This study was also limited to the construction

industry in UAE and therefore do not capture the broader influence of the country across all the businesses. The findings from this study open doors to more research on safety culture, particularly establishing specific influences on individual factors that have been discussed within it.

One area of future study would be the influence of local 'job culture', where there is an interaction of people, hardware and the procedures on the overall safety culture. The study shall extend its scope to measuring group perceptions along with individual perceptions to validate the influences. Almost all companies have crews who work in a group, and seldom alone. Therefore, the group perception could have a much more significant influence than the individual perception.

In developed and developing nations the governments are continuously implementing safety procedures and guidelines to be followed by construction companies and organisations across the world are implementing the governmental regulations and strictly executing safety standards leading to safety culture and system. This study has documented the weakness of UAE construction sector in developing, implementing and measuring an effective safety management system. All stakeholders including the regulatory authorities, local authorities, and senior management of the organization should be involved in the implementation process. Accordingly researching by widening the scope of this study with the involvement of regulatory bodies can be considered which can complement the findings of this report. This study had limitations regarding the sample size which was limited to just six active construction projects in UAE. Expanding the case study across all the emirates including other non-construction industries will help in reinforcing the findings discussed in this study. This study can be further widened by focusing on other influences on safety culture like 'personal' and larger 'societal' and 'environmental' factors. A specifically focused study on legislative influences on local safety culture and practices could also be carried out, to explore how they shape individual organisation's cultures. This study can further be extended by comparing the legislation and practices with other gulf countries.

Finally, this study provides some insights into the limitations of using a quantitative method to establish cause and effect relationship between factors which are more subjective and multi-dimensional. Future researches must explore the possibility of finding a comprehensive tool to measure all aspects of safety on the overall business performance, covering quality, production, financial performance and business sustainability of organizations.

Chapter 7: References

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APPENDIX A: Survey Questionnaire

Demographic Data (Must)						Information
Gender	Male		**Organization Level**	Sr. Mgmt		1. Please do not enter your name anywhere on the survey. 2. Please complete the demographic details. This is designed to provide key data only and cannot be traced back to any individual. 3. After completing the survey, please return it to your HSE Manager or Govindan Pradeep Nair (pnair.ehs@gmail.com) by 21/10/2017. Thank you.
	Female			Line Mgmt		
Age Group	18-35			Manager		
	36-50			Admin/Support		
	>50			Crew		
Language Skills	English		**Trade**	Skilled		
	Hindi/Urdu			Unskilled		
	Arabic		**Ethnicity**	UAE National		
	Others			Arabs		
Overall Experience	<10 years			Westerner		
	11-20 years			South Asian		
	>20 years			Others		

No	Factors	S.Agree	Agree	Neutral	Disagree	S.Disagree
Organisational Leadership						
1	Senior managers set self-example by and demonstrate right safety attitude.					

2	Safe practices are actively promoted by senior managers consistently throughout the organization.					
3	Senior managers provide adequate resources					
4	Senior managers include safety consideration in their decision making.					
5	Senior managers attend safety meetings/briefings.					
Management Commitment and Involvement						
6	All safety critical activity has direct involvement of line managers.					
7	Safety seminars, talks and training have involvement of line managers.					
8	The safety risks in my job are well understood by my manager					
9	Safety issues are regularly explained to me by my manager					
10	My manager has a positive attitude towards safety.					
Employee Empowerment						
11	I understand my role in improving the safety of my job					
12	I am allowed to take decisions on safety.					
13	I can introduce safety improvements to my job.					
14	My job safety is my responsibility					

15	I am proud of my company's safety performance.					
Reward System						
16	Good safety behaviour is rewarded and appreciated by management.					
17	Unsafe employees are punished for their behaviour.					
18	Company has a formal procedure to measure employee safety behaviours.					
19	Management is consistent in the evaluation of safe and unsafe behaviours.					
20	Management is consistent in rewarding and punishing safe and unsafe behaviours.					
Reporting System						
21	Company promotes free and open reporting of safety observations.					
22	We have a written reporting system which is implemented.					
23	I am free to report any good or bad issues related to safety.					
24	Company promotes learning from incidents, and unsafe observations reported.					
25	I am given feedback on safety issues reported by me.					
Risk Taking and Risk Perception						
26	I will not start my job without understanding the risks.					

27	I can stop others who are behaving unsafely.					
28	I understand the hazards'/risks involved in my job.					
29	I am capable of preventing risks in my job.					
30	Company do not permit anyone to take risks to finish the job.					
Mutual Trust						
31	Trusting each other is very important to work together.					
32	I can freely discuss any issues with my line manager.					
33	My supervisor is very fair with me when I report a safety issue or an incident.					
34	Departments exchange information on safety freely among them.					
35	We need to improve trust between employees and supervisors.					
Legal Environment						
36	I understand my legal responsibilities related to Health and Safety at Work					
37	Management has no tolerance on legal violations.					
38	Local authority inspectors come to site for visit and advice.					
39	I will be personally prosecuted by legal authorities for safety violations.					

40	It is easy to understand and implement the technical requirements/safety codes in the regulations					
Compensation Environment						
41	I am aware of my entitled compensation for workplace injuries					
42	Injured employees are paid compensation as per the existing laws					
43	I am aware of the process of claiming compensation for my injuries/ill-health due to work					
44	I am satisfied with my employer's commitment towards injury/ill-health compensation					
45	Insurance companies are very strict and influence HSE improvements in the company.					
Management System						
1	Our director has provided a framework for setting and reviewing OHS objectives, and they are communicated throughout the organization.					
2	Our Management System provides the necessary tools to understand all the stakeholder's requirements and help us objectively measure the performance and consistently improve.					
3	We have a committed and formal program to report issues and reward employees for improvement suggestions.					
4	We have a cross-functional team involving all stakeholders including employees for developing control procedures.					
5	Our risk control programs and procedures are easy to use and identify our HSE responsibilities and accountabilities.					

APPENDIX B: Interview Questionnaire

	Questions	Explored Factors
Q1	**What is the company's vision/mission statement/policy that addresses safety? Where is that statement/policy located? What goals does that statement/policy specify?**	**Leadership, Management Commitment, Communication**
A	Signed and updated by company chairman. Sets objectives for all levels of manager's employs. Expresses commitment to comply with all legal requirements and needs of stakeholders. It is posted in all common areas and is included in the HSE MS documents.	Org leadership mean = 3.85 highest Management commitment mean = 3.90 highest Reporting system = 3.75 highest
B	Project safety policy is signed by the Project Manager and expresses a commitment to comply with all legal and contractual requirements. It says everyone is responsible for his or her own safety.	**Coy B** Org leadership mean = 3.33 lowest Management commitment mean = 3.59 mediocre Reporting system = 3.35 mediocre **Coy C** Org leadership mean = 3.40 Management commitment mean = 3.480 lowest Reporting system = 3.19 lowest **Coy D** Org leadership mean = 3.80 Management commitment mean = 3.54 mediocre Reporting system = 3.19 lowest
C	HSE policy signed by the project manager and communicated through displaying it in notice boards. The policy is committed to a zero tolerance for safety violations.	
D	Project safety policy signed by the project manager. HSE department drives the policy by developing plans and monitor implementation. Displayed on notice boards. Note:- mean score indicate the degree of implementation	
Q2	**In your experience, how well do the managers at this site communicate in a clear way that safety is a high priority? Please provide an example of effective communication. Did it change anything about how you think about your work or how you do it? If so, what changed?**	**Communication/Mutual Trust**

A	Managers take part in site level coordination meetings. Set self-example by complying to rules. Participate in tools box talks. All meetings start with a safety moment. Jobs safety observations are made, and corrections are made on site. Job safety analysis is done by the involvement of the local safety committees.	Reporting system = mean = 3.75 highest Mutual trust mean = 3.84 highest
B,C,D	Daily tools box talks are conducted by the supervisors and monitored by the HSE team. Monthly safety meetings are attended by Project Manager. Managers talk to employees when they are found violating safety rules.	**Coy B** Reporting system = 3.35 mediocre Mutual trust mean = 3.41 mediocre **Coy C** Reporting system = 3.19 lowest Mutual trust mean = 3.11 lowest **Coy D** Reporting system = 3.19 lowest Mutual trust mean = 3.07 lowest
Q3	**How is the safety performance measured in your company? What are your main concerns and how do you think you can improve it?**	**Management System, Management Commitment**
A	We perform internal and external health and safety audits to check laid down management and are based on the output records. An annual HSE perception survey is carried out by the corporate head office to measure the attitudes and practices.	Management commitment mean = 3.90 highest Management system mean = 3.89 mediocre
B	HSE department identifies the key performance indicators such as Lost time injuries, property damages, first aid cases etc., and record them and continuously improve.	**Coy B** Management commitment mean = 3.59 mediocre Management system mean = 3.92 highest
C,D	There is an increased emphasis on environmental compliance. HSE department does the audits and inspections. Concerned about not consulting others in setting performance goal. Holding people accountable for non-compliance is a concern. More focus on individual targets that group/company targets.	**Coy C** Management commitment mean = 3.480 mediocre Management system mean = 3.71 lowest **Coy D**

		Management commitment mean = 3.54 mediocre Management system mean = 3.86mediocre
Q4	**Do you get timely information about the safety issues from your supervisor? What do you think can be improved related to reporting of safety concerns? Please describe.**	**Mutual Trust, Management Commitment**
B,D	HSE department submits a monthly report and highlights the issues and problems. Supervisors report to the HSE department, and they drive the system. An on-time reporting system could improve transparency. Maybe, everyone could be involved in safety reporting.	**Coy B** Management commitment mean = 3.59 highest Mutual trust mean = 3.41 highest **Coy D** Management commitment mean = 3.54 lowest Mutual trust mean = 3.07 lowest
Q5	**Do people on site have authority to stop work? If you did stop work, what kind of reactions did you receive from co-workers? your immediate supervisor/manager? higher-level management, if they became involved?**	**Employee empowerment, Management commitment, Management System**
A	Red card system to stop work. Everyone is empowered to use it. Senior management seldom reattributes for stopping work. Annual review meeting does a trend analysis of the stop works and the actions initiated.	Management commitment mean = 3.90 highest Management system mean = 3.89 mediocre Employees empowerment mean = 4.0 highest
C,D	HSE department is authorized to stop all unsafe activities and report to the management. Management discusses with the project team and takes action.	**Coy C** Management commitment mean = 3.480 lowest Management system mean = 3.71 lowest Employees empowerment mean = 3.4 mediocre **Coy D** Management commitment mean = 3.480 lowest Management system mean = 3.86 mediocre Employees empowerment mean =2.8 lowest
Q6	**In terms of safety, what is your personal approach to your own work? Who do you look to for guidance on safety issues?**	**Management System, Risk Perception**

A	I believe all accidents can be prevented by pre-empting the causes and putting control measures. If in doubt about a situation, I refer the company codes of practices and seek advises from the HSE experts.	Coy A Management system mean = 3.89 mediocre Risk perception mean = 3.85 highest **Coy C** Management system mean = 3.71 lowest Risk perception mean = 3.22 mediocre **Coy D** Management system mean = 3.86 mediocre Risk perception mean = 3.15 lowest
B,C,D	Accidents are unfortunate events. There is always a risk element in work. Ensure that all work proceeds only with strong supervision. For guidance, the standards and local codes can be referred to.	
Q7	**Is it communicated to personnel which procedures require verbatim compliance, as a minimum? Are such procedures followed? If not, please explain.**	**Management System, Communication**
A	The field documents such as method statements and job safety analysis are mandatory to comply as a minimum. Any changes required undergoes a change management procedure and re-assessment is done before updating the MS.	Coy A Management system mean = 3.89 highest Reporting system = mean = 3.75 highest
B	Contractual documents and method statements are developed and complied. Non-compliances are raised by a quality control team and accordingly the method is changed.	**Coy B** Management system mean = 3.92 highest Reporting system = 3.35 lowest
Q8	**How do you actively encourage your employees to bring concerns to you? Give examples (e.g. reward/incentive programs; communications).**	**Reporting and reward systems, Employee empowerment**
A	People at all levels are involved in safety and take responsibility for safety, such that there is a rich communication concerning safety issues. Employees are encouraged to make verbal reports, as well as observation cards, are made available on site which can be filled and submitted. A monthly award on good reporting is given department and work group-wise. Feedback is given to the employee/workgroup on the actions taken or not taken with justification	Coy A Employees empowerment mean = 4.0 highest Reporting system = mean = 3.75 highest Reward system mean = 3.76 highest

B,C,D	All workers are encouraged to report to their supervisor or safety officer on any issues they encounter related to safety. If actions are not taken, then it is escalated to the project manager level.	**Coy B** Employees empowerment mean = 3.20 mediocre Reporting system = 3.35 mediocre Reward system mean = 3.22 mediocre **Coy C** Employees empowerment mean = 3.4 mediocre Reporting system = 3.19 lowest Reward system mean = 3.09 lowest **Coy D** Employees empowerment mean = 2.8 lowest Reporting system = 3.19 lowest Reward system mean = 3.14 lowest
Q9	**Is there a formal process that enables staff to raise health and safety or welfare issues with senior management? Describe.**	**Reporting System, Communication/Mutual trust**
A	All sites have observation/near miss reporting stations, which can be used by all employees as well as third parties. Any actions not resolved, can be brought to the field safety committees and then further escalated to the project management committee. A monthly tracker tracks all the issues raised, and action is taken, and the corporate HSE department intervenes if required.	Coy A Reporting system = mean = 3.75 Mutual trust mean = 3.84
Q10	**What do you take into consideration when making a decision on whether a situation is safe (in terms of safety) to continue operation? What about your supervisor? Your management?**	**Management System, Risk Perception**
A	There are work specific risk assessments and job analysis done by the project team and monitored by the HSE department. The workers are consulted for their feedback, and the information is then used to develop a specific method statement which is approved by the Construction manager and then communicated to all involved in the work. Supervisors lead the implementation and monitoring.	Coy A Management system mean = 3.89 mediocre Risk perception mean = 3.85 highest

B,C,D	A method statement is developed by the construction team and the risk assessment done by the safety department. A method statement is reviewed and approved by the project manager. Tools box talks are given to all employees before starting the work.	**Coy B** Management system mean = 3.92 highest Risk perception mean = 3.40 mediocre **Coy C** Management system mean = 3.71 lowest Risk perception mean = 3.22 mediocre **Coy D** Management system mean = 3.86 mediocre Risk perception mean = 3.15 lowest
Q11	**How do you view the manager's role in managing safety in your project? What do you think is critical about management leadership to improve safety?**	**Management commitment, Risk perception, Employee empowerment**
A	Irrespective of senior management right attitude and motivations to safety, but their efforts are sometimes muddled by middle managers and supervisors on the site. Therefore, the line management must be made more competent and influence the worker's safe behaviours.	Employees empowerment mean = 4.0 highest Management commitment mean = 3.90 highest Risk perception mean = 3.85 highest
B	Managers must be trained and competent in safety aspects, and they must visit sites and monitor the activities. Take strict actions to rectify an unsafe situation.	**Coy B** Employees empowerment mean = 3.20 mediocre Management commitment mean = 3.59 mediocre Risk perception mean = 3.40 mediocre **Coy C** Management commitment mean = 3.480 mediocre Risk perception mean = 3.22 mediocre Employees empowerment mean = 3.4 mediocre **Coy D** Management commitment mean = 3.54 mediocre Risk perception mean = 3.15 lowest
C,D	Management must be involved in all health and safety activities, and give full support to the HSE team to deliver their roles.	

		Employees empowerment mean = 2.8 lowest
Q12	**What key challenges are faced by your organization with respect to management commitment and employee consultation and involvement?**	**Management commitment, employee empowerment**
B,C	Top management do want safety to be a key element within the company, but there are always barriers between senior managers and workers, these barriers are created by middle managers being resistant to change. Middle managers may hear safety rhetoric from senior management but are confronted daily with other, often stronger messages of cost-cutting, downsizing and productivity levels, which makes it quite difficult for them to implement safety culture elements within the organization.	**Coy B** Employees empowerment mean = 3.20 mediocre Management commitment mean = 3.59 mediocre Risk perception mean = 3.40 mediocre **Coy C** Management commitment mean = 3.480 mediocre Risk perception mean = 3.22 mediocre Employees empowerment mean = 3.4 mediocre
A	We make sure that senior managers spend adequate time alongside safety officers on safety issues with front-line employees. As a project progresses, project managers spend at least one hour per day. First line managers spend 30% of their time and senior executive usually schedule at least an hour per week for concentrating on safety with employees.	Employees empowerment mean = 4.0 highest Management commitment mean = 3.90 highest Risk perception mean = 3.85 highest
D	Listening to one's employees is a form of true management leadership and commitment. The role of management to provide a safe workplace should not exist in a vacuum.	**Coy D** Management commitment mean = 3.54 mediocre Risk perception mean = 3.15 lowest Employees empowerment mean = 2.8 lowest
Q13	**Do you read relevant HSE information? What about external information? How often? Is the information provided to you in a timely manner? Is it useful? Is it accessible?**	**Management system, legal environment**

A	Company planning activities starts much prior to project mobilization and a requirement register is developed which identifies all the required H&S compliances and standards to follow. The project specific safety plan identifies and tracks all such external information continuously. As there are no clear H&S prescriptive laws available, all the standards and information are derived from the corporate manuals and standards complied. To some extent, the contractual document specifies the standards and requirement that needs to follow.	Coy A Management system mean = 3.89 mediocre Legal environment mean = 3.03 lowest
C	All information required is provided by the client and consultant, and if there is anything missing, a request for information process is initiated as per the contractual norms.	**Coy C** Management system mean = 3.71 lowest Legal environment mean = 3.60 highest
Q14	**How does the site management/supervisor promote good safety practices? Can you give some practical example?**	**Employee empowerment, management commitment, communication**
A	Here supervisors and worker safety representatives are fully aware of their responsibility for safety. Supervisors and worker representatives react swiftly and act resolutely. The safety representative has the mandate to act. The supervisor follows up to ensure that safety measures have actually been implemented. The supervisor plays an important role in developing a good safety culture that permeates all levels. In organizing the site, there is a centrally placed person with generic responsibility for safety and to whom anyone can turn, since such a person can bridge the organisational divisions between different work teams.	Employees empowerment mean = 4.0 highest Management commitment mean = 3.90 highest Reporting system = mean = 3.75 highest
Q15	**How does the Health and Safety professionals in your company assist and support in improving the safety on site? How confident is the management on their involvement and inputs?**	**Management commitment, leadership**
A	Health and safety professionals spend most times of the day communicating by emails, telephone, writing instructions and responding to technical and not so technical queries from employees and other colleagues. This approach is always required and should	Management commitment mean = 3.90 highest Org leadership mean = 3.85 highest

	be backed up by informal talks and discussions on site by front-line supervisors and managers in a manner that encourages front-line employees to speak up on safety matters without waiting for their safety officers. In doing this, we receive a lot of information on other risks that may not be channelled or identified through pre-planned risk assessments.	
Q16	**How do you ensure that unsafe conditions and incidents are recorded and reported appropriately? Are there any formal means to assist this process.**	**The reporting system, employee empowerment**
A	Our supervisors and managers listen and act on concerns of employees; in this case, people contribute more efficiently in this environment that provides a framework for consultation and communication and creates conditions where individuals are encouraged and prepared to report hazards, near misses and incidents.	Employees empowerment mean = 4.0 highest Reporting system = mean = 3.75 highest
Q17	**How do you respond to incidents and unsafe actions and conditions on site? How do you make sure that it is corrected and not repeated again?**	**The reporting system, communication, management commitment, employee empowerment**
A	No one individual is blamed when near misses or minor accidents occur. We encourage everyone to report incidents without the fear of retribution. All incidents minor or major are investigated depends on the depth and level required. Corrective and preventive actions are communicated, implemented and monitored. The corporate HSE department kept a track of all the management failure and addressed them at the corporate level.	Employees empowerment mean = 4.0 highest Management commitment mean = 3.90 highest Reporting system = mean = 3.75 highest
C	Major incidents are investigated by the HSE department, and the actions to fix the problem is reviewed by the project manager and is implemented in the project. HSE department is given the full authority to suspend/stop the work and initiate disciplinary actions to individuals who violate safety rules.	Employees empowerment mean = 3.4 mediocre Management commitment mean = 3.480 mediocre Reporting system = 3.19 lowest

Q18	**How do you ensure that the employees have the right safety perceptions and skills to perform their activities safety? What process do you follow?**	**Employee empowerment, management commitment**
B,C,D	Our employees are given safety training periodically, and as new hazards arise from technology and projects, this has helped to maintain safe working systems across our sites and projects.	**Coy B** Employees empowerment mean = 3.20 mediocre Management commitment mean = 3.59 mediocre **Coy C** Management commitment mean = 3.480 mediocre Employees empowerment mean = 3.4 mediocre **Coy D** Management commitment mean = 3.54 mediocre Employees empowerment mean = 2.8 lowest
A	A training needs analysis is done based on the responsibility matrix, and accordingly, a schedule of training are drawn and budgets and resources identified as part of the planning for the project. HSE Management system procedures identify the process of competency development and each safe operating procedures identify the different process owners and their specific training needs, both hard skill and soft skills. For safety-critical task, an authorization card is issued after the mandatory training are attended by the individuals	**Coy A** Employees empowerment mean = 4.0 highest Management commitment mean = 3.90 highest
Q19	**While establishing and deciding the budget for safety intervention/modifications what are the information/factors that will be considered? How would you assess the cost of the interventions, the benefit and payback period?**	**Management system, leadership, Insurance environment**
A	The exercise of budgeting is driven by the corporate HSE department taking into consideration all previous experience in	Org leadership mean = 3.85 highest Management system mean = 3.89 mediocre

	terms of losses incurred, the kind of insurances required, the risk levels, the legal standards to achieve, the safety resources required. The specific safety precautions are budgeted as an operational cost, while the cost of HSE staffs, training, campaigns; third-party inspections and audits are all costed as HSE expense.	Compensation environment mean = 3.65 highest
D	A separate budget is allocated as a percentage of the contract value, and the budget owner is the project manager, who consults his team to allocate and expend the budget.	**Coy D** Management system mean = 3.86 mediocre Org leadership mean = 3.30 lowest Compensation environment mean = 3.14 mediocre
B,C	HSE department prepares the budget, and the project manager approves it. All costs involved in HSE activities are tracked and measured.	**Coy B** Management system mean = 3.92 lowest Org leadership mean = 3.33 lowest Compensation environment mean = 3.23 mediocre **Coy C** Management system mean = 3.71 mediocre Org leadership mean = 3.40 mediocre Compensation environment mean = 3.06 lowest

APPENDIX C : Leading and Lagging Indicators

SN	KPIs	2015-2016				2014-2015				2013-2014			
		Coy A	Coy B	Coy C	Coy D	Coy A	Coy B	Coy C	Coy D	Coy A	Coy B	Coy C	Coy D
Lagging Indicators													
1	Lost Time Injury (FR)	0.00	0.25	0.09	0.45	0.00	0.32	0.24	0.18	0.22	0.30	0.19	0.16
2	Medical Treatment (FR)	0.09	0.50	0.64	0.56	0.20	0.47	0.47	0.36	0.32	0.51	0.37	0.32
3	First Aid Cases (FR)	1.12	2.09	1.37	2.24	1.47	1.74	2.01	1.08	1.62	2.54	1.94	1.59
4	Near Misses (FR)	2.99	0.34	0.18	0.00	3.52	0.55	0.47	0.18	3.02	0.51	0.00	0.00
5	Property Damages (FR)	0.00	0.17	0.09	0.11	0.00	0.24	0.59	0.45	0.00	0.71	0.28	0.16
6	Work Stoppage (FR)	0.00	0.00	0.18	0.11	0.00	0.32	0.47	0.27	0.11	0.51	0.19	0.16
7	Legal Notices (FR)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leading Indicators													
1	HSE Training (FR)	71.0	16.7	20.1	16.7	80.2	16.5	17.7	16.2	80.8	15.2	11.1	11.9
2	HSE Inspection (FR)	38.4	24.2	23.8	31.3	40.1	23.8	36.6	27.0	37.7	26.3	25.0	19.9
3	HSE Audit (FR)	1.12	0.25	0.37	0.11	1.17	0.24	0.47	0.18	1.29	0.41	0.09	0.16
4	HSE Meeting (FR)	35.1	4.02	4.40	5.37	36.7	3.79	5.67	4.32	40.5	4.87	4.44	3.83
5	HSE MS Review (FR)	0.19	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.22	0.00	0.00	0.00
6	Management HSE Walkthrough (FR)	5.61	3.02	2.75	2.68	6.06	3.16	4.26	1.80	6.47	4.26	3.33	2.07
7	HSE Campaign/Promotions (FR)	0.75	0.08	0.09	0.11	0.98	0.08	0.12	0.09	0.86	0.10	0.09	0.08
8	Task Risk Assessment (FR)	48.5	16.7	22.8	16.7	59.6	19.7	21.2	10.8	60.3	18.2	18.5	7.97
9	HSE Suggestions (FR)	3.08	0.00	0.00	0.00	1.66	0.00	0.00	0.00	1.08	0.00	0.00	0.00
10	Health Surveillance (FR)	1.49	0.08	0.00	0.00	1.37	0.08	0.12	0.09	1.29	0.00	0.00	0.00

**Frequency Rates (FR) = (No of KPIs x 1,000,000) / Total Manhours Worked (year)*

APPENDIX D: Interview Responses and Explored Factors

SN	Assessment Factor	Explored/Identified Attributes			
		Company A (Benchmark)	**Company B**	**Company C**	**Company D**
1	Organisational Commitment	• Organisational Commitment • Legal Environment • Compensation Environment • Mutual Trust • Continuous Improvement • Formal Management System • Employee Empowerment	• Legal Environment • Top Down Communication • Resourcing and Budgeting • Continuous Improvement • Organisational Commitment	• Legal Compliance • Top Down Communication • Continuous Improvement • Organisational Commitment • Management Commitment	• Legal Compliance • Top Down Communication • Continuous Improvement • Organisational Commitment • Management Commitment
2	Management Commitment and Involvement	• Management Commitment & Involvement • Mutual Trust • Organisational Commitment • Competency & Supervision • Risk Perception and Risk Taking • Formal Management System • Reward System	• Management Commitment & Involvement • Mutual Trust • Risk Perception & Risk Taking • Reward System	• Management Commitment & Involvement • Mutual Trust • Competency & Supervision • Risk Perception and Risk Taking • Reward System	• Management Commitment & Involvement • Mutual Trust • Competency & Supervision • Risk Perception and Risk Taking • Reward System
3	Employee Empowerment	• Formal Management System	• Informal Communication • Reporting System	• Employee Empowerment & Participation	• Employee Empowerment & Participation

		• Employee Empowerment & Participation • Mutual Trust • Reward System • Organisational Commitment • Reporting system • Risk Perception and reduced risk taking	• Risk Perception & Risk Taking • Reward and Punishment System • Management Commitment	• Mutual Trust • Reward System • Organisational Commitment • Reporting system • Risk Perception and reduced risk taking	• Mutual Trust • Reward System • Organisational Commitment • Reporting system • Risk Perception and reduced risk taking
4	Reward System	• Reward System • Legal Environment • All round communication • Mutual Trust • Employee Empowerment • Risk Perception and reduced risk taking • Reporting System • Organisational Commitment • Formal Management System	• Formal Reward System • Formal Reporting System • Communication • Management Commitment • Employee Empowerment	• Reward System • Mutual Trust • Employee Empowerment • Risk Perception and reduced risk taking • Reporting System • Organisational Commitment	• Reward System • Mutual Trust • Employee Empowerment • Risk Perception and reduced risk taking • Reporting System • Organisational Commitment
5	Reporting System	• Formal Management System • Employee Empowerment • Rewards System • Communication-based on mutual trust	• Employee Empowerment • Rewards System • Mutual Trust • Risk Taking and Risk Perception • Legal Environment	• Employee Empowerment • Rewards System • Mutual Trust	• Employee Empowerment • Mutual Trust • Risk Taking and Risk Perception • Legal Environment

		• Risk Taking and Risk Perception • HSE Management System • Legal Environment • Organisational commitment	• Management Commitment	• Risk Taking and Risk Perception • Legal Environment • Organisational commitment	• Organisational commitment
6	Risk Taking and Risk Perception	• Employee Empowerment • Mutual trust • Management Commitment • Organisational Commitment • Improved HSE competency	• Employee Empowerment • Mutual trust • Management Commitment • Reward System	• Mutual trust • Management Commitment • Reward System	• Mutual trust • Management Commitment • Reward System
7	Mutual Trust	• Management Commitment & Involvement • Mutual trust • Reporting System • Employee Empowerment • Risk Taking & Risk Perception	• Management Commitment • Mutual trust • Reporting System • Employee Empowerment	• Management Commitment • Mutual trust • Reporting System • Employee Empowerment	• Management Commitment • Mutual trust • Reporting System • Employee Empowerment
8	HSE Management System	• Organisational Commitment • Management Commitment & Involvement • Communication-based on mutual trust	• Organisational Commitment • Management Commitment & Involvement	• Organisational Commitment • Management Commitment & Involvement	• Organisational Commitment • Management Commitment & Involvement

		• Risk Perception & Risk Taking • Legal Environment • Compensation Environment • Reward System • Reporting System • Employee Empowerment	• Risk Perception & Risk Taking • Legal Environment • Reward System • Reporting System	• Risk Perception & Risk Taking • Legal Environment • Reward System • Reporting System	• Risk Perception & Risk Taking • Legal Environment • Reward System • Reporting System
9	Legal Environment	• Organisational Commitment • Management Commitment • HSE Management System • Employee Empowerment	• Organisational Commitment • Management Commitment • Reporting System	• Organisational Commitment • Management Commitment	• Organisational Commitment • Management Commitment
10	Compensation Environment	• Organisational Commitment • Management Commitment • HSE Management System • Employee Empowerment • Mutual Trust • Legal Environment	• Organisational Commitment • Legal Environment • Reporting System	• Organisational Commitment • Legal Environment • Reporting System • Legal Environment	• Organisational Commitment • Legal Environment • Reporting System • Legal Environment

APPENDIX E: t-Test results for Organization A and Organizations B, C, D

		Levene's Test		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Organisational leadership	Variances assumed Equal	21.16	.000	4.983	229	**.000**	.506	.102	.306	.707
	Variances not assumed equal			6.025	197.827	**.000**	.506	.084	.341	.672
Management commitment	Variances assumed Equal	.797	.373	3.254	229	**.001**	.3552	.1092	.1401	.5703
	Variances not assumed equal			3.510	149.825	**.001**	.3552	.1012	.1553	.5552
Employees empowerment	Variances assumed Equal	42.97	.000	8.904	229	**.000**	.8424	.0946	.6560	1.0289
	Variances not assumed equal			10.859	201.511	**.000**	.8424	.0776	.6895	.9954
Reward system	Variances assumed Equal	46.24	.000	5.322	229	**.000**	.606	.114	.382	.830
	Variances not assumed equal			6.715	215.132	**.000**	.606	.090	.428	.784
Reporting system	Variances assumed Equal	31.36	.000	4.121	229	**.000**	.5061	.1228	.2641	.7480

	Variances not assumed equal			4.974	197.013	**.000**	.5061	.1017	.3054	.7067
Risk taking and perception	Variances assumed Equal	18.29	.000	4.352	229	**.000**	.5837	.1341	.3194	.8480
	Variances not assumed equal			4.972	172.789	**.000**	.5837	.1174	.3520	.8155
Mutual trust	Variances assumed Equal	16.17	.000	5.365	229	**.000**	.6368	.1187	.4029	.8706
	Variances not assumed equal			6.414	192.799	**.000**	.6368	.0993	.4410	.8326
Legal environment	Variances assumed Equal	39.64	.000	3.625	229	**.000**	.4765	.1315	.2175	.7355
	Variances not assumed equal			4.354	194.830	**.000**	.4765	.1095	.2607	.6924
Compensation environment	Variances assumed Equal	3.646	.057	4.643	229	**.000**	.5319	.1146	.3062	.7577
	Variances not assumed equal			5.182	162.994	**.000**	.5319	.1027	.3292	.7346
Management system	Variances assumed Equal	37.93	.000	10.810	229	**.000**	1.053	.097	.861	1.245
	Variances not assumed equal			14.243	226.974	**.000**	1.053	.074	.907	1.198

t = t statistics, F = F statistics, Df = degree of freedom, Sig. = significance,Std. Error Difference = standard error difference

APPENDIX F: t-Test results for skilled and unskilled

		Levene's Test		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
orgldr	Equal variances assumed	4.038	.047	1.811	117	.073	.270	.149	-.025	.565
	Equal variances not assumed			2.125	60.572	.038	.270	.127	.016	.524
mgmtcmt	Equal variances assumed	.084	.773	1.913	117	.058	.2626	.1373	-.0092	.5345
	Equal variances not assumed			1.744	39.422	.089	.2626	.1506	-.0419	.5672
emppow	Equal variances assumed	.612	.436	1.745	117	.084	.2923	.1675	-.0395	.6241
	Equal variances not assumed			1.761	45.558	.085	.2923	.1660	-.0419	.6265
rewsys	Equal variances assumed	3.002	.086	1.356	117	.178	.234	.173	-.108	.576
	Equal variances not assumed			1.409	47.828	.165	.234	.166	-.100	.568
reportingsys	Equal variances assumed	1.054	.307	1.011	117	.314	.1912	.1891	-.1833	.5657

	Equal variances not assumed			1.041	47.005	.303	.1912	.1838	-.1785	.5609
risktap	Equal variances assumed	.260	.611	1.112	117	.269	.2192	.1972	-.1713	.6098
	Equal variances not assumed			1.071	42.472	.290	.2192	.2047	-.1937	.6322
mutrust	Equal variances assumed	.000	.990	.901	117	.369	.1698	.1884	-.2034	.5429
	Equal variances not assumed			.856	41.630	.397	.1698	.1984	-.2307	.5702
legenvmt	Equal variances assumed	.027	.871	1.091	117	.277	.2165	.1984	-.1764	.6094
	Equal variances not assumed			1.083	44.402	.284	.2165	.1998	-.1861	.6191
compenvmt	Equal variances assumed	.139	.710	-.477	117	.634	-.0791	.1659	-.4077	.2494
	Equal variances not assumed			-.479	45.201	.634	-.0791	.1652	-.4118	.2535
mgmtsys	Equal variances assumed	.524	.470	-.941	117	.349	-.159	.169	-.495	.176
	Equal variances not assumed			-.865	39.849	.392	-.159	.184	-.532	.213

t = t statistics, F = F statistics, Df = degree of freedom, Sig. = significance,Std. Error Difference = standard error difference

APPENDIX G: Correlation between lagging and leading indicators

	Lag1	Lag2	Lag3	Lag4	Lag5	Lag 6	Lag 7	Ld1	Ld2	Ld3	Ld4	Ld5	Ld6	Ld7	Ld8	Ld9	Ld10
Lag1	1																
Lag2	.662*	1															
Lag3	.73**	.54	1														
Lag4	-.583*	-.731**	-.403	1													
Lag5	.396	.372	.483	-.520	1												
Lag6	.426	.452	.422	-.474	.904**	1											
Lag7	.c	.c	.c	.c	.c	.c	.c										
Ld1	-.56	-.69*	-.43	.987**	-.595*	-.533	.c	1									
Ld2	-.322	-.534	-.197	.814**	-.250	-.232	.c	.812**	1								
Ld3	-.565	-.642*	-.370	.974**	-.454	-.377	.c	.974**	.826**	1							
Ld4	-.549	-.730**	-.416	.980**	-.580*	-.523	.c	.995**	.812**	.969**	1						
Ld5	-.564	-.741**	-.434	.982**	-.594*	-.539	.c	.995**	.793**	.966**	.999**	1					
Ld6	-.393	-.550	-.072	.907**	-.293	-.225	.c	.884**	.834**	.933**	.892**	.883**	1				

Ld7	-.578*	-.730**	-.409	.987**	-.577*	-.533	.c	.993**	.815**	.959**	.990**	.990**	.885**	1			
Ld8	-.523	-.601*	-.337	.971**	-.558	-.467	.c	.979**	.822**	.968**	.972**	.969**	.932**	.974**	1		
Ld9	-.663*	-.818**	-.512	.869**	-.533	-.542	.c	.851**	.714**	.826**	.859**	.864**	.732**	.842**	.794**	1	.
Ld10	-.612*	-.788**	-.478	.985**	-.575	-.544	.c	.984**	.813**	.958**	.986**	.988**	.868**	.979**	.949**	.921**	1

*p< 0.05 level (2-tailed)/ **p< 0.01 level (2-tailed)/ C Cannot be computed because at least one of the variables is constant

APPENDIX H: Analysis of Variance Results (ANOVA)

a: ANOVA results - Language

		Sum of Squares	df	Mean Square	F	Sig.
Organisational leadership	Between Groups	5.561	3	1.854	3.499	***.016***
	Within Groups	120.257	227	.530		
	Total	125.817	230			
Management commitment	Between Groups	3.862	3	1.287	2.195	.089
	Within Groups	133.136	227	.587		
	Total	136.997	230			
Employees empowerment	Between Groups	4.355	3	1.452	2.574	.055
	Within Groups	128.055	227	.564		
	Total	132.411	230			
Reward system	Between Groups	1.538	3	.513	.734	.533
	Within Groups	158.502	227	.698		
	Total	160.040	230			
Reporting system	Between Groups	2.399	3	.800	1.034	.378
	Within Groups	175.600	227	.774		
	Total	177.999	230			
Risk taking and perception	Between Groups	2.449	3	.816	.876	.454
	Within Groups	211.616	227	.932		
	Total	214.065	230			
Mutual trust	Between Groups	2.643	3	.881	1.165	.324
	Within Groups	171.591	227	.756		
	Total	174.234	230			
Legal environment	Between Groups	2.795	3	.932	1.068	.363
	Within Groups	197.991	227	.872		

	Total	200.786	230			
Compensation environment	Between Groups	7.628	3	2.543	3.843	***.010***
	Within Groups	150.179	227	.662		
	Total	157.807	230			
Management system	Between Groups	2.828	3	.943	1.385	.248
	Within Groups	154.524	227	.681		
	Total	157.353	230			

Df = degree of freedom, F = F statistics, Sig. = significance

b: ANOVA results - Ethnic origins

		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Organisational leadership	Between Groups	3.808	4	.952	1.764	.137
	Within Groups	122.009	226	.540		
	Total	125.817	230			
Management commitment	Between Groups	3.089	4	.772	1.303	.270
	Within Groups	133.909	226	.593		
	Total	136.997	230			
Employees empowerment	Between Groups	1.729	4	.432	.747	.561
	Within Groups	130.682	226	.578		
	Total	132.411	230			
Reward system	Between Groups	1.190	4	.298	.423	.792
	Within Groups	158.850	226	.703		
	Total	160.040	230			
Reporting system	Between Groups	2.845	4	.711	.918	.454
	Within Groups	175.154	226	.775		

	Total	177.999	230			
Risk taking and perception	Between Groups	4.083	4	1.021	1.099	.358
	Within Groups	209.982	226	.929		
	Total	214.065	230			
Mutual trust	Between Groups	3.824	4	.956	1.268	.283
	Within Groups	170.410	226	.754		
	Total	174.234	230			
Legal environment	Between Groups	5.635	4	1.409	1.632	.167
	Within Groups	195.151	226	.864		
	Total	200.786	230			
Compensation environment	Between Groups	7.981	4	1.995	3.010	**.019**
	Within Groups	149.826	226	.663		
	Total	157.807	230			
Management system	Between Groups	1.603	4	.401	.581	.676
	Within Groups	155.750	226	.689		
	Total	157.353	230			

Df = degree of freedom, F = F statistics, Sig. = significance

c: ANOVA results - Age groups

		Sum of Squares	df	Mean Square	F	Sig.
Organisational leadership	Between Groups	5.879	2	2.939	5.588	**.004**
	Within Groups	119.938	228	.526		
	Total	125.817	230			
Management commitment	Between Groups	4.946	2	2.473	4.270	**.015**
	Within Groups	132.051	228	.579		
	Total	136.997	230			
Employees empowerment	Between Groups	3.037	2	1.519	2.677	.071
	Within Groups	129.373	228	.567		
	Total	132.411	230			
Reward system	Between Groups	2.258	2	1.129	1.632	**.**198
	Within Groups	157.781	228	.692		
	Total	160.040	230			
Reporting system	Between Groups	9.552	2	4.776	6.465	**.002**
	Within Groups	168.447	228	.739		
	Total	177.999	230			
Risk taking and perception	Between Groups	7.431	2	3.715	4.100	**.018**
	Within Groups	206.634	228	.906		
	Total	214.065	230			
Mutual trust	Between Groups	11.560	2	5.780	8.101	**.000**
	Within Groups	162.673	228	.713		
	Total	174.234	230			
Legal environment	Between Groups	.019	2	.009	.011	.989

	Within Groups	200.768	228	.881		
	Total	200.786	230			
Compensation environment	Between Groups	9.102	2	4.551	6.977	**.001**
	Within Groups	148.706	228	.652		
	Total	157.807	230			
Management system	Between Groups	3.475	2	1.737	2.574	.078
	Within Groups	153.878	228	.675		
	Total	157.353	230			

Df = degree of freedom, F = F statistics, Sig. = significance

d: ANOVA results – Organisational Levels

		Sum of Squares	df	Mean Square	F	Sig.
Organisational leadership	Between Groups	11.847	4	2.962	5.873	**.000**
	Within Groups	113.971	226	.504		
	Total	125.817	230			
Management commitment	Between Groups	11.736	4	2.934	5.294	**.000**
	Within Groups	125.261	226	.554		
	Total	136.997	230			
Employees empowerment	Between Groups	7.476	4	1.869	3.381	**.010**
	Within Groups	124.935	226	.553		
	Total	132.411	230			
Reward system	Between Groups	10.404	4	2.601	3.928	**.004**
	Within Groups	149.636	226	.662		
	Total	160.040	230			
Reporting system	Between Groups	7.830	4	1.957	2.600	**.037**
	Within Groups	170.169	226	.753		
	Total	177.999	230			
Risk taking and perception	Between Groups	10.933	4	2.733	3.041	**.018**
	Within Groups	203.132	226	.899		
	Total	214.065	230			
Mutual trust	Between Groups	16.597	4	4.149	5.949	**.000**
	Within Groups	157.637	226	.698		
	Total	174.234	230			
Legal environment	Between Groups	3.427	4	.857	.981	**.419**

	Within Groups	197.360	226	.873		
	Total	200.786	230			
Compensation environment	Between Groups	25.261	4	6.315	10.768	**.000**
	Within Groups	132.546	226	.586		
	Total	157.807	230			
Management system	Between Groups	6.960	4	1.740	2.615	**.036**
	Within Groups	150.392	226	.665		
	Total	157.353	230			

Df = degree of freedom, F = F statistics, Sig. = significance

e: ANOVA results - Overall Experience

		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Organisational leadership	Between Groups	8.027	2	4.014	7.769	.001
	Within Groups	117.790	228	.517		
	Total	125.817	230			
Management commitment	Between Groups	8.606	2	4.303	7.642	.001
	Within Groups	128.391	228	.563		
	Total	136.997	230			
Employees empowerment	Between Groups	3.936	2	1.968	3.492	.032
	Within Groups	128.475	228	.563		
	Total	132.411	230			
Reward system	Between Groups	4.967	2	2.484	3.652	.027
	Within Groups	155.073	228	.680		
	Total	160.040	230			

Reporting system	Between Groups	10.944	2	5.472	7.468	.001
	Within Groups	167.056	228	.733		
	Total	177.999	230			
Risk taking and perception	Between Groups	9.041	2	4.521	5.027	.007
	Within Groups	205.024	228	.899		
	Total	214.065	230			
Mutual trust	Between Groups	13.954	2	6.977	9.925	.000
	Within Groups	160.280	228	.703		
	Total	174.234	230			
Legal environment	Between Groups	7.074	2	3.537	4.163	.017
	Within Groups	193.712	228	.850		
	Total	200.786	230			
Compensation environment	Between Groups	10.530	2	5.265	8.151	.000
	Within Groups	147.277	228	.646		
	Total	157.807	230			
Management system	Between Groups	5.017	2	2.508	3.754	.025
	Within Groups	152.336	228	.668		
	Total	157.353	230			

Df = degree of freedom, F = F statistics, Sig. = significance

APPENDIX I: Papers Published and Curriculum Vitae

I (a): Papers Published

Research Paper 1: Leadership: Predictors of Safe Behaviors and Performance

- Authors: Govindan Pradeep Nair and Dr Kanchan Deoli Bahukhandi
- Paper presented and published in National Conference on Agricultural sustainability by the cultivation of Medicinal and Aromatic Plants, at UPES, India on 18th December 2017
- Publisher: International Journal of Engineering Science and Mathematics, India, www.ijesm.co.in ISSN 2320-0294

Research Paper 2: Predicting the effectiveness of Management Systems: Measuring Successes vs Failures

- Authors : Govindan Pradeep Nair and Dr Syed Mohammad Tauseef
- Publisher : Paper Presented and Published in International Journal of Engineering Technology Science and Research IJETSR, Volume 5, Issue 1, January 2018, ISSN 2394-3386

Research Paper 3: Non-Pecuniary factors affecting the success of construction projects in United Arab Emirates

- Authors : Govindan Pradeep Nair and Dr Kanchan Deoli Bahukhandi/ Dr Syed Mohammad Tauseef
- Publisher: International Journal of Scientific & Technology Research Volume 9, Issue 1 January 2020, IJSTR – ISSN 2277-8616.

I (b): Curriculum Vitae

Summary

Govindan Pradeep Nair brings more than 23 years of rich cross-cultural experience in HSE Management/Consultancy in a Civil, MEP, Oil & Gas EPC (Engineering, Procurement, and Construction) environment

Qualifications	**Professional memberships**	**Language skills**
MSc (OSH) in Occupational Health & Safety Management from Loughborough University (UK) in 2011 PGDFP (Post Graduate Diploma in Fire Protection) from MIT, Pune (India) in 2012 National Diploma (Level 6 – NEBOSH) in Occupational Health & Safety Practice with credit – (UK) in 2007 National Diploma (NEBOSH) in Environmental Management with distinction (UK) in 2008 National General Certificate (Level 3 - NEBOSH) with credit (UK) in 2003	Certified Safety Professional (CSP) from Board of Certified Safety Professionals, USA Chartered Member of Institute of Occupational Safety & Health (CMIOSH) Leicester – UK. Member of International Institute of Risk & Safety Management (MIIRSM), London - UK. Practitioner Member of Institute of Environmental Management & Assessment (PIEMA), – UK. OSHAD ‘Grade A’ HSMS Generalist Abu Dhabi (UAE).	English, Hindi, Malayalam, Tamil **Nationality** Indian **Years of experience** 23

Professional Summary

- Certified Safety Professional (CSP), from Board of Certified Safety Professionals, BCSP, USA.

- Competent in devising meaningful solutions, managing day to day operations and projects for maintaining sound environmental and safety conditions.
- Extensive experience in conducting OHS Risk Assessment Studies/Environment Impact Assessments and developing Safety /Environment Management Plans for organizations.
- Accredited Trainer for up to Level 6 Diploma programs of NEBOSH (all courses), IOSH, IEMA, MEDIC First Aid and HABC certification programs
- Adequate knowledge and experience in Hazard Identification/ Risk Analysis Techniques, Loss causation theories and Root Cause Analysis of Incidents.
- Sufficient knowledge in using proprietary accident modeling/risk assessment software like Phast Risk (fire/explosion, toxic gas dispersion, QRA, etc.)
- Deft in maintaining and controlling safety documents, HSE Statistics, Manuals, and procedures.
- Sound knowledge of safety drills and procedures regarding firefighting and personnel survival techniques.
- Proficient in the reviewing, developing, integrating, implementing, maintaining and auditing of ISO standards, ISO 9001 (QMS), ISO 14001 (EMS) & OHSAS-18001 (OHSMS).
- Adept in carrying out HSE Competency Management system, identifying training needs, designing training modules/workshops and establishing a focus on enhancing EHS standards through training & development.
- Sound knowledge and experience as specialist consultant for Estidama (Abu Dhabi Sustainability Initiatives - Pearl Building Rating System/ Pearl Community Rating System)
- Excellent communication & interpersonal skills with strong analytical, team building, problem solving and organizational abilities.
- Deft in engaging negotiations with management and worker/worker groups to handle grievances related to wages/welfare, to secure their prompt

redress, and act as a liaison officer between management and employees to ensure a harmonious relationship between both.

- Completed IRCA Lead Auditor training for ISO: 14001 (EMS) & OHSAS: 18001.

Career Contour

Company	AECOM Middle East, Abu Dhabi UAE
Period	October 2017 – Till Date
Designation	SH & E Manager
Company	International HSE Council (IHSEC), Technopark, Dubai UAE
Period	January 2015 – October 2017
Designation	Senior HSE Consultant
Company	Turner International Middle East, Abu Dhabi, UAE
Period	February 2014 – January 2015
Company	Bunya LLC, Reem Island, Abu Dhabi, UAE
Period	January 2011 – May 2014
Designation	Manager, HSSE & Logistics
Company	Lindenberg Emirates LLC, Abu Dhabi, UAE
Period	April 2007 to May 2010
Designation	Company QHSE Manager
Company	J Ray McDermott Middle East Inc (JRM), Dubai, UAE
Period	March 2004 to April 2007
Designation	Sr. HSE Advisor
Company	Juma Al Majid – Electromechanical Works (EMW) LLC, Abu Dhabi, UAE
Period	February 2002 to March 2004
Designation	QHSE Engineer
Company	Arabian Construction Company (ACC), Abu Dhabi, UAE
Period	December 2000 to January 2002
Designation	HSE Engineer
Company	Corps of Engineers – Indian Army
Period	June 1995 to June 2000
Designation	Captain/Company Commander

Personal Details

Date of Birth : 11th July 1973.

Place of Birth : Trivandrum, Kerala

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Influence of Management Systems in Developing Safety Culture: Case of Construction Industry in the United Arab Emirates (UAE)

By

Govindan Pradeep Nair

COLLEGE OF ENGINEERING/ SCIENCE (Department of Health, Safety and Environment)

Submitted

IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF THE DEGREE OF DOCTOR OF PHILOSOPHY

To

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

DEHRADUN

December 2018

Under the Guidance of:

Dr Kanchan Deoli Bahukhandi

Dr S. M. Tauseef

PhD Thesis

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