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Influence of Human Factors on the safety performance in Saudi Arabian Construction industry

Submitted in Partial Fulfilment of the Requirements of Degree of PhD.

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March 2020

ABSTRACT

In Saudi Arabia, the construction industry is inflicted with the occurrence of many accidents. Reports released by the government show that the Saudi Arabian construction industry is responsible for the highest number of accidents as compared to the other industries in the country. Research studies pointed out that accident occurs due to various factors such as unsafe working conditions and unsafe actions of the workers. In Saudi Arabia, workers' unsafe actions are blamed as one of the key reasons behind the occurrence of accidents. However, there is no exploratory study available related to Saudi Arabian construction industry which has identified the human factors that influences the workers to carry out unsafe acts which contribute in the occurrence of the accidents by the use of mix methods including review of accident reports. Accident causation theories suggested that workers' unsafe actions are influenced by numerous factors that are associated with the job and the organisation. Therefore, this research study was focused on the identification of the human factors which cause accidents in the construction industry and explore the challenges and barriers the Saudi Arabian construction industry is facing in maintaining safe worksite. The research objectives in this research study were fulfilled with the use of three research techniques: archival reports, interviews, and questionnaire surveys. In the first step, accident reports of eight construction companies were studied, followed by conducting the interviews with twenty-three construction professionals. In the last step, the questionnaire survey was conducted with 150 participants working in the Saudi Arabian construction industry. Results of the accident reports revealed twenty-six human factors associated with the individuals, task and workplace that caused eighty-six accidents in eight construction sites. Thematic analysis of the interviews revealed seven challenges and barriers involving the Saudi government and construction companies which are affecting the safety performance of the Saudi Arabian construction industry. The result of the questionnaire survey revealed that workers' non-compliance to safety rules, lack of training, lack of awareness and unsafe working conditions are the significant human factors that contribute towards the occurrence of accidents in the Saudi Arabian construction industry. Results from the accident reports, interviews and questionnaire surveys imply that in the Saudi Arabian construction industry, H&S issues are multifaceted involving a combination of more than one human factor. These results also emphasised that workers' unsafe actions are influenced by their limited knowledge and awareness about the identification of the hazards at the workplace and the control measures that need to be applied to mitigate those hazards. Management fails to provide safe working conditions at the construction sites with no proper hazard management which increases the H&S risks for the workers. Most of the workers are coming from Asian countries where there is not a proper safety culture. These workers have no or limited skills about their job and mostly have to learn the skills at the job site. Saudi Arabian construction sites do not provide enough training related to the task they have to perform resulting in increasing the chances of mistakes or errors which can cause an accident. To reduce the occurrence of the accidents and improve the safety performance of the Saudi Arabian construction, there is a need for strong commitment and

control measures especially from the government and the construction companies. Construction professionals need to realise the significance of the H&S which is eventually to protect them from being involved in the accidents. This research study contributed to knowledge with the identification of the human factors which influence the workers to work unsafely and explored the underlying human factors that affect the overall safety performance of the Saudi Arabian construction industry. This research provided practical and detailed recommendations that will be applicable in the Saudi Arabian construction industry to minimise the accidents and improve safety performance.

ACKNOWLEDGMENT

I would like to express my sincere gratitude to my supervisor, Dr Yingchun Ji for his continuous support and guidance throughout the PhD programme. This thesis would not be possible without the support of my beloved mom, brothers, sisters, wife, and son. I would like to thank the construction companies who provided me with data for this thesis. Participants involved in the interviews and questionnaire surveys require special thanks as their opinions and feedback were very useful in this thesis.

PUBLISHED RESEARCH JOURNAL

Azmat, Y., & Saad, N. (2018). The Safety Policies Practiced in the Construction Industry of Saudi Arabia. J Ergonomics, 8(242), 2.

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Chapter 1

Introduction

1.1 Introduction

This chapter contains the research background in which the brief introduction of the global and Saudi Arabian construction industry is being presented. In addition to that in the background section, the Saudi Arabian construction industry H&S issues are being highlighted. The research justification section contains information about the workforce in the Saudi Arabian construction industry and the importance of improving the H&S performance of the Saudi Arabian construction industry. Research aim and objectives are being mentioned in this chapter.

1.2 Research Background

The construction industry is one of the most booming industries in the world over the past decades. Construction is one of the largest sectors in the world that meets the requirements of the economy and the programs of construction, reconstruction, maintenance and removal of buildings in all countries (Timofeeva, Ulrikh, & Tsvetkun, 2017). Globalconstruction2020 (2009) reported that construction today is a $7.5 trillion market accounting for 13.4% of world output. Millions of people around the globe are associated with the construction sector. The occurrence of accidents in the construction industry is a major issue for most countries around the globe. The construction industry is one of the most hazardous industry which has a high ratio of the occurrence of accidents. The construction industry is the most dangerous sector of the economy (Timofeeva et al., 2017). Azmat and Saad (2018) mentioned that the global construction industry is one of the most hazardous industries and is responsible for the occurrence of many fatalities due to the occurrence of accidents. The construction industry is a high-risk industry due to its unique nature of activities and the occurrence of a high number of accidents (Hamid, Majid, & Singh, 2008). Eyiah, Kheni, & Quartey (2019) pinned that construction is rated among the five most high-risk sectors with solutions to occupational health and safety (OHS) issues proving invisible. An assessment carried out by the International Labour Organization mentioned that up to 60,000 fatal work injuries occur annually on construction sites all over the world (Timofeeva et al., 2017).

Among the Gulf Cooperation Countries, Saudi Arabia, Qatar, and United Arab Emirates are developing numerous megaprojects. Qatar is building infrastructure and transport networks to get ready for the Fifa World Cup 2022 that will be held in Qatar. Qatar is spending billions of dollars to complete the mega construction projects. Saudi Arabia is the largest exporter of crude oil in the world and the export of crude is the main part of the GDP. Between 2004-2014, crude oil

prices remained high in the global market and Saudi Arabia earned significantly due to high crude oil prices. In Saudi Arabia, the construction industry has emerged as one of the fastest-growing sectors in the past two decades. Alrashed, Alrashed, Taj, Phillips, & Kantamaneni (2014) mentioned that the construction market of Kingdom of Saudi Arabia (KSA) is significantly huge in the Middle East, which currently estimates to be >$122 Billion per year (in recent times) and this is anticipated to reach >$610 Billion in next five years. Saudi Arabia is constructing new healthcare, tourism, infrastructure, and transport projects mainly in Riyadh, Jeddah, and Makkah. However, a high number of construction projects are facing many obstacles such as project delays, low quality, and occurrence of the accidents. Saudi Arabian construction industry employs the highest number of manpower as compared to other industries (GOSI, 2018). Furthermore, the construction industry of Saudi Arabia is also experiencing a high number of accidents as compared to other industries which are a significant concern. Hot weather, unqualified subcontractors and manpower, and design issues are some of the challenges the Saudi Arabian construction industry is facing that are affecting the H&S of the projects. Poor safety performance has always been a significant concern for the Saudi Arabian governmental as well as private organizations (Azmat & Saad, 2018). Al-Haadir and Panuwatwanich (2011) researched in determining the critical success factors for the safety program implementation among construction companies in Saudi Arabia and emphasis that the Saudi Arabian construction industry is facing many challenges related to attaining the good safety performance on many fronts. The high number of accidents in the Saudi Arabian construction industry suggests that there is an urgent need for measures to be taken to improve health and safety in the Saudi Arabian construction industry and protect the safety of the workers.

1.3 Research Justification

Saudi Arabian construction industry is large and expanding with immense structure and manpower, but the poor safety performance of the Saudi Arabia's construction industry is one of the major concerns as it constitutes almost half of the occurrence of accidents as compared to other industries (Mosly, 2015). Statistics by the General Organisation of Social Insurance (GOSI) suggest that the construction industry is responsible for many accidents in Saudi Arabia. These construction accidents were responsible for many fatalities and injuries. A report by the General Organisation of Social Insurance has disclosed that in 2015 alone, 307 people lost their lives related to occupational accidents, whereas 53% of the reported cases were associated with the construction sector (Atlas-mag, 2016). In recent years, many accidents were reported in the construction industry that resulted in fatalities and serious injuries. In 2015, one of the deadliest construction accidents occurred in Makkah when a crane collapsed due to strong wind and heavy rains which resulted in killing more than 100 people while injuring more than 250 people (Bbc, 2015). Gulfnews (2015) reported a deadly accident in 2015 at Qasim, which claimed 11 foreign workers' lives due to poor formwork structure that collapsed when concrete pouring was ongoing. Aldhafeeri (2016) mentioned different major accidents occurred in the construction

industry which caused many deaths and injuries as a result: one person dead, 18 injured in Makkah, 1 dead in Najran, 9 dead in Qassim and 3 dead, 11 injured in Riyadh. Arabnews (2014) reported that in 2014, six workers died and five injured as a result of a wall collapsed in the building project in Makkah. Another accident at the construction site in Riyadh, three workers were killed (Arabnews, 2014). Meanwhile, Arabnews (2013) reports that two construction workers died as a result of crashing with soil while cleaning pipes in Abha city. In 2010, a scaffold collapsed and caused the death of five workers in King Abdullah Financial District, Riyadh (Constructionweekonline, 2010). These accidents suggest that Saudi Arabian construction industry is prone to accidents which caused the high number of losses to the lives of the workers working at the construction sites. Therefore, there is an urgent need for the improvement of safety performance in the Saudi Arabian construction industry by minimizing the occurrence of accidents.

Saudi Arabia is experiencing a construction boom during the past three decades, attracting construction professionals from all over the world (Mahamid, Al-Ghonamy, & Aichouni, 2013). The construction industry in Saudi Arabia constitutes foreign manpower who are hired temporarily for certain projects and are relatively low skill and low paying, although some are highly trained professionals, such as architects, engineers, construction tradesmen and supervisors (Fass et al., 2016). Each workplace consists of people working in white-collar jobs and blue-collar jobs. In the Saudi Arabia construction industry, white-collar jobs are being performed by Saudi nationals and expatriates. However, blue-collar jobs are mostly being performed by expatriates which are coming from Asian countries mostly. Blue-collar workers are involved with more risks and have more chances of being involved in the occurrence of accidents. Statistics from GOSI (2015) revealed that migrant workers are involved with 97.82% of the total number of accidents between 2005 to 2011. There are many reasons for the involvement of migrant workers in the occurrence of accidents. Migrant workers are hired because they have low salaries and the majority of the migrant workers are not competent for the job they are assigned. Saad (2016) mentioned that migrant workers are coming from countries where there is no good H&S safety culture and they have limited awareness about safety which influences their safety behaviour. In addition to that, workers face miscommunication issues when they arrive in Saudi Arabia and this influences their understanding of tasks and procedures resulting in carrying out unsafe works.

Researchers and accident causation theories mentioned that humans have a significant influence on the occurrence of the accidents and the casual factors associated with the individuals influence the outcome of the incident. If the workers carry out unsafe actions and violate safety rules it will probably result in the immediate cause of the accidents. Jannadi & Assaf (1998) pinned that unsafe acts and unsafe conditions are the immediate causes of accidents. Workers' negligence, failure to obey safety regulations by workers, poor workers' attitude towards safety are the main causes of construction accidents (Abdul Rahim et al., 2008). Heinrich's domino theory also pointed out the significance of workers' actions and mentioned that 88% of the

accidents occur by unsafe acts, 10% of the accidents occur by unsafe conditions and 2% of the accidents are unavoidable (Yates, 2015). Thus, it is safe to say that workers' actions have a significant role in the occurrence of accidents, and it remains a challenge for the construction industry to control the worker's actions that lead to the occurrence of the accidents.

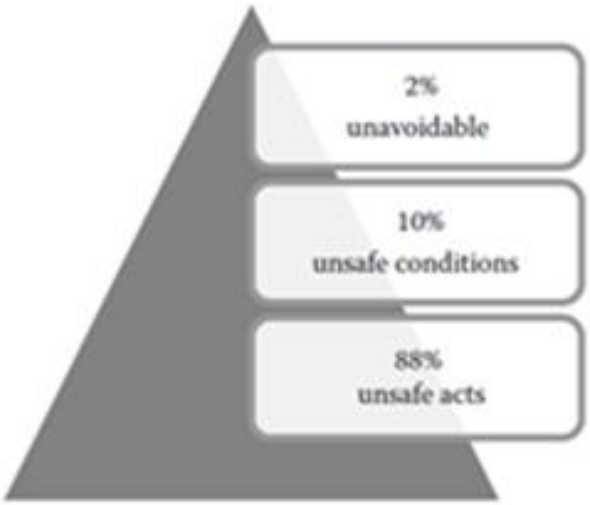

Figure 1.1: Heinrich's Conclusion (Yates, 2015)

Human factors associated with the humans not only consist of the person who led to an accident but also extends to all those who directly or indirectly influence the working environment and safety system. Jobs are being carried out by the humans, who are capable of mistakes, errors or violations which can be associated with their attitude, belief or behaviour of a person, and that error/mistake/violation can become the immediate cause of the accident. People's attitude and beliefs towards safety are important as safety culture of an organization are dependent on it and it is individual vision and beliefs that lead to the successful implementation of organizational safety policies, and safety program with hazard management (Wachter & Yorio, 2014). Humans can have different behaviours and attitudes which can influence safety while performing tasks. The difference in characteristics is mainly due to gender, environment and family influence, education, and occupational training. It is important to realize that workers' behaviour and actions are influenced by external factors such as the working environment. If a worker is working in a team that is taking care of safety and are following safety rules, then most chances are that the worker will also take care of his safety and follow the safety rules.

Accident causation theories mention that workers are being influenced by various contributing factors. Multiple Causation theory was proposed by Dan Petersen which suggests that management has a strong role in the prevention of accidents and the occurrence of accidents is being contributed through multiple causes (Hosseinian & Torghabeh, 2012). System theory pointed out that there is an interlink of man, machine and environment and if one of the elements is disturbed or not maintained properly, the occurrence of an accident can happen (Yates, 2015).

Human factor theory suggests that human mistakes are the primary reason behind the occurrence of accidents but there are some contributing factors such as, poor design of the workplace and inadequate machinery which can lead to accidents. AbdulHamid et al. (2008) explain that this theory does not recognize workers as the main problem but considers other factors that take part as the reason the accident happened.

Researchers have identified different drivers which have a major impact on safety performance and concluded that in Saudi Arabian construction industry and the main sources of occurrence of accidents are multifaceted (Al Haadir & Panuwatwanich, 2011; Alrehaili, 2016; Awad, 2013; Azmat et al., 2018; Balgheeth, 2016; Erogul and Alyami, 2017; Mosly, 2015; Saad, 2016). Unsafe acts or unsafe conditions are responsible for about 80% of the occurrence of accidents (Vondráčková et al., 2016). Workers are responsible for the direct cause of the accidents as they are at the front line performing the task but there are indirect human factors related to task and workplace which influence the workers as a contributing factor towards the occurrence of the accidents. Findings shared by Hide, Atkinson, Pavitt, Haslam, Gibb, & Gyi (2003) concluded that construction accidents arise from a failure in the interaction between human factors associated with the workers, their workplace and the materials and equipment. Vondráčková et al. (2016) emphasized the importance of managing human factors and argued that it is necessary to consider the concept of human factors into organizational culture and safety culture. There is a lack of exploratory study available related to Saudi Arabian construction industry which has explored the relationship between human factors and safety performance and investigate the reasons behind workers unsafe by the use of mix methods such as, accident reports. Therefore, this study will identify the human factors that causes accidents and explore the reasons behind workers' unsafe actions to reduce the occurrence of humanly related accidents and enhance the safety of the workforce in the Saudi Arabian construction industry. This study will use of mix methods by including archival reports which have not been used in previous research studies to find the main causes of the occurrence of the accidents. In addition to that interviews and questionnaire surveys will be used as research techniques in this study. It is also important to explore the human factors that impact the safety performance of the Saudi Arabian construction industry as it will help the researchers and construction professionals to apply concrete measures that can enhance safety performance.

1.4 Problem Definition

From the existing literature it can be derived that the Saudi Arabian construction industry contains different issues related to the accident causation and safety performance which needs to be explored in detail:

i) Workers unsafe actions are blamed but there is a need of identifying the human factors that influence the workers in acting unsafely by the use of mix methods such as accident reports; ii)

There is a need to explore the relationship between human factors on the safety performance using mix methods; iii) Challenges that Saudi Arabian construction industry is facing in maintaining safety practices needs to look into; iv) Practical and detailed recommendations are needed for the Saudi Arabian construction industry that will provide guidelines to enhance the safety performance and safety practices.

1.5 Research Aim and objectives

The research aims to propose recommendations that will improve the safety performance of the Saudi Arabian construction industry and minimize humanly related accidents.

To achieve the above-mentioned research aim, the main objectives of this research study are mentioned below:

- Identify human factors that cause accidents in construction.
- Explore influencing human factors that lead to the occurrence of the accidents in the Saudi Arabian construction industry.
- Examine the challenges and barriers the Saudi Arabian construction industry is facing in maintaining safe worksite.
- Propose recommendations that will improve the safety performances of the Saudi Arabian construction industry.

1.6 Overview of the Research Design

In this research study, research onion has been used as a research methodology to answer the research aims and objectives. This study utilised mix methods as a research technique with the combination of archival reports, interviews and questionnaire survey. Archival reports include accident reports of eight construction companies working in Saudi Arabia. Interviews and questionnaire survey were conducted with construction professionals working in Saudi Arabian construction industry. Each research objective was achieved with the use of one or more than one research techniques (Table 4.2). Further details about the research methodology is mentioned in the chapter 4.

1.7 Structure of this research study

This research study contains six chapters: Introduction, Literature review, Research methodology, Result, Discussion, and Conclusion and Recommendation (Figure 1.2).

In the first chapter of the introduction, background about the global and Saudi Arabian construction industry and its safety records are being briefly introduced. Justification of the

research has been discussed in which the safety performance of the Saudi Arabian construction industry is being discussed and the role of human factors in the occurrence of accidents. Existing literature contains the gaps in exploring human factors that influence the workers in working unsafely in the Saudi Arabian construction industry. Research aims and objectives are described in this chapter.

Chapter two contains the literature review in which an extensive literature review has been done in understanding the safety performance of the global and Saudi Arabian construction industry. The literature review also provided an overview of the human factors and the role of human factors in the occurrence of accidents. In addition to that human factors that influence the safety performance of the Saudi Arabian construction industry have been identified. Summary of the findings from the primary data has been stated in the last section of the chapter.

The third chapter is about the research methodology in which general knowledge is being mentioned about the research design, strategies, techniques and analyzation methods. In this chapter, the research techniques utilized in this research study are being explained. In this research study, mix methods have been used to achieve the research objectives and justification for using mix methods has been mentioned in chapter three. The design and sample size of the data collection techniques are being explained. Ethical considerations are also mentioned in this chapter.

This study deployed mix methods as data collection techniques. Chapter four contains the results gathered through the analysis of accident reports, interviews and questionnaires. In this chapter, results derived by the use of the thematic analysis, factor analysis, and descriptive statistics are being performed.

Chapter five “Discussion” contains a summary of the research findings has been presented and discussed which was obtained from the literature review, study of document analysis, interviews, and questionnaire surveys. In this chapter, the discussion was made for each research objective.

In chapter six, there will be three sections: conclusion, recommendations, and contribution to knowledge. In this chapter, a summary of the outcome of the research study is being explained and recommendations are being presented that will help minimise the occurrence of accidents and enhance the safety performance of the Saudi Arabian construction industry. This chapter discussed the contribution this research study has made to the theory and practice.

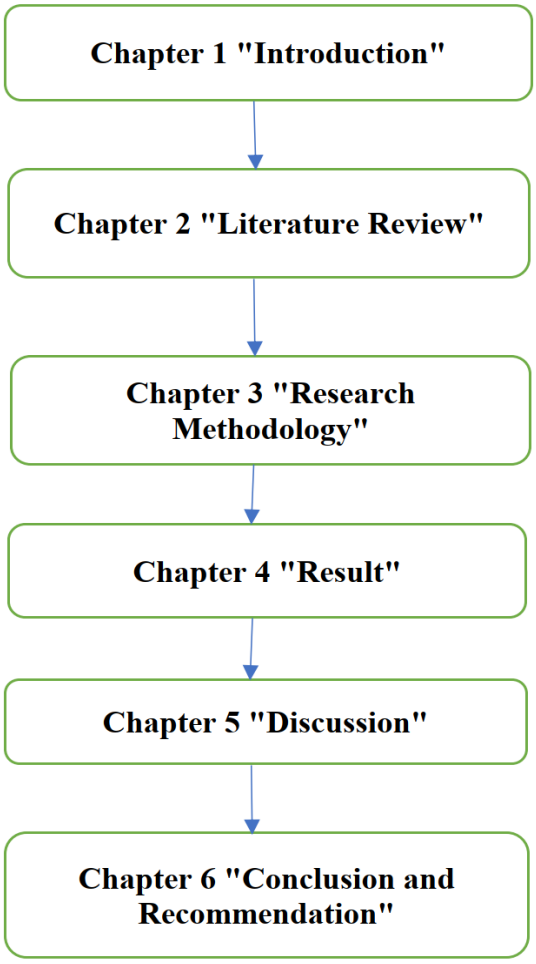

Figure 1.2: Structure of the research study

1.8 Summary

This chapter briefly provided an overview of the global and Saudi Arabian construction industry. General information in terms of the occurrence of accidents in the global and Saudi Arabian construction industry was made. Research problem related to the occurrence of accidents in the Saudi Arabian construction industry was explored which justified this research study. Research aim and objectives were presented based on the research problem. The structure of the research study was mentioned which will help in understanding how this research study will be carried out. The new chapter is a literature review, which will provide detail knowledge about the different topics related to this research study such as, the concept of H&S, Human factors, etc.

Chapter 2

Literature Review – Global

2.1 Introduction

Globally construction industry is considered the backbone for the economy with the involvement of many companies and manpower. The construction industry is experiencing projects in different sectors such as rail network, infrastructure, or high-rise buildings. Due to the dynamic and complex nature of the projects, the construction industry is one of the most hazardous industry in the world (AlHaadir & Panuwatwanich, 2011) and responsible for the loss of human lives, resources and time as a result of accidents. Developed countries, as well as developing countries, are experiencing accidents in the construction industry. The occurrence of accidents in the construction industry is a major concern as it results in loss of worker's lives as well as man-hours.

2.2 Overview of the Global construction industry

Construction is the backbone of most of the countries as it is not just involved with the development of the infrastructure but also hundreds of thousands of people are associated with this industry. Al-Haadir and Panuwatwanich (2011) mention that the construction industry plays a fundamental role in increasing the economy of many countries. The construction industry is one of the important parts of the economy requiring a large number of professionals despite the mechanization and occupational risks for workers (Timofeeva et al., 2017). Coble (1997) mentioned (cited in Al-Haadir and Panuwatwanich, 2011) that the construction industry provides the infrastructure required for other parts of the economy to grow, thus reflecting the level of the economic development of the countries. The construction industry is also dependent on the overall economy of the country. If the country's economy suffers a major fall which will rise in inflation it will also affect the construction industry.

Past decades have seen the rise of the construction industry. A survey report by Turner & Townsend (2017) shows that the construction sector around the world has shown improvements in the annual productivity over the past two decades averaging 1 per cent. Economics (2015) pinned that the global construction market is expected to grow at a faster pace than world GDP over the next decade as Asian economies continue to industrialise and the US recovers from the sharp downturn during the global financial crisis. Turner and Townsend (2017) pointed out that the construction industry grows by 3.7% per cent in 2016 and it is expected that in 2017, global construction costs are expected to increase by 3.7%. The rise in the construction industry is due to the creation of new infrastructure projects, economics zones, industries, and urbanization of the cities.

It is estimated that by 2020, construction output will have grown by 70% to $12.7 trillion and will account for 14.6% of world output (Ibid). Developed countries as well as developing countries experiencing construction projects as per the needs of the country. It is forecasted that most dynamic growth for construction over the next decade will come from emerging markets in India, China, Asia Pacific, South and Central America, Middle East and Africa and parts of East Europe (Globalconstruction2020, 2009). Economics (2015) highlighted that Asia will be one of the pioneer markets for the construction industry where rising populations, rapid urbanization, and strong economic growth are drivers for construction.

It is expected that North America to be the highest-growth region amongst the developed countries over the next 10 years with particularly high growth in the US from 2011 to 2013 (Globalconstruction2020, 2009). In the United States, new administration policies have helped in bringing many businesses in the country and it is expected the construction sector will do well. In the US, the outlook for construction has been looking up after a prolonged period of stagnation (Economics, 2015). The new administration of the US promised to improve the country's infrastructure and transport network of the country (Turner & Townsend, 2017). New York City saw spending of USD 43 billion in the construction sector in 2016 alone, which is more than any city of the US (Ibid). San Francisco is also experiencing the building of residential and non-residential projects.

China is investing a significant amount of money in the construction industry. Economics (2015) stated that the scale of construction in China has been, and continues to be, truly immense, as the challenge of transforming from a predominantly rural-based society into a modern, urban-based international economy continues. As of 2014, the urban population in China was at 54%, still a considerable way off the major advanced economies, and suggestive of a further residential building to come (Economics, 2015). In the next decade, China is planning to build megacities and move 250 million of the country's population to these megacities (Turner & Townsend, 2017). In China, most of the mega-projects are ongoing in the railway, road and water transport sectors.

In India, construction has a major part in the economic growth of the country. India alongside China is expected to show amongst the highest growth rates in construction over the next decade (Globalconstruction2020, 2009). India's urban population stands at just 32%, amongst the lowest in the world. The scale of building work required to do this is truly awesome (Economics, 2015). Growth of the construction in India will be even more explosive than in China with double-digit growth expected in both the residential and non-residential markets in the short term (Globalconstruction2020, 2009). Numerous projects are underway in the public and private sectors of India. Famous ongoing construction projects are the Mumbai trans-harbour link and two new metro lines in Mumbai (Turner & Townsend, 2017).

Japan is one of the leading countries in Asia for the construction industry. Despite a slip in economic activity as a result of the tax hikes that dampened consumer spending growth,

construction growth in Japan has been a bright spot over the past few years with Abenomics providing the impetus (Economics, 2015). Since 2003, Japan has been overtaken by China as the second-largest construction market in the world and will fall behind India in the latter half of the next decade as India becomes the third-largest market, further underlining the shift in importance from developed countries to emerging markets (Globalconstruction2020, 2009). Turner & Townsend (2017) pinned that in Japan, the tourism sector has been boosted and construction is strong due to the anticipation of the 2020 Olympic games. Key ongoing projects in Japan are a 48 billion USD project of railway high-speed link between Tokyo and Nagoya and Kengo Kuma's stadium (Ibid).

In 2017, Malaysia is spending around 8 per cent in its construction industry (Turner & Townsend, 2017). Construction of high-rise buildings and public transport are the main projects ongoing in Malaysia. Key ongoing projects in Malaysia are the high-speed link between Kuala Lumpur and Singapore and the redevelopment of Kuala Lumpur financial district (Turner & Townsend, 2017). Australia's economic growth is improving, and the country is investing in the construction of public road and rail infrastructure and residential buildings (Turner & Townsend, 2017). In Turkey, the construction industry is doing quite well and continued to grow. The Turkish government is focusing on improving the infrastructure with major projects such as the undersea tunnel project and new airport construction projects in Istanbul (Turner & Townsend, 2017).

Western Europe will be one of the lowest-growth regions for construction to 2020 (Globalconstruction2020, 2009). The UK and Greece will show the highest growth whereas construction in Spain, Italy, and France should grow much slower than the Western European average (Ibid). The UK construction sector remains buoyant and the growth path of construction remains stable (Economics, 2015). Construction projects in the UK are ongoing by the public and private sectors. Transport, infrastructure, and building structure projects are underway in London and other parts of the UK. In France, "Grand Paris" is one of the key construction projects ongoing around Paris consisting of a new transport masterplan with 200 km and 69 stations being added to the rail network (Turner & Townsend, 2017). Germany has weakened demand for industrial construction due to a reduction in capital goods demand from China (Economics, 2015). Germany reported between 5 to 6 per cent growth rate in the construction industry with a turnover of approximately 106.5 billion Euro networks (Turner & Townsend, 2017). For ten years, Germany is building many construction projects such as the construction of the Frankfurt Airport and Munich metro-rail project (Ibid). Eastern Europe will outstrip Western European countries with growth averaging over 100% in the next decade, led by Russia and Poland. In Russia, tumbling investment driven by collapsing confidence and a withdrawal of foreign capital has meant that spending on new construction projects will recede over the coming years, with only a tepid recovery from 2017 onwards (Economics, 2015). Russia has been massive construction projects in recent years due to the 2018 World Cup.

Gulf Cooperation Countries (GCC) have experienced slow progress in their economy due to lower oil prices in recent years. UAE government is facing pressure to cut its spending due to the low price of oil and resulted in slow growth in the construction sector since 2016. Dubai Creek Harbour and Mall of the World are the key ongoing projects in the UAE. It was estimated by Globalconstruction2020 (2009) that relatively strong growth in infrastructure and overall the construction market in UAE will grow positively in the next decade. In Oman, there is a decrease of investable funds by the government which resulted in halts of many construction projects (Turner & Townsend, 2017). On the other hand, the private sector is investing in the building of hotels and leisure places (Ibid). Qatar has suffered from lower oil prices and budget cuts were made since 2016. Most of the construction projects are ongoing around Doha city while construction of projects associated with the 2022 football World Cup is also underway (Turner & Townsend, 2017). In 2018, it is expected that Qatar's construction sector will improve (Ibid). This section shows that the construction industry has grown significantly in most countries of the world with many projects are ongoing. With the ongoing construction projects, the construction industry is also experiencing many challenges on many fronts such as project delays, design issues. One of the important issues that are with the construction industry is the increase in the occurrence of accidents in the industry which is resulting in many fatalities and injuries. Due to the occurrence of many accidents, the safety performance of the construction industry is also labelled as low. In the next section, the safety performance of the global construction industry will be explored and compare it with other industries. In addition to that, it will be examined what are the sources which led to the occurrence of the accidents in the construction industry.

2.3 Safety performance of the Global Construction industry

The construction industry experiences a significant number of accidents and as a result of these accidents, workers working in the construction industry experience a higher ratio of fatalities and injuries. Diane et al. (1999) mention (cited in Ashraf, 2013) that fatalities and injuries ratio in the construction industry is more than other sectors. According to the International Labour Organisation, the construction workers could have 10 or even 20 times higher risk of fatal accidents than the average worker belonging to non-construction sector (AbdulRahim et al., 2008). This means that one fatal work injury occurs every 10 minutes in this sector, and about 17% of fatal work injuries occur on the construction sites (Timofeeva et al., 2017). One reason for a high number of accidents in the construction industry is because of high-risk activities involved in this industry such as construction high rise buildings and working with electrical equipment.

Developed countries, as well as developing countries, are experiencing accidents in the construction industry. Countries like the US and UK which have better safety records as compared to other countries are still experiencing a high number of injuries in the construction industry. In the United States, the construction industry accounts for only seven per cent of the

occupational workforce but is responsible for twenty per cent of all industrial fatalities between 1995 and 2000 (Ashraf, 2013). U.S. Bureau of Labor Statistics report shows as figure 2.1 suggests that 197.7 thousand non-fatal occupational injuries and 5.7 thousand illnesses associated occurred in the private sector of the construction industry in 2016 alone (BLS, 2017). In the US, Construction industry is one of the top six industry which experiences the high number of injuries due to occupational accidents (BLS, 2017).

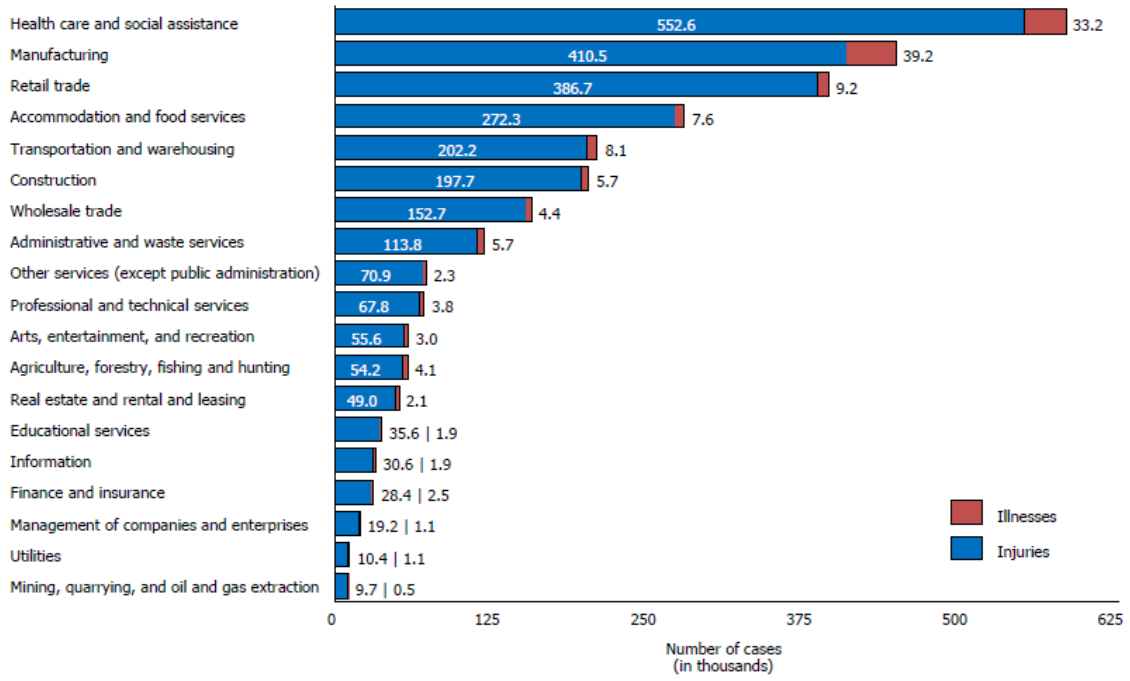

Figure 2.1: Distribution of nonfatal occupational injuries and illnesses by private industry sector, 2016 (Source: BLS, 2017)

In Europe, the United Kingdom has the lowest fatal injury rate but still, the construction industry of the UK has the highest accident and injury ratio in the country as compared to other industries. The construction industry of the UK has around four times higher injury rates than all industries (HSE, 2017). In the United Kingdom, as reported by the Health and Safety Executive (HSE), each year most of the fatalities occur in the construction and agriculture industry (Ibid). Figure 2.2 shows that between 2012-2016, on an annual average of 39 fatalities occurred in the UK construction industry (Ibid). However, in the period of 2016/17, the construction industry recorded 30 fatalities which are more than any other industry (HSE, 2017).

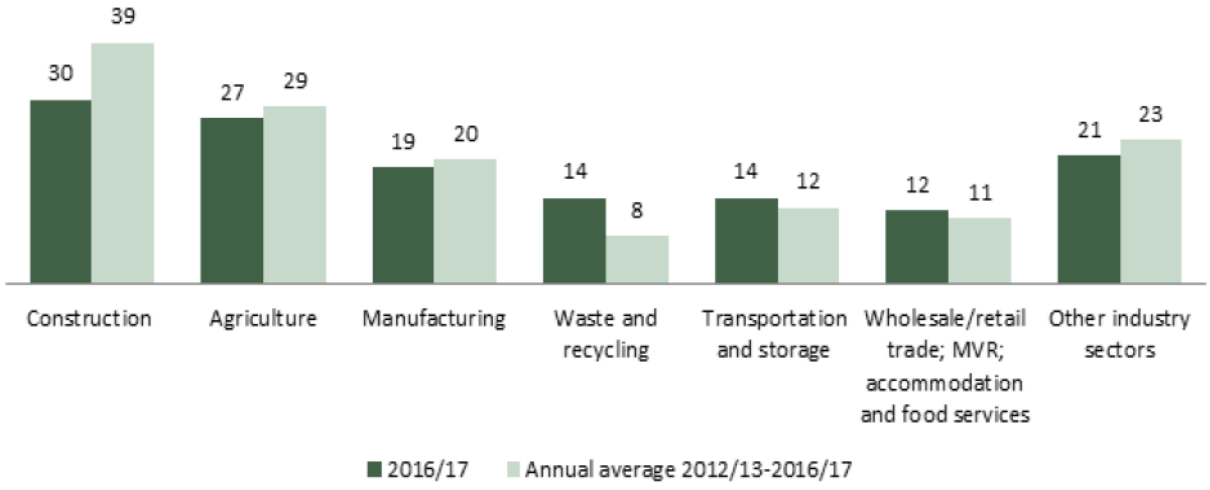

Figure 2.2: Number of fatal injuries by main industry group, 2016/17p and the annual average for 2012/13-2016/17p (Source: HSE, 2017)

In European union, the number of fatal accidents has dropped in the last decade but still, a high number of accidents in the construction industry are occurring as suggested in figure 2.3. In the year of 2014, in EU-28 (28 members of the European Union), over two-thirds of the work-related fatal accidents occurred in the construction, transportation and storage, manufacturing, and agriculture, forestry, and fishing sector (Eurostat, 2016). The construction industry recorded the occurrence of the highest number of fatal accidents more than other industries (Ibid). In 2014, the construction industry was responsible for 20.9 % of the fatal accidents and 11.6 per cent of the non-fatal accidents at work in the EU-28 (Eurostat, 2016).

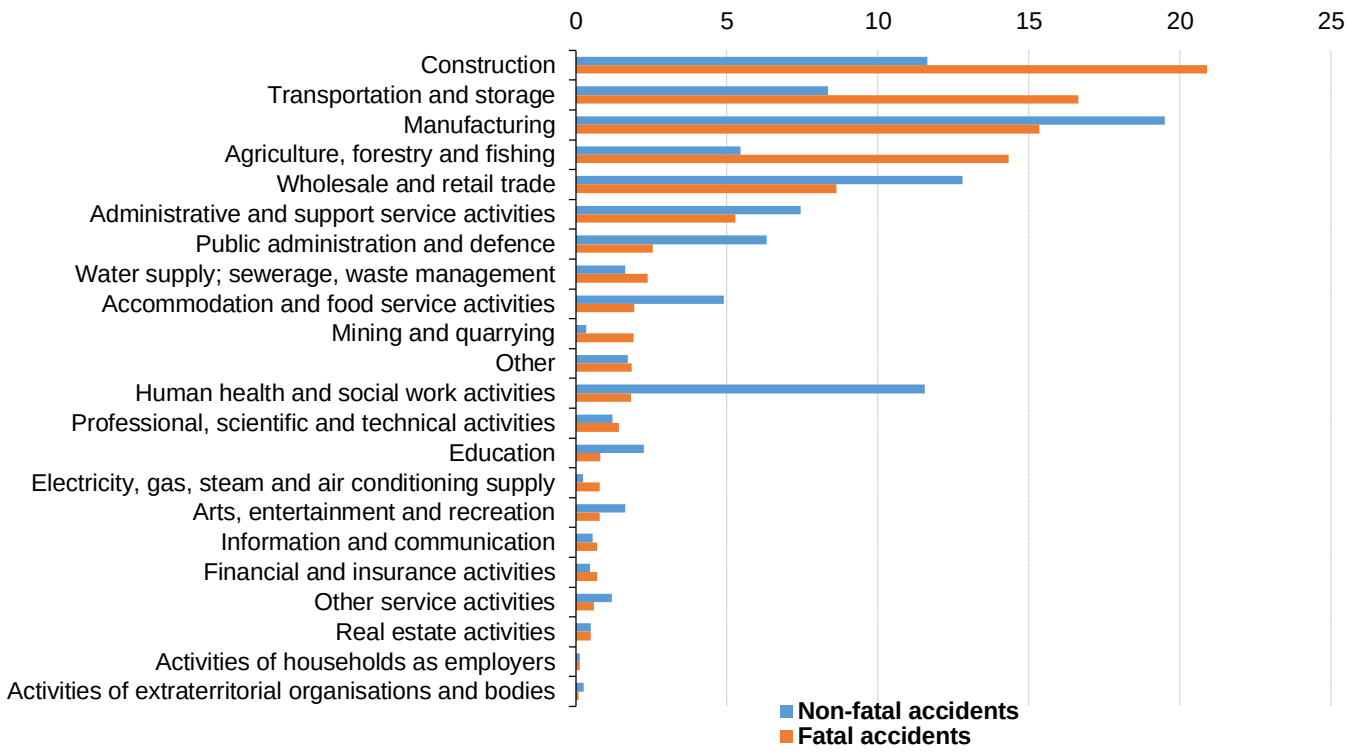

Figure 2.3: Percentage of fatal and non-fatal accidents in 2014 (Source: Eurostat, 2016)

In the Russian construction industry, the rate of occurrence of accidents is also high. The occupational accidents frequency rate in Russia is higher than in Scandinavian countries, Canada and the United States (Dudarev, Karnachev, and Odland, 2013). In Russia between 2004–2010, Dudarev et. al., (2013) reported that occupational accidents mostly occurred in agriculture, hunting, forestry, manufacturing, transport and communication, and the construction industry. Table 2.1 suggests that the construction industry in Russia has an average accident frequency rate of 6.2 between 2004 and 2010 which is the third-highest after agriculture and manufacturing industry (Ibid). This accident frequency rate indicates the high ratio of occurrence of the accidents in the Russian construction industry.

Table 2.1: Number of occupational accidents in different industries, 2004–2010, Russia (Source: Dudarev et. al., 2013)

	Types of industry						
	Total	Agriculture, hunting, forestry	Mining	Manufacturing	Production and distribution of electric energy, gas and water	Construction	Transport and communication
	Thousands people						
Total number of accidents							
2004	87.8	19.9	5.5	32.3	3.3	7.1	8.5
2005	77.7	15.9	4.9	28.9	3.1	7.2	7.9
2006	70.7	12.9	4.2	27.1	3.0	6.6	7.4
2007	66.1	10.6	3.9	26.6	2.6	6.6	7.2
2008	58.3	7.9	3.3	23.8	2.4	6.3	6.6
2009	46.1	6.7	2.7	17.0	2.1	4.9	5.6
2010	47.7	6.1	2.8	18.7	2.2	4.6	5.9
Number of fatal accidents							
2004	3.3	0.7	0.3	0.8	0.2	0.5	0.4
2005	3.1	0.6	0.3	0.8	0.2	0.5	0.4
2006	2.9	0.5	0.3	0.7	0.2	0.5	0.4
2007	3.0	0.5	0.4	0.7	0.2	0.6	0.4
2008	2.6	0.4	0.2	0.6	0.2	0.6	0.3
2009	2.0	0.3	0.2	0.4	0.2	0.5	0.3
2010	2.0	0.3	0.3	0.5	0.2	0.4	0.3

Israel construction industry experiences a high number of accidents annually. It was reported by Haaretz (2016) that between the years 2000 and 2015, 480 fatalities occurred in the construction industry which shows that the construction accident rate in Israel is higher than in western countries. Accident frequency rate has risen to 33.2 per 100,000 in 2015 as compared to 25.4 fatalities per 100,000 in 2010 (Haaretz, 2016). In Malaysia, the construction industry experiencing a high number of accidents despite the implementation of national safety regulations. NSTP (2000) mentioned that the fatality rate from construction accidents are among the highest compared to the overall industry in Malaysia (AbdulRahim et al. 2008). In Malaysia, as reported by AbdulRahim et al. (2008) the number of construction accidents has increased by 5.6 per cent from 4,406 cases in 1995 to 4,654 cases in 2003. Furthermore, the fatality rate has increased by 58.3 per cent from 60 cases in 1995 to 95 cases in 2003 in the Malaysian construction industry (Ibid). AbdulRahim et al. (2008) argue that the Malaysian construction industry requires a fast overhaul to reduce the cause of accidents in the industry.

In the Middle East, the construction industry is responsible for the most number of occupational accidents. Qatar will be hosting the 2022 Fifa World Cup and many construction projects are occurring in the country. It has been reported that at least 1,000 deaths are occurring each year in Qatar and most of the deaths are in the construction industry (Migrant-rights, 2017). In Kuwait, the construction industry is declared the most dangerous sector as recent reports suggest (Ibid). In Kuwait, death among construction workers comprising half of all worker injuries whereas, 83% of the victims of construction accidents sustains permanent disabilities (Migrant-rights, 2017).

2.3.1 Injury by accident type

Workers suffer accidents that cause minor or major injuries and even deaths. Various sources led to the occurrence of construction accidents. Convey (2010) indicated (cited in Saad, 2016) that falls from heights, electrocution, excavation accidents, a crash by vehicles and strikes by falling objectives are the main ranking causes of accidents. U.S. Bureau of labour statistics reports as figure 2.4 shows that overexertion and bodily reaction, falls, slips & trips and contact with objects or equipment are the three main accident types for non-fatal injuries and illness in the US between 2012 – 2016 (BLS, 2017).

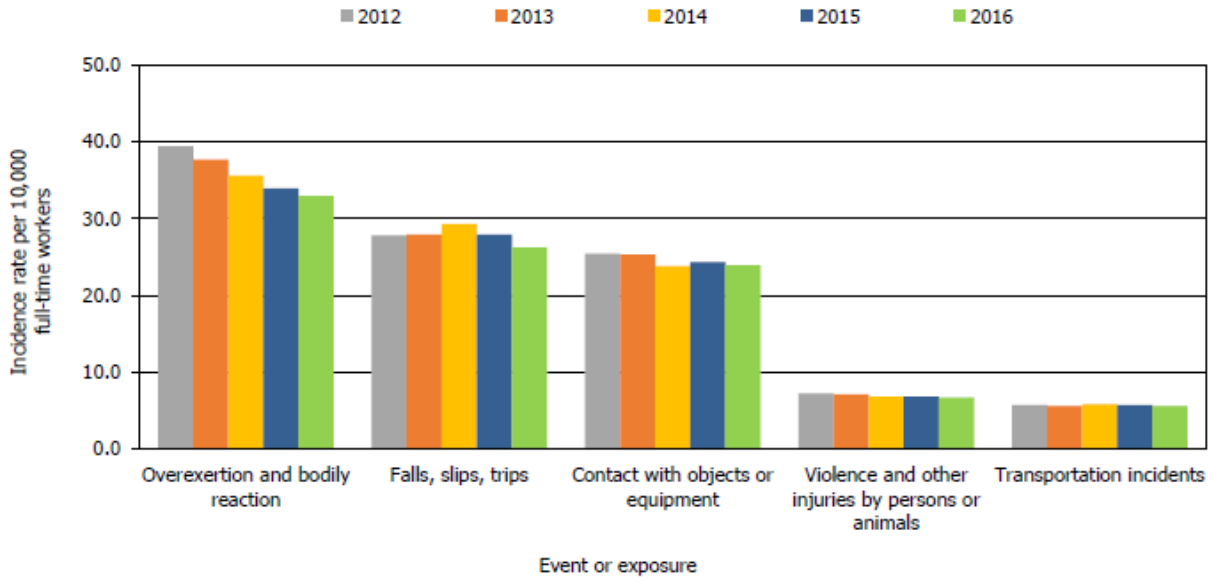

Figure 2.4: Nonfatal occupational injury and illness incidence rates for cases with days away from work by selected event or exposure, all ownerships, 2012-16 (Source: BLS, 2017)

In the United Kingdom, Health and Safety Executive (HSE) statistics show that between 2012 – 2017, most of the work-related fatal accidents occurred were of six accident types (HSE, 2017). Figure 2.5 shows that being stuck by moving the vehicle, falls from height, struck by moving objects, trapping and contact with moving machinery and electricity were the main accident types in the UK (HSE, 2017).

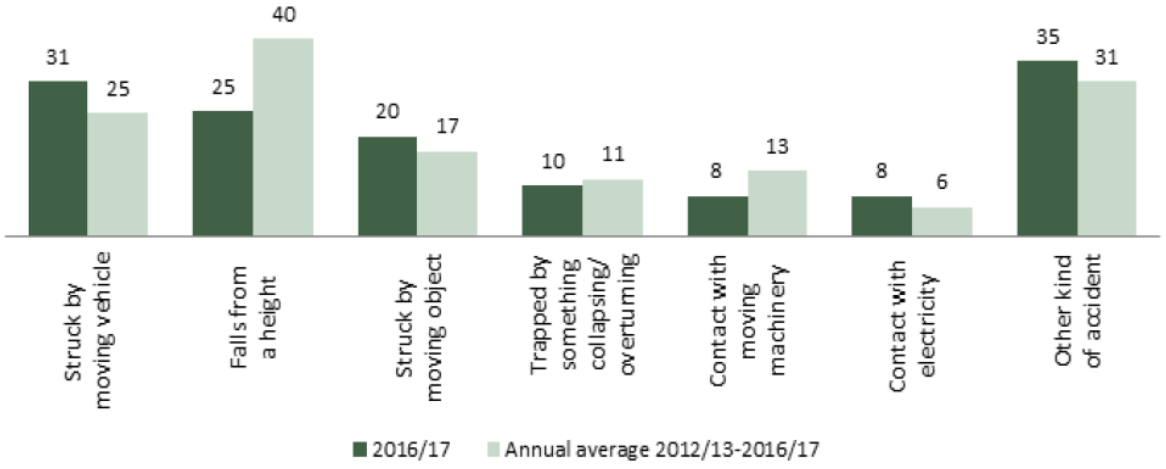

Figure 2.5: Number of fatal injuries to workers by accident kind, 2016/17p and the annual average for 2012/13-2016/17p (Source: HSE, 2017)

In European Union member countries, Europeancomission (2009) reported that the majority of the non-fatal accidents at the workplace occurred due to loss of control of the machine, means of transport, handling equipment, falls of persons and physical stress. Furthermore, figure 2.6 suggests that loss of control was responsible for 41% of the fatal accidents at the workplace in the EU (Ibid).

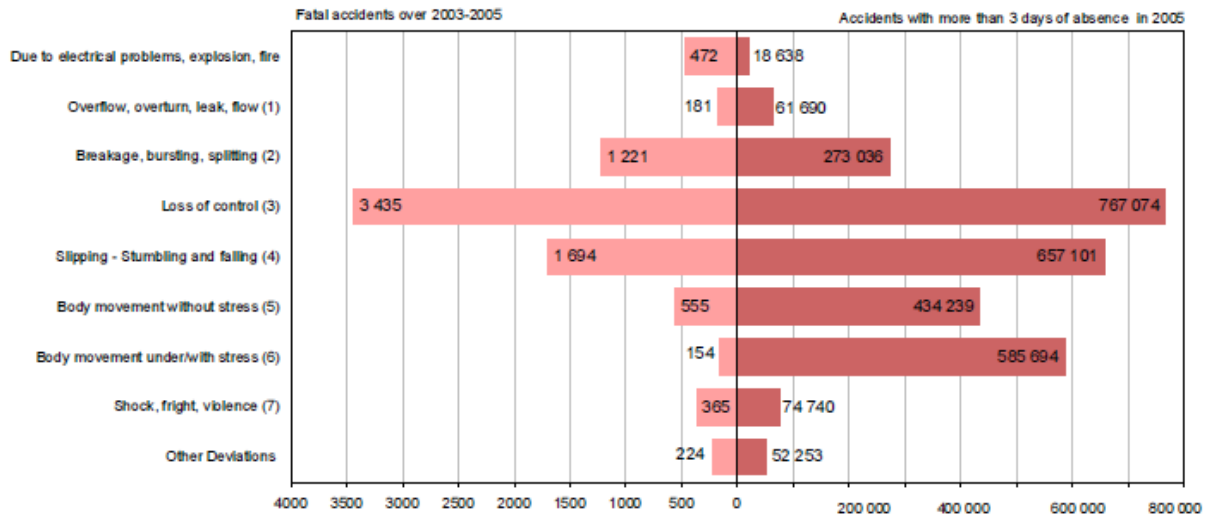

Figure 2.6: Number of accidents at work by deviation and severity, 2005 and for 2003-2005 (Source: Europeancommsion, 2009)

The previous section shows that health and safety performance in the construction industry is low and the construction industry is experiencing many accidents. Improving health and safety in

the construction industry is important. It is highly desirable to decrease the rate of labour accidents for employees working in the construction industry all over the world (Hino, Ohdo, Takanashi, & Takahashi, (2011). The government, employers and employees must work together to improve the health and safety performance of the construction industry. Developed countries, as well as the developing countries, are involved in the occurrence of accidents. The development and implementation of health and safety standards are necessary to reduce the occurrence of accidents. Eyiah, et al. (2019) argues that poor implementation of OHS standards in the construction industry will lead to frequent and more OHS incidents and accidents which could negatively impact on the progress of many projects.

2.4 Theoretical overview of the accident causation theories

Accidents are defined as an unwanted event that may or may not cause any harm to the workers or damage to the facility. The occurrence of accidents is common in any industry. Accidents are caused by numerous contributing factors. To minimize the cause of the occurrence of the accidents in it necessary to understand the reasons that are acting as an immediate and underlying cause of the accidents. One way of understanding the factors that influence the occurrence of the accidents are the accident causation theories. Accident causation theories reveal most of the accidents occur through the involvement of more than one factor, with one factor interlinked with another factor. Many accident theories like Domino theory propose that human's unsafe actions are the reason behind the occurrence of the accidents. In 1932, Heinrich Domino proposed a theory explaining five factors that can either cause near miss or injuries to the personnel when an accident happens (Yates, 2015). According to Domino's theory, unsafe actions by the workers are the most important factor in the occurrence of accidents. Heinrich Domino mentioned unsafe actions are derived by their unsafe behaviour which is inherited from the surrounding environment (Figure 2.7).

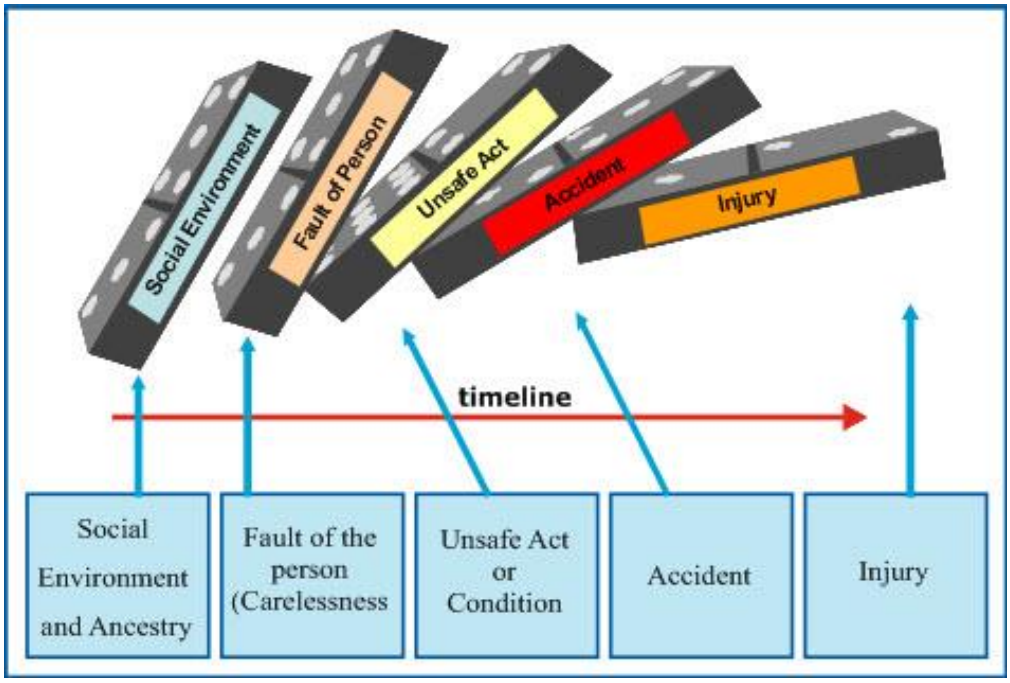

Figure 2.7: Graphical representation of the Domino Theory (Source: Yates, 2015)

Heinrich studied 75,000 accidents and concluded that human unsafe actions cause the most number of accidents (88%) followed by unsafe conditions (10%) while (2%) of the accidents are unavoidable. Another theory named "Behaviour-based safety" theory also mentions that workers' behaviour has a significant impact on their actions. Workers who have safe behaviour will eventually work safely while if they have unsafe behaviour than it will lead to unsafe actions (Hosseinian & Torghabed, 2012). These theories demonstrate that individuals have a strong role in workplace safety and human actions have a significant role in the occurrence of accidents. However, many accident causation theories proposed that accident occurs due to the involvement of numerous factors involving individuals and working conditions. Multiple causation theory and Birds theory propose that workers' unsafe actions and unsafe working conditions contribute towards the occurrence of the accidents. In 1971 Dan Petersen proposed a theory, "Multiple Causation theory" that reveals that the occurrence of accidents is happening because of multiple causes as seen in the figure (Hosseinian & Torghabeh, 2012). According to Multiple Causation theory, unsafe actions and unsafe conditions are the two main reasons behind the occurrence of the accidents (Figure 2.8). Multiple causation theory also mentioned that the prevention of accidents is possible with the involvement of the management.

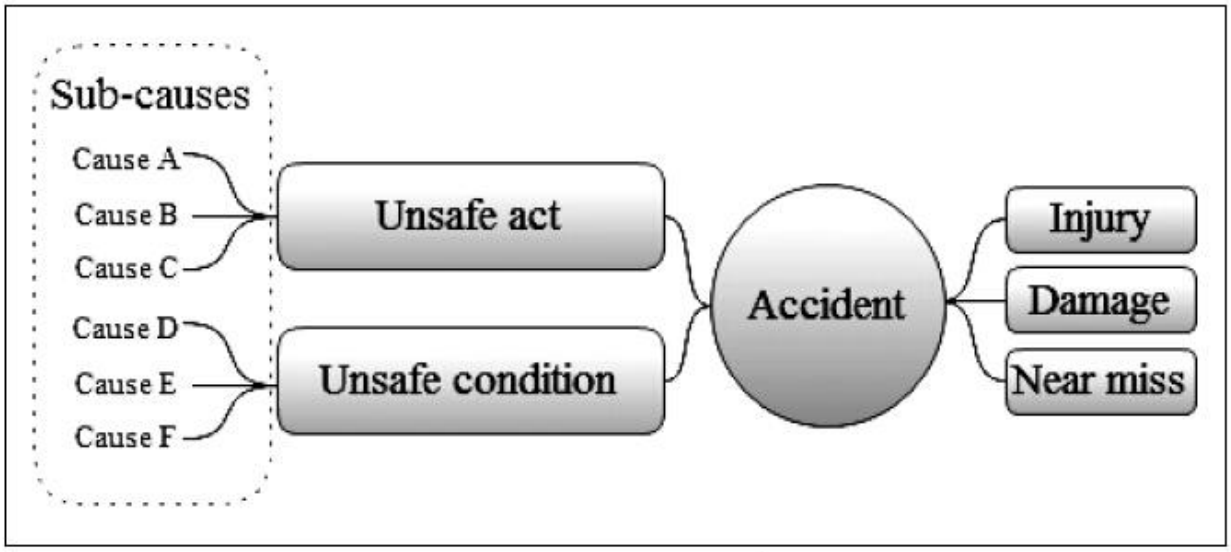

Figure 2.8: Multiple Causation Theory (Source: Hosseinian & Torghabeh, 2012)

Bird and Loftus updated the Domino Theory and made their theory named "Bird theory". According to Bird theory, three factors lead to the occurrence of the accidents: lack of control and lack of management, basic causes and immediate causes (Hosseinian & Torghabed, 2012). Birds' theory also mentioned that inadequate working conditions provided by the management at the workplace have an impact on workers' actions and can lead to a worker making an error or mistake causing an accident. Reason (1990) has developed a Swiss Cheese Model that was developed to determine the cause of the failure or any mishap. Reason classified the failure types into two; Active and Latent failures. Active failure is related to human error while latent failure is related to the technical error or lack of safety controls (Reason, 1990). Reason believed that active failures have an immediate effect on the organization and the surrounding while latent failures are hidden and take time to impact but are more dangerous. In the Swiss Cheese Model, as shown in Figure 2.9, Reason (1990) explains that any incident/accident can occur after the succession of four failures. The first failure occurs due to lack of organizational commitment and instructions, the second failure occurs due to poor or inadequate supervision and monitoring, the third failure occurs due to poor implementation of procedures and the final failure occurs due to human error (Sowayigh, 2014).

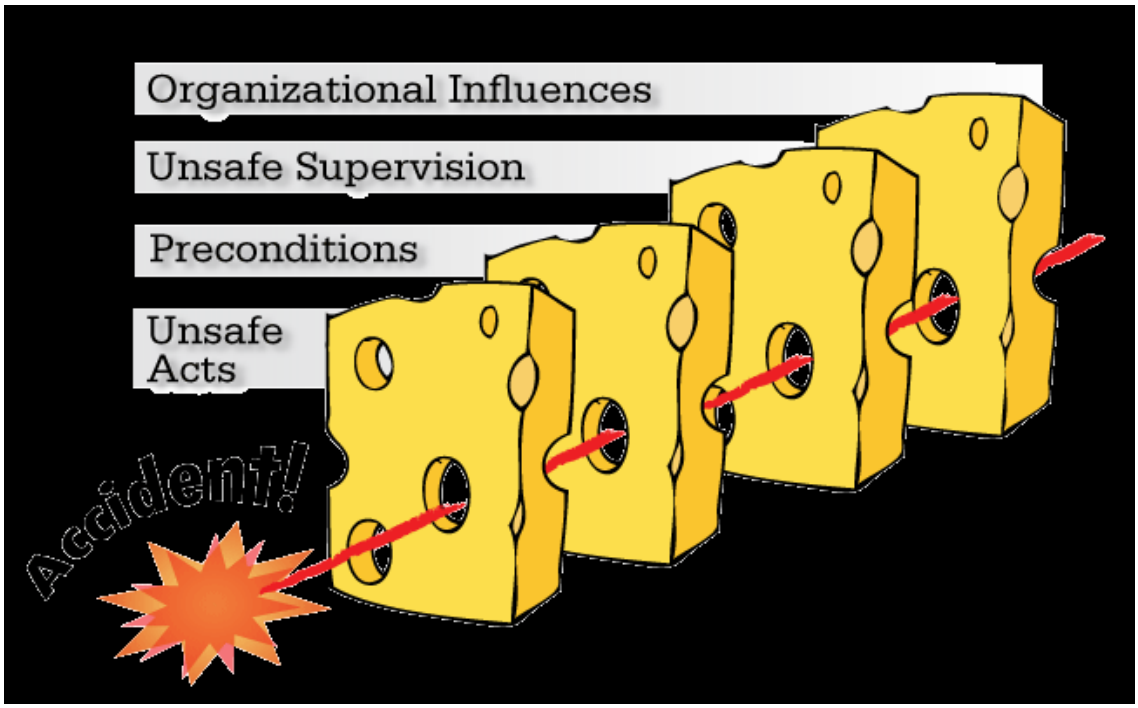

Figure 2.9: Reason's Swiss Cheese Model (Source: Sowayigh, 2014)

There is another theory named, "System theory" which mentioned that there is an interrelation between man, machine and the environment at the workplace (Yates, 2015). The occurrence of the accident occurs when one element is disturbed or not maintained properly. This theory maintains man as the most valuable source and pointed out that the attributes and characteristics of the person can influence their decisions leading towards unsafe actions/errors/mistakes which can cause an accident. Furthermore, system failure and unsafe environment also contribute towards the occurrence of the accidents.

Figure 2.10: System Theory (Yates, 2015)

Human factor theory suggests that human mistakes are the reason behind the occurrence of accidents whereas, there are some contributing factors such as, poor design of the workplace and inadequate machinery which creates unsafe situations and accidents occurs. Human factor theory does not blame humans as the main culprit behind the causation of the accidents but highlights that accidents occur due to various other casual factors. Another system related to Human factor was developed by Shappell & Wiegmann (2000) known as, Human Factor Analysis and Classification System (HFACS) through Reason's model to identify the different aspects of the Swiss Cheese Model more clearly. In HFACS, four failure types were used, Organisational Influences, Unsafe Supervision, Preconditions for Unsafe Acts and Unsafe Acts as explained in the Reason's Swiss Cheese Model (Shappell & Wiegmann, 2000). HFACS placed an Organisational factor on the top of the chart and described it as the most critical because all other failures occur due to failure of Organisational safety management. In the next steps, unsafe supervision and preconditions for unsafe acts were described as a contributing factor for the occurrence of the accidents (Ibid). In HFACS the last stage that is related to individual and is known as unsafe acts which are further classified into two types; Error and Violations (Figure 2.11).

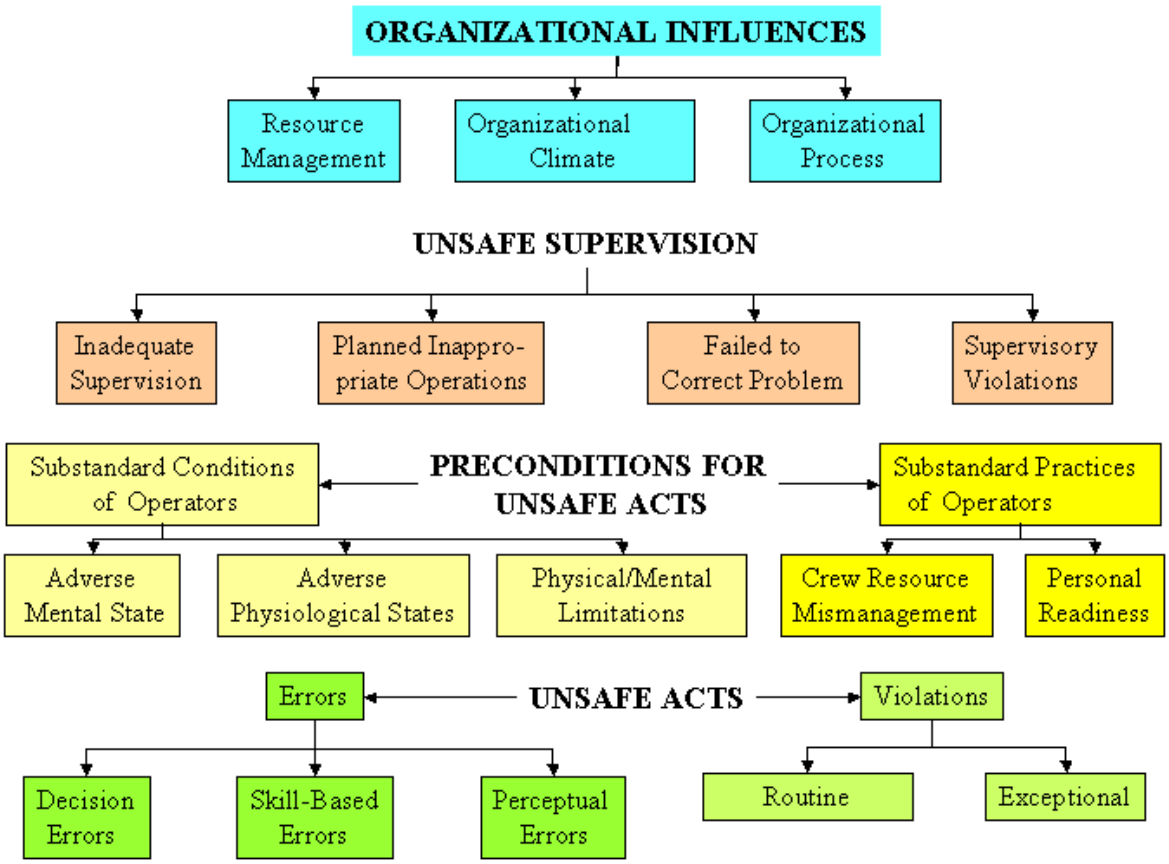

Figure 2.11: Human Factor Analysis and Classification System (Source: Lee & Harrison, 2000)

Lee & Harrison (2000) made a study regarding the causation of accidents in the Chinese Aviation Authority and identified that most accidents are caused by either, skilled-based errors or ruled based errors. The study recommended that safety can be improved through the effective involvement of leadership and management and by the strict enforcement of safety procedures. A safety culture pyramid was developed by (Patankar, Brown, Sabin & Peyton, 2012) which consists of four divisions: Safety performance, Safety climate, Safety strategies, and Safety values as shown in Figure 2.12. According to the study, the safety culture is dependent upon these four elements and safety performance can be improved by effectively defining and practically implementing safety values and safety strategies (Patankar, Brown, et al., 2012).

Figure 2.12: Safety Culture Pyramid. (Source: Patankar, Brown, et al., 2012)

Accident causation theories presented above describes that most of the accidents are the result of the failure of numerous casual factors. An accident occurs due to immediate and underlying sources. It can be evaluated from the accident causation theories presented above that unsafe actions by the workers act as an immediate cause of the accidents, but underlying sources are emerging from the organization, workplace, and tasks. Individuals' actions and behaviour are influenced by organisational factors and working conditions. Furthermore, design and supervision as part of job factors have a significant role in the occurrence of accidents. In the next section, research studies will be reviewed to examine how humans are causing accidents and what are the reasons behind workers' unsafe actions.

2.5 Theoretical review of the involvement of humans in the occurrence of the accidents

The previous section containing the accident causation theories revealed the significance of human actions in the occurrence of the accidents and provided an understanding of the fact that human actions are influenced by different casual factors. In this section, research studies and literature will be reviewed to understand the role of individuals in the occurrence of accidents as

suggested by the accident causation theory and explore the reasons why the individuals are involved with such actions.

Jobs are being carried out by humans, who can make mistakes or even violate safety rules. These mistakes and violations can contribute to the occurrence of the accident. Workers' actions are always considered the immediate source of accidents. Peterson (1982) emphasized that people are the fundamental reason behind the cause of accidents (Oswald, 2016). Donald and Canter (1993) pinned that accidents occur due to the involvement of the workers (Sui et al., 2003). A review of the research study shows that most of the reported accidents are due to human failures, unsafe actions, violations of safety rules, errors and mistakes. Human failures have contributed to many accidents. Vondráčková et al. (2016) mention that human error accounts for 80% as the causes of failure which leads to accidents. Workers' negligence, failure to obey safety regulations by workers, poor workers' attitude towards safety are the main causes of construction accidents (Abdul Rahim et al., 2008).

Human unsafe actions, errors, and lapses are the result of different reasons. Personal factors play a significant role in influencing the human to work unsafely or commit an error. Accident causation theories reveal that unsafe actions by the workers are associated with their factors such as an individual's attitude, belief or behaviour. Workers' actions are influenced by their behaviour which was suggested in Domino theory. Behaviour is the way a worker reacts toward a certain situation. H&S reports and research studies show that human behaviour is one of the key factors which influence that worker in acting safely or not. Unsafe behaviour will eventually lead to unsafe actions causing an accident. (HSE, 2007) mentioned that a significant number of accidents reportedly caused by inappropriate behaviour. Patankar and Sabin built a safety culture pyramid and describes that there is a relationship between human behaviours and the safety performance of the person in the organization (Hejduk and Tomczyk, 2015). Workers' behaviours are influenced by different personal and environmental factors. The attitude of the worker has a strong impact on the behaviour of the worker. Dobson (2015) pointed out that workers' risk-taking behaviour is emerging from their emotional state, risk attitude, passive or submissive personality, reluctant to interrupt and overconfidence. Human errors or mistakes are not intentional but rather a response to a particular situation. The working environment and organizational factors tend to influence the behaviour of the workers. Dobson (2015) mentioned that sometimes human behaviour that results in an error is occurring because of limitations in the design, organizational and situational factors. It must be recognized that any person inherently can cause an accident if placed under certain circumstances since human behaviours fluctuate (Shi & Shiichiro, 2012). Dobson (2015) highlights that human error occurs as it is a human's natural tendency to minimize the cognitive effort that opens the door to a wide variety of shortcuts in unintentional decision making. Workers may not intend to have an accident but due to worker's lapse of concentration or slip which leads to the occurrence of accidents (Sui et al., 2003).

Workers' perception of safety also influences the workers' actions and plays an important role in the occurrence of accidents. Workers' perception about safety is also known as, Safety climate. Safety climate is defined by Erogul and Alyami (2017) as an individual's perspective on safety policies, measures, and procedures regarding safety concerns, which affect an individual's safety. Different studies have shown that there is an association between workers' perceptions and expectations towards safety and non-injury outcomes such as workers' compliance with safety regulations (Smith et al., 2006). Fang et al. (2006) report (cited in Wamzuiri, 2008) that there is a relationship between the safety climate on-site and personal characteristics of the employees. Smith et. al (2006) indicated that workers' perception of the hazard and risk at the workplace is likely an important factor that formulates the safety climate. Workers' attitude towards safety is a significant part of the safety climate. Cheyne et al. (1998) argue (cited in Sui et al., 2004) that employee attitudes are the most important indices of the safety climate. Patankar and Sabin mention in his safety culture pyramid that safety climate which contains attitudes and opinions impacts the safety of the employees in the organization (Ibid). Sui et al. (2004) made research in examining the relationship of safety climate, psychological stress and safety performance among the construction workers in Hong Kong and concluded that safety attitude has an indirect relationship with accident rates, mediated by psychological distress. Safety climate is influenced by various personal and working environment factors. Chib and Kanetiker (2014) explain that the elements of personal factors such as competence and perception influence the safety climate. At the workplace, workers' perceptions are developed through experience, training and organizational safety culture. Zohar (2000) pointed out that supervisors' actions also develop perceptions and expectations towards the safety of the workers (Smith et al., 2006).

Violations to safety rules by the workers are one of the main sources of the occurrence of the accidents. Many reasons are being discussed earlier which are related to personal that influence the workers to carry out work in an unsafe manner by violating the safety rules. However, workers' actions are also affected by the factors associated with the workplace. Wang (2013) argue that safety violations are not only influenced by individual factors but is influenced by the interactions between the different factors at various levels. Alper and Karsh (2009) pointed out that poor management, time pressure, and workload are some of the key factors that influence the workers in violating safety rules (Wang, 2013). Work-related factors such as workload and job strains affect the worker's ability to work safely as they are more focused on finishing the task than following safety rules and working safely. Sui et al. (2004) reported that during workload, workers report more anxiety and take fewer safety precautions resulting in involvement with more risks causing accidents. Workers' safety performance is also affected by workload. Sui et al. (2004) argue that workers experience psychological strains due to workload which impacts their safety performance. Alsowayigh (2014) pointed out that workplace work pressures are one of the factors that influenced the workers in violating safety rules.

In this section, it was revealed that individuals can have different behaviours, attitudes, beliefs, and characteristics which can influence safety while performing tasks. The difference in characteristics is mainly due to gender, environment, family influence, education, and occupational training. Tasks and characteristics of the human need to be considered carefully as it will help to perform the job effectively and safely. Personality is fixed and cannot be modified while skills can be developed and improved by training which will enhance the attitude and behaviour (Towlson, 2003).

2.6 Human Factors and their components

Accident causation theories and research studies share homogenous information as discussed in sections 3.4 and 3.5 and 3.6 that human actions have a significant influence in the causation of the accidents. A worker's unsafe actions create a risky situation that may end up causing an accident. It was also pointed out human factors associated with the individual, task, organisation, and environment are influencing human actions and affect the overall safety performance. Al-Humaidi and Tan (2010) mentioned that in construction safety management, various factors such as labour, materials, and equipment are known to influence the total safety performance (Zhang, Zhu, Zhang, & Zhao, 2019). To understand the role of human actions on safety performance, it is necessary to explore the human factors that are impacting individual safety through direct or indirect involvement. To understand factors emerging from the individual, job, workplace, and environment it is important to examine "Human Factors".

The human factor is referred to as, the involvement of different factors that influence human behaviour and actions. Definitions of human factors suggest that it is not only the factors associated with individuals but also linked with the factors related to workplace, task and the environment. The human factor is defined by World Health Organisation (WHO) as the study of the interrelationships between humans, the tools and the equipment they use in the workplace, and the environment in which they work (WHO, 2019). World Health Organisation (WHO) refers to the term human factors to describe interactions between three interrelated aspects: individuals at work, the task at hand and the workplace itself. Health and Safety Executive (HSE) of the UK explain Human factors as to environmental, organisational and job factors, and human and individual characteristics, which influence behaviour at work in a way that can affect health and safety (HSE, 2019). Definitions of human factors from WHO and HSE provide a similar view that there is a close relationship between the workers, task and the workplace. These three components are interrelated.

The term Human factors were first introduced in 1979, after the Three Mile accident to cope with trauma caused by the accident. International Atomic Energy Agency (IAEA) suggested that to prevent human and organizational error, human factors must be considered (IAEA, 1998). Findings from the research studies suggested the components of human factors is influencing the safety performance. A survey was conducted in Japan by Ministry of Economy, Trade, and

Industry to understand the direct causes for industrial accidents that have occurred since 2002 and result shows that more than 70% of all accidents were caused by human factors including manipulation, misjudgment, and defective manuals (Shi & Shiichiro, 2012). Wang (2013) investigated the reasons behind the worker's violations of safety and concluded that worker violates safety rules due to numerous factors associated with the social environment, workplace, and individuals. Schmid (2005) writes that human capacity or performance is often affected by a variety of human factors interacting in a complex way (Abubakar, & Wang, 2019).

Vykopalová & Cupal (2014) mentioned that all human activity is influenced mainly by individual factors (personality traits - mental and physical) and external factors (situational, social and technical). HSE (2019) emphasise the importance of job, individual and organization factors which is concerned with what people are being asked to do (the task and its characteristics), who is doing it (the individual and their competence) and where they are working (the organisation and its attributes). Health and Safety Executive (HSE) describes that in the concept of human factors three main factors that are interrelated are the job, the individual and the organization (HSE, 2019). Vykopalová & Cupal (2014) also pinned that workers' actions are influenced by individual, job and organizational factors. Research study shows that human factors are associated with three main components: individual, job and organisation (HSE, 2019; Vykopalová & Cupal, 2014; Wang, 2013; Shi & Shiichiro, 2012). Furthermore, these three components influence the behaviour and actions of the workers. In this following sub-section, the role of individual, job and organisational will be explored to understand their effect on the safety of the workplace and how these components are influencing the individuals directly or indirectly in the occurrence of the accidents.

2.6.1 Individual

No incident or accident arises spontaneously but through failures and the emergence of errors in human behaviour (Vykopalová and Cupal, 2014). Hobbs (2008) identified human error as a threat to virtually all advanced technological systems. Human unsafe actions have led to many accidents in different occupational industries. Vykopalová & Cupal (2014) pins that there is a strong impact of human behaviour on the occurrence of accidents. It has been estimated that human error is involved in 70 per cent of aircraft accidents, as well as 80 per cent of shipping accidents, and at least 58 per cent of medical misadventures (Hobbs, 2008). In the railway industry, driver error is one of the significant reasons behind the cause of accidents. It was reported that in 2005 at the Amagasaki rail crash in Japan, the driver was so stressed that he chose to use a service brake, instead of an emergency brake (Dobson, 2015). Hobbs (2008) said that violations may be involved in 70 per cent of accidents in some industries. A study made by Panuwatwanich (2016) shows that in the nuclear processing plant, a significant and positive relationship between negative behaviour and the probability of an accident which involves personal injury was found in a study of among the employees.

Individuals are related to humans who are either carrying out the task or somehow associated with the planning, management, supervision, and execution of the tasks that are being carried out. HSE (2019) explains that individual factors include his/her competence, skills, personality, attitude, and risk perception. Individuals' attitudes, beliefs, and behaviour have a strong impact on their actions. It is important to understand that each worker has some limitations in terms of understanding or carrying out some activity. These limitations are associated with many reasons associated with their knowledge, beliefs, and experience. McLay, & Anderson (2018) emphasis that humans have many unique capabilities, but they also have recognized limitations in terms of sensory capability, perception, memory, knowledge, physical capabilities, emotional makeup, beliefs, and motivation and are thus less than 100% reliable. Workers limitations and expertise need to be considered while hiring them for a specific job as if workers are not qualified for that job, he/she may end up in making error resulting in unsafe acts and causing disruption in the safe system of work which can affect not only his/her safety but impact the overall safety of the surrounding. Awareness, knowledge, and skills of the workers have a strong influence on the safety of the workers. Research has shown that collective knowledge, skills, and abilities of the employees have a significant impact on the individual's performance (Luthans, et al., 2004). One important reason worker violates safety rules are due to their inadequate competence level. Workers are hired for jobs in which they have no or limited experience, knowledge or training resulting in carrying out the activity which either results in an error or unsafe actions resulting in causing an accident. Wang (2013) mentioned limited safety awareness and experience of the workers as a contributing reason behind workers violating safety rules.

Workers' habits, knowledge, perception, behaviour, and skills have a significant influence on their actions. Hejduk and Tomczyk (2015) highlighted that the effectiveness of a person is only possible when a person has adequate habits along with knowledge and skills. Motivation and commitment are the keys to the success of the organization (Hejduk and Tomczyk, 2015). Taylor (2010) emphasized the importance of perception of the workers and states that it is necessary to analyze the perception of employees and their beliefs regarding safety in the organization (Hejduk & Tomczyk, 2015). It is important to understand that the organisation needs to develop knowledge and confidence among the employees through various measures such as training. Training and practical experience help the workers in gaining knowledge and confidence to work effectively with safety. Luthans et al. (2004) emphasis that in the present era, both individual and organisational performance can be improved by developing confidence, hope, optimism, and resilience. Bandura (1997) states that confidence has been demonstrated to have a strong positive relationship with work-related performance (Luthans et al. 2004). Taylor (2010) argued that the relationship between beliefs and behaviour will help in understanding the safety culture in the organization and the motivation of employees (Hejduk & Tomczyk, 2015). Vondráčková et al. (2016) emphasized the importance of managing human factors and argued that it is necessary to consider the concept of individual factors into organizational culture and safety culture. This section discussed how various factors of the individuals such as behaviour, attitude, knowledge, beliefs have a strong influence on their actions. Also, there is a need to understand that individual

behaviour and actions are influenced by the factors associated with the job and organisation. Therefore, in the next section role of job in impacting the safety performance of the workplace as well as the workers will be examined.

2.6.2 Job

Job factors include the subfactors such as the nature of the task, workload, the working environment, the design of displays and controls, and the role of procedures (HSE, 2019). Titas (2013) identified in his study that accidents on construction sites can be also qualified as a defect of a company's occupational safety management system caused by the totality of a wide variety of factors including technical and technological factors that are associated with the tasks. A job site, complex machinery, tools, and devices have a strong impact on the psychological behaviour of the operator. Vykopalová & Cupal (2014) argues that increasingly complex technological devices require superior human interaction with the technical system and increase the proportion of mental burden over the physical.

Vykopalová & Cupal (2014) pinned that job factors impact the mental state of the workers which are subject to several changes (exhaustion, illness, intoxication by various substances and drugs, lack of sleep, etc.) that significantly affect mental performance and generation of errors and incorrect behaviour. A job site, workers who are exposed to heavy workload and time pressure which often leads to violations and creates more chances of experiencing fatigue by the workers. McLay and Anderson (2018) mention that several factors can critically affect the ability of people to detect stimuli and make decisions. The more obvious of these include fatigue appearing from shift work, workload and work environments. Parida and Ray (2015) conducted a study in which workers belonging to masonry and carpentry experience musculoskeletal injuries/disorders due to tiredness, fatigue, stress, awkward posture, heavy, strenuous and repetitive workload. Hobbs (2008) mentions that in the maintenance of the aviation industry, time pressure is particularly likely to lead to memory lapses and procedural violations, such as where an engineer uses a procedure shortcut to enable an aircraft to depart on time.

The design of the equipment and the workplace have affected workers' safety. Titas (2013) argues that any adverse event on a construction site is associated with construction design in the broadest sense. McLay and Anderson (2018) mention that the investigation of numerous disastrous events has revealed that many of them resulted from a lack of considering individual capabilities and limitations in system design. Individuals must have certain limitations and if these limitations are not addressed or taken into consideration then there is a chance that later individuals' actions will be affected by it. McLay and Anderson (2018) explain that when humans are critical components in a system (their actions/inaction can lead to a system failure), the design that does not consider these limitations can result in inadequate human performance with catastrophic system results such as those experienced at Three Mile Island, Bhopal, and

Chernobyl. HSE (2019) stressed the importance of designing the tasks with ergonomic principles to take account of both human limitations and strengths matching the job to the physical and the mental strengths and limitations of people. McLay and Anderson (2018) argue that humans are error-prone therefore system design must take that propensity to err into consideration when the interactions of the human with the rest of the system are designed and developed. In Japanese train control technology, Dobson (2015) highlighted that human error is avoided through the use of behavioural techniques, extensive procedural checks, strict discipline, and rigorous maintenance regimes.

This section examined the role of factors associated with the job on the behaviour and actions of the individuals. It was identified that job factors such as, workload, design and poor ergonomics influence the individuals which further affect their safety performance. To have workers work safely, elements of job factors must be carefully managed by considering the persons who will carry out this job. HSE (2017) mentioned that the organisation has significant responsibility in maintaining the overall safety of the workplace and there are numerous accidents reported that is due to the failure of organisational factors. Therefore, in the next section role of the organisation in maintaining safety and influencing workers will be explored.

2.6.3 Organisation

The organisation has an important role in keeping workers and workplace safety. The organisation contains various factors that influence the overall safety of the workplace. HSE (2019) explains that the work patterns, the culture of the workplace, resources, communications, and leadership are some of the key parts of the organisation. HSE (2019) emphasized the importance of organizational factors and stated that these factors have a significant influence on individual and group behaviour. Hobbs (2008) presented a model of accident and incident causation which was derived from the Swiss Cheese model as shown in figure 2.13. Accident and incident causation models show that accidents are triggered by individual actions such as workers, in the context of local conditions such as workplace conditions (Ibid). All factors of the model of accident and incident are influenced by the organization factors such as company policies, resource allocation, and management decisions (Ibid). Hobbs (2008) mentioned that to understand the various factors of the model it is necessary to understand organizational factors.

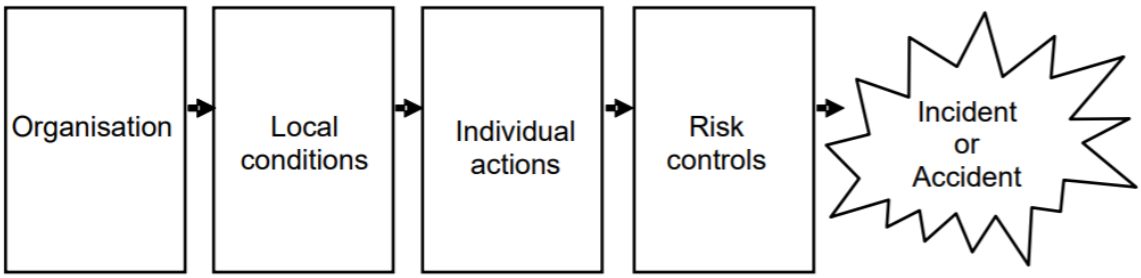

Figure 2.13: A model of accident and incident causation (Source: Hobbs, 2008)

Organisational failures and limited defences against hazards result in the causation of the accidents. Many reported accidents were caused by organisational factors. Hobbs (2008) identified that in many cases, maintenance errors in the aviation industry are symptoms of underlying problems emerging from the organisation. Titas (2013) also implied that accidents on construction sites are the result of different factors associated with the organization. Accidents on the construction sites can be also qualified as a defect of a company's occupational safety management system caused by the totality of a wide variety of factors including organizational factors (Titas, 2013). Abdelhamid et al. (2000) examined different accidents in the Malaysian construction industry and revealed that many accidents occurred due to poor site management and unsafe working conditions provided by the organization. Liska and Goodloe, (1993) & Hinze, (2002) stated two different studies by Construction Industry Institute (CII) identified that factors that have a significant impact on construction safety: safety planning, safety training, written safety-incentive programs, alcohol-abuse programs, and accidents investigations, management commitment, safety staffing, safety education, worker involvement, evaluation and recognition, subcontract management (Zhang et al., 2019).

Hobbs (2008) identified organisational-level factors such as training and qualification systems; the allocation of resources; and the cultural or value systems that permeate the organization and act as an underlying cause for the occurrence of the accidents. Zhang et al. (2019) stress the importance of taking precautionary measures and managing the site better to control the hazards. Luthans, Luthans & Luthans (2004) pinned that the organisation needs to effectively develop and manage employees' knowledge, experience, skills and expertise as it has become the key success factor for sustained organizational performance. Employers and employees need to be accustomed to taking reasonable actions, complying with technical standards, maintaining workplace order, checking environmental conditions and immediately removing all kinds of hazards (Zhang et al., 2019). Workers' work in an organisation and workers' behaviour are influenced by the working environment. If the organisation has a poor safety culture, and management is not committed towards safety and does not consider safety as a priority then workers will eventually have unsafe behaviour which will lead them to work unsafely. Furthermore, if the organisation fails to provide safe working conditions to the workers and there

is a poor safe system of work, most chances are that there will be an occurrence of the accident. Research studies mentioned in the previous studies suggested that safety performance is influenced by numerous factors emerging from the individuals, job and organisation. The occurrence of the accident happens when there is a failure in factors associated with the individuals, job or organisation. Workers' actions contribute as an immediate cause of the accident, but job and organisational factors act as an underlying cause of the accident.

2.7 Summary

The safety performance of any organisation is associated with two important things: the rate of the occurrence of accidents and their adherence to the implementation of safety procedures. Saad (2016) mentioned that safety performance just not only is related to the number of reported incidents but also includes many other factors including the safety culture of the organisation. The primary purpose of measuring health and safety performance is to provide information on the progress and current status of the strategies, processes, and activities used by the organisation to control risks to health and safety (HSE, 2001). Globally health and safety performance of the construction industry is poor. Chen, McCabe, & Hyatt, (2017) pointed out that the construction industry has hit a plateau in terms of safety performance. The safety performance of the construction industry is always a reason for concern for the employers as well as the employees. There are many reasons behind the poor safety performance of the construction industry. In developing countries, poor safety performance is reported due to a lack of national safety policy and safety regulations (AlHaadir & Panuwatwanich, 2011). Whereas, AbdulRahim et al. (2008) argue that companies give less importance to the safety of the employees whereas, time, cost and quality are always the main factors considered ahead of safety. Furthermore, safety issues are always considered secondary and take a back seat in construction (AbdulRahim et al. (2008).

Chapter 3

Literature Review – Saudi Arabia

3.1 Introduction

Projects are designed, planned and operated by people. People working at the workplace have skills, beliefs, attitudes, behaviour, and goals which is influencing their actions. Workers' actions whether intentionally or unintentionally cause the occurrence of many accidents. In recent times workers' actions caused many incidents that occurred in different industries around the works that ended up causing massive loss to the facility and human lives. Some of the incidents as mentioned by Stranks (2007) are Bhopal in India, Moorgate, Kegworth and Longford, Victoria, South Australia, together with the Piper Alpha incident. It is important to realise that human failures or unsafe actions are the immediate reasons behind the occurrence of accidents but many underlying reasons influence the occurrence of the accidents. To understand the worker's actions and their behaviour at the workplace, the phenomena "human factor" needs to be discussed and understood. Stranks (2007) defines Human factors as an area of study concerned with people, the organizations they work for and the work they undertake. Stranks (2007) added that human factors are also concerned with communication systems within organizations and the training systems and procedures in operation, all of which are directed at preventing human error. Therefore, it can be understood that human factors have an association with people's work and the task being performed. To understand the actions and behaviour of the people, it is also important to examine the causal factors that directly and indirectly influence the safety of the people as well as the organization. This research will explore the human factors that are influencing the people and resulting in the occurrence of the accidents. In this chapter, the role of human factors which has a significant impact on the overall safety of the construction sites and the construction industry will be examined. This chapter will explore in detail the H&S challenges in the global and Saudi Arabian construction industry which is affecting the safety performance of the global and Saudi Arabian construction industry.

3.2 Overview of the Saudi Arabian construction industry

Saudi Arabia is the biggest country in the GCC (Gulf Cooperation Countries) in terms of population, land and oil reserves. Saudi Arabian economy is part of G-20 and is one of the top 20 biggest economies in the world. As, the largest producer of oil in the world, Saudi Arabia is amongst the fastest growing economies of the Middle East (Alrashed, Alrashed, Taj, Phillips, & Kantamaneni, 2014). The immense revenue being generated from its vast oil reserves, which boosts the country's economy in recent periods (Alrashed et al., 2014). Being the largest exporter of oil in the world, the Saudi economy is constantly on the rise and the construction sector specifically has seen significant increases in activity (Practicallaw, 2013).

O'Brien & Al-Biqami (1999) mentioned that the development of the Saudi Arabian construction industry was synonymous with the rapid growth of the domestic economy, which was fuelled by enormous oil revenues. The Saudi Arabian construction industry is an important element of the country's non-oil GDP sector. Ikediashi et al. (2014) states (cited in Erogul & Alyami, 2017) that over the past three decades, the contribution of the Saudi Arabian construction industry in the Saudi Arabian economy is unique and unprecedented. According to Saudi Arabia's ministry of planning, the construction sector is one of the most important contributors to the gross domestic product (GDP) accounting for about 9% of its total value (O'Brien & Al-Biqami, 1999).

Figure 3.1: Saudi Arabian map (Source: Twitter, 2012)

The Saudi Arabian construction industry has seen many ups and downs since 1980 due to either non-completion of the projects or halting of government spendings (Bubshait, & AL-Juwairah, 2002). Since 2015, Saudi Arabian economy growth remained slow due to the decrease in oil prices in the international market. Saudi Arabia along with the other GCC (Gulf Cooperation Countries) economy relies mostly on the revenues coming from the oil. Jadwa (2017) expected that in 2017 the Saudi Arabian economy will remain slow due to the negative growth in the oil sector. Despite recent challenges faced by the sector due to declining oil prices and lack of qualified workers, construction sector growth clocked in at 4.1% in 2018 (Mefic, 2019). Annual 2018 report by Jadwa (2018) suggests an improvement in the Saudi Arabian economy in 2019 and it is also expected that the non-oil and oil sectors will improve in 2019. Construction, non-oil manufacturing, and transport sectors will be key non-oil sectors that will show growth in the Saudi Arabian economy (Jadwa, 2018).

The kingdom's construction market is expected to show significant growth and offer lucrative potential due to its Vision 2030, NTP 2020, and ongoing reforms to diversify away from oil (Intersec-ksa, 2018). Report by Mefic (2019) suggests that the construction sector's outlook in the short term seems appealing with the sector expected to grow at CAGR of 6.1% from 2018 to

2022 as economic diversification gathers pace. In 2018, Saudi Arabia presented the largest ever budget in which there will be a 14 per cent rise in the capital expenditure by the government (Jadwa, 2018) which will have a positive impact on the non-oil sector, such as construction and manufacturing. Targeted part of the 2018 budget is dedicated to the housing, construction and transport sector (Ibid). Meanwhile, 6 per cent of the 2018 budget will be solely invested in the transport and infrastructure projects as figure 3.2 shows (Intersec-ksa, 2018).

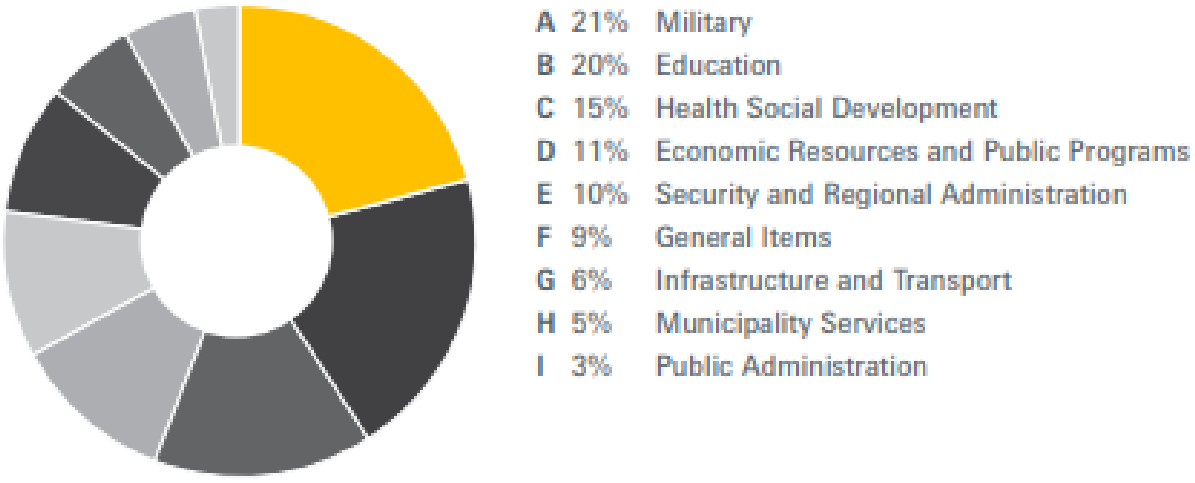

Figure 3.2: 2018 Budget Allocation (Source: Intersec-KSA, 2018)

In 2017, the construction sector of Saudi Arabia contributed 8.1 per cent in the Non-Oil GDP sector however in 2018 it is expected that 0.5 per cent of the growth in the construction sector will be seen from 2017 (Jadwa, 2018). Government spending in recent years in the construction projects has amounted to 338 billion SAR whereas, 83 billion SAR is allocated for construction projects by the government in 2018 (Ibid). According to BNC Network's report, over 5,200 projects are currently ongoing in the country valued at USD819 bn, accounting for around 35% of the total value of active projects across the Gulf region (Mefic, 2019). In Saudi Arabia construction industry comprises of three categories: building, infrastructure, and energy. It is forecasted by Intersec-ksa (2018) that contractor awards across the building, infrastructure and energy sectors are to increase from US$ 34,151 Million in 2017 to US$ 40,068 Million. in 2018. Figure 3.3 (Intersec-ksa, 2018) shows that the building construction sector is expected to register the highest contractor awards followed by the energy and infrastructure sectors in 2018.

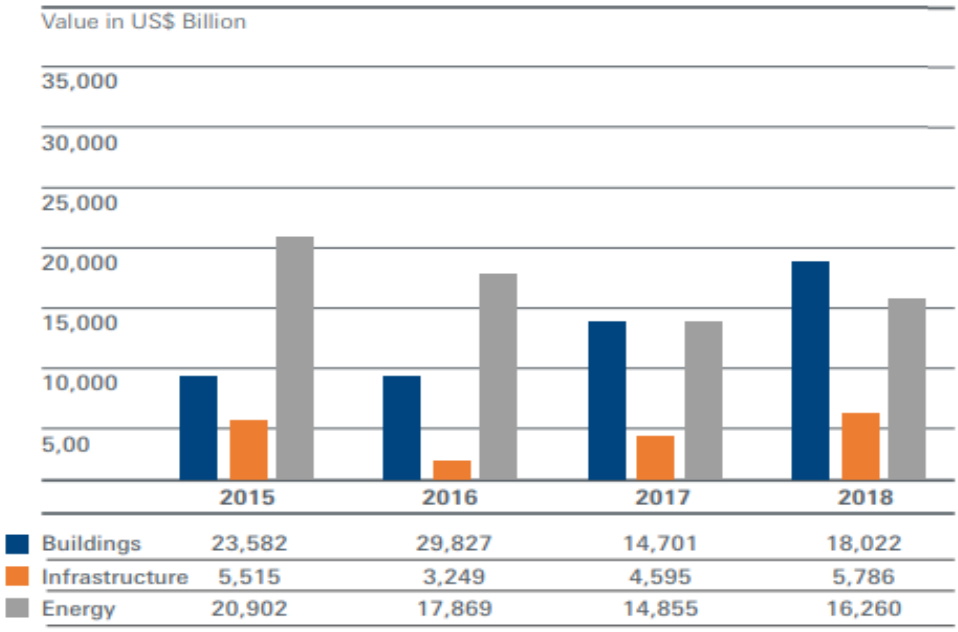

Figure 3.3: KSA Contractor Awards by Sector [2015-2018] (Source: Intersec-KSA, 2018)

In Saudi Arabia, the construction industry employs more than one-third of the workforce. Jadwa (2017) reported that the construction industry in Saudi Arabia employed an average of 40.7 per cent of the total workforce in 2017. In 2016, as Figure 3.4 (Jadwa, 2017) suggests the Saudi Arabian construction industry employed 41.5 per cent of the total country's workforce which declined to 40.3 in the second quarter of 2017 with around 66 thousand of the non-Saudi's and 4.4 thousand Saudi's leaving the sector. Lower government spending and delay in payments were the key reasons that led to the halting of construction projects and as a result affected the led to a decrease in the workforce in the construction industry (Jadwa, 2017).

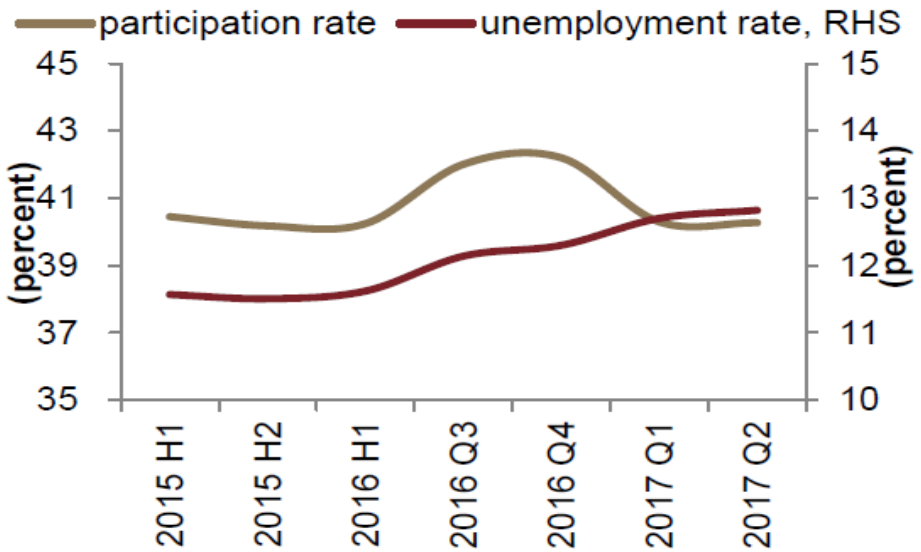

Figure 3.4: Participation rate between 2015 – 2017 Q2 (Source: Jadwa, 2018)

Saudi Arabia is experiencing a construction boom in different parts of the country. Infrastructure, railway and road networks, health care facilities and tourism are the key sectors in which construction projects are ongoing. Alrashed et al. (2014) pointed out that about 20% of the total construction projects are implemented in the transportation sector. Construction projects are underway in different regions of Saudi Arabia whereas, government projects are mostly underway in the big populated cities: Riyadh, Jeddah, Makkah, and Madinah. Riyadh is the capital of Saudi Arabia with a population of more than 4 million (Worldpopulationreview, 2018). In the capital of Riyadh, Qiddiya Entertainment City, King Abdullah Financial District and Riyadh Metro are significant projects (Sauditenders, 2018). Holy cities of Makkah and Madinah are witnessing projects related to Islamic tourism and pilgrimage. Key projects ongoing in the two holy cities are Expansion of Grand Mosque of Makkah, Jabal Omar Area Development Project, Makkah Public Transport System, and Al Fasalyia City, Madinah Haj City (Sauditenders, 2018). Jeddah city is the second biggest city in Saudi Arabia with a population of more than 2 million (Worldpopulationreview, 2018). In Jeddah key, underway construction projects are Expansion of King Abdulaziz International Airport, Haramain High-Speed Railway Project, New Jeddah University Project, and KAUST Housing Complex Project (Sauditenders, 2018). One of the largest projects in the aviation sector is the current expansion of the King Abdulaziz International Airport (Jeddah International Airport) which is expected to cost $7.2 billion (Alrashed, 2014). The government has announced the development of the NEOM city project in which the Saudi government, the Public Investment Fund, and local and international investors are expected to invest over half a trillion dollars into it in the coming years (Investec-ksa, 2018). The major urban construction projects reported by Mefic (2019) in Saudi Arabia include the King Abdullah Security Compounds (Phase 5), and the Grand Mosque, each valued USD21.3 bn. The Saudi government is striving to add 3,900 Km of the track to its extensive railway network. This project is expected to gulp a total of $25 Billion (Alrashed, 2014). Saudi Arabian construction industry is one of the key elements of the country's economy which employs more than one-third of the total workforce. However, the construction industry is facing many challenges related to suitability, quality, time, cost and health and safety. The Saudi Arabian construction industry is experiencing different projects in certain parts of the country, but the construction companies are facing challenges in maintaining good safety performance. Therefore, in the next section, the Saudi Arabian construction industry safety performance will be reviewed to understand the actual situation of the H&S in the country.

3.3 Safety performance of the Saudi Arabian construction industry

Saudi Arabian construction industry is large and expanding with immense structure and manpower, but the poor safety performance of the Saudi Arabia's construction industry is one of the major concerns as it constitutes almost half of the occurrence of accidents as compared to

other industries (Mosly, 2015). The Saudi Arabian construction industry is responsible for most of the occupational accidents in the country. Alsamari et al. (2012) mention that the safety level on Saudi Arabian construction sites lags behind the current development and is considered relatively poor. Mosly (2015) researched determining the safety performance of small and medium-sized private companies of the Saudi Arabian construction industry and concluded that due to the existence of many hazards on the worksite, the safety performance of the Saudi Arabian construction industry is low and requires urgent improvement. Mosly (2015) pinned that in Saudi Arabian construction industry, most of the accidents are occurring in the private sector and small-to-medium-sized projects suffer the most accidents in the private sector of the Saudi Arabian construction industry. One way of determining the safety performance is by measuring the rate of the occurrence of the accidents so, in the next sub-section, the rate of accidents will be measured in the Saudi Arabian construction industry to examine the statistics related to the causation of the accidents.

3.3.1 Accident frequency rate

Saudi Arabian construction industry employs more manpower than other industries in the country and is responsible for more occupational injuries than other industries. Alasamri, Chrisp, and Bowles (2012) did a comparative study on determining the rate of major occupational injuries occurring in the construction sector among the countries: UK, Australia, UAE, US, Kuwait, Jordan, Bahrain, and Saudi Arabia. Comparative table 3.1 (Alasamri et. al., 2012) shows that Saudi Arabia has the highest number of major injury rate per 100,000 employees per year as a result of accidents in the construction industry among other countries which suggest the poor safety performance of the country's construction industry.

Table 3.1: Comparative study from 2008 (Source: Alasamri et al., 2012)

Country	Labour (Thousands)	No. injuries	No deaths	Rates of major injuries/ 100,000 employees/year	Rate of fatal injuries/100,000 Employees/Yr.	Date issued
United Kingdom	2404	Major 3286 Minor 6789	53	254.1 524.9	3.4	2008
Australia	926	Major 1621 Minor 13118	55	175 1416	5.9	2008
United Arab Emirates	1349	Serious	20*	233.03*	6.7*	2008
United States Of America.	13735	Major 164900 Minor 316800 Job 207900 Transfer	975	1200 1500 23000	9.7	2008
Kuwait	127	Serious 1257	13	1013	10.4	2008
*Jordan	374	Serious 2306	-	615.9	-	2008
Bahrain	133	Serious 475	-	357.1	-	2008
Saudi Arabia	1248	Serious 38929	-	3117	28.19	2008
Max Rate of Non-Fatal injuries (major)		3111 per 100,000 (Saudi Arabia)				
Max . Rate of Fatal injuries		28.19 per 100,000(Saudi Arabia)				

In Saudi Arabia, the Government Organisation of Social Insurance (GOSI) estimates that 122,645 occupational injuries were recorded between 2015 and 2016 (GOSI, 2018). GOSI (2018) statistics show that construction, trade and manufacturing sector were responsible for most of the number of injuries at the workplace between 2015 and 2016. GOSI (2018) states the construction industry was responsible for 24,760 work-related injuries which account for 46.36% of total recorded occupational injuries in 2016. Table 3.2 (GOSI, 2018) shows that in 2015, 35,552 occupational injuries were recorded by GOSI in the construction industry which account for 51.35% of the total occupational injuries. In 2014, 69,000 accidents were reported at the workplace and 51% pertain to the construction sector of Saudi Arabia (Atlas-mag, 2016).

Statistics from GOSI suggests that foreign manpower is mostly involved with the site activities and experiences more injuries by accidents compared to Saudi manpower. In the Saudi Arabian construction industry expatriates are working for most of the jobs ranging from low skill positions to highly trained positions (Fass et al., 2016). Table 3.2 (GOSI, 2018) shows that in the construction industry between 2015 to 2016, expatriates (59,142) suffered the most work-related injuries in the construction industry as compared to Saudi nationals (790).

Table 3.2: Work Injuries by Establishment Economic Activity between 2015 and 2016 (Source: GOSI, 2018)

Economic Activity	Saudi		Non-Saudi		Total		Percentage	
	2016	2015	2016	2015	2016	2015	2016	2015
Construction	309	481	24,760	35,071	24,760	35,552	46.36%	51.35%
Trade	368	544	11,471	12,404	11,471	12,948	21.48%	18.70%
Manufacturing	903	1,242	8,589	10,158	8,589	11,400	16.08%	16.46%

In the city of Khobar, Al-Dawood (2000) reported that due to occupational injuries, only 1.5% of the Saudis were admitted to private hospitals. Meanwhile, expatriates' workers constitute 98.5% of the reported admissions in private hospitals as shown in the below table 2.4 (Ibid).

Table 3.3: Nationality, the cause of injury and body parts injured in 468 admitted employees in the cohort of 65,915 workers (Source: Al-Dawood, 2000)

Variable	No. (%)
Nationality	
Saudis	7 (1.5)
Indian subcontinent	344 (74.8)
Filipinos	61 (13.3)
Other Arabs	38 (8.3)
Others	10 (2.1)
Cause of injury	
Fall	158 (33.8)
Tools related	112 (23.9)
Falling objects	68 (14.5)
Car accidents	56 (12.0)
Lifting	25 (5.3)
Fire	21 (4.5)
Others	28 (6.0)
Body parts injured	
Hands and fingers	150 (32.1)
Multiple parts	97 (20.7)
Lower limbs	96 (20.5)
Eyes, head and neck	54 (11.5)
Back	43 (9.2)
Others	28 (6.0)

Figure 3.5 (Aldhafeeri, 2014) shows the occupational injuries that occurred in the construction industry between 2003 – 2013. In Saudi Arabia between 2003 – 2013, construction, manufacturing, and commercial sector are responsible for most of the accidents. However, the construction industry recorded the highest number of injuries at work due to accidents as

compared to other industries between 2003-2013 as figure 3.6 suggests (Ibid). In 2011, 48% of the occupational injuries occurred in the Saudi Arabian construction industry (Zekri, 2013).

Figure 3.5: Number of injuries in the Saudi Arabian construction industry between 2003 - 2013 (Source: Aldhafeeri, 2014)

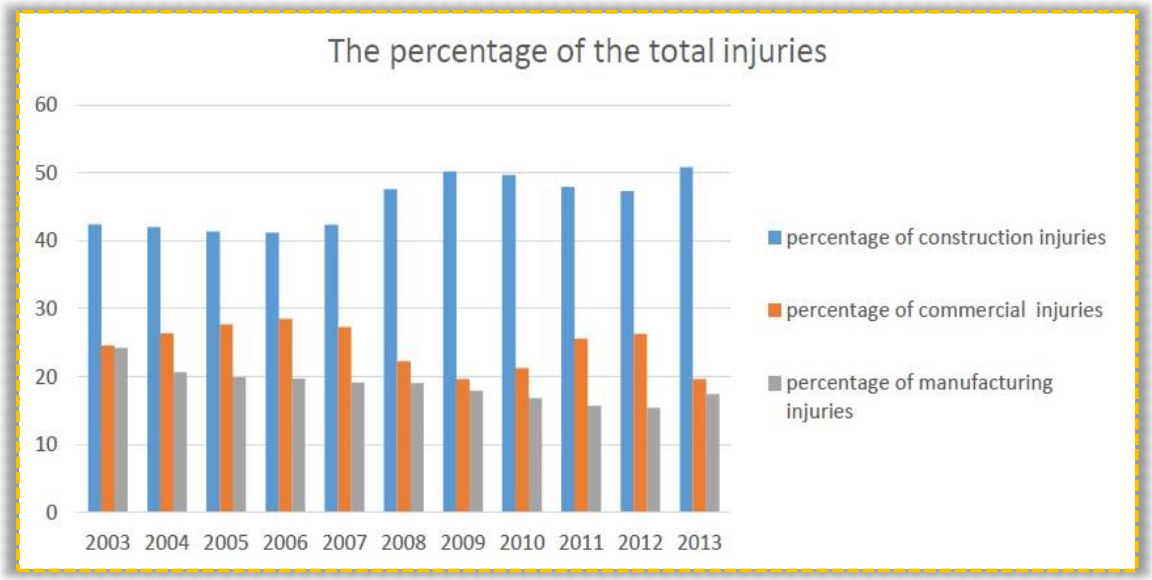

Figure 3.6: Percentage of total injuries between 2003 - 2013 (Source: Aldhafeeri, 2014)

Construction projects are ongoing in different parts of Saudi Arabia. Eastern province and the Central province are experiencing most of the mega projects and these regions are experiencing a high number of accidents. In 2015, the Saudi Arabian construction industry reported most of the occupational injuries in the Riyadh and Makkah region (Thebig5hub, 2016). In 2014, the city of Jeddah was responsible for the highest number of occupational accidents in Saudi Arabia: 23,764

accidents (Mosly, 2015). In Jeddah, the construction industry was responsible for more than half of the occurrence of occupational accidents: 12,438 accidents (Ibid).

3.3.2 Accident by type

Accidents in the construction industry occur due to different sources of accidents including falling from a height, slip, trips and falls and electrical shocks. In Saudi Arabia, the construction industry recorded most of the accidents by falling from height for the year 2016 (Arabnews, 2017). Collision and excavation digging was also the most common construction industry accident types (Arabnews, 2017). Between 2015 and 2016, GOSI recorded as shown in table 3.4 (GOSI, 2018) that most of the occupational injuries occurred due to: struck by (average: 27.16%), falling from a height (average: 27.90%), and rubbed and abraded (average: 17.07%).

Table 3.4: Major occupational injury types in Saudi Arabian (Source: GOSI, 2018)

Injury Type	Number of Injuries		Percentage	
	2016	2015	2016	2015
Struck by	14,368	18,993	26.90%	27.43%
Falling from height	14,475	19,877	27.10%	28.71%
Rubbed and Abraded	9,725	11,030	18.21%	15.93%

Aldhafeeri (2014) records that falling from height is the main type of accident in the Saudi Arabian construction industry. Apart from fall from a height, scratch, overburden and stuck by objects are the distribution of accident types in the Saudi Arabian construction sites as shown below in figure 3.7 (Aldhafeeri, 2014). Al-Dawood (2000) researched in determining the incidence rate of non-fatal injuries requiring admission into the private hospitals in the city of Khobar. In the city of Khobar, falls were the main cause of injury (33.4%), followed by tools-related injuries (23.9%) and falling objects (14.5%) (Ibid).

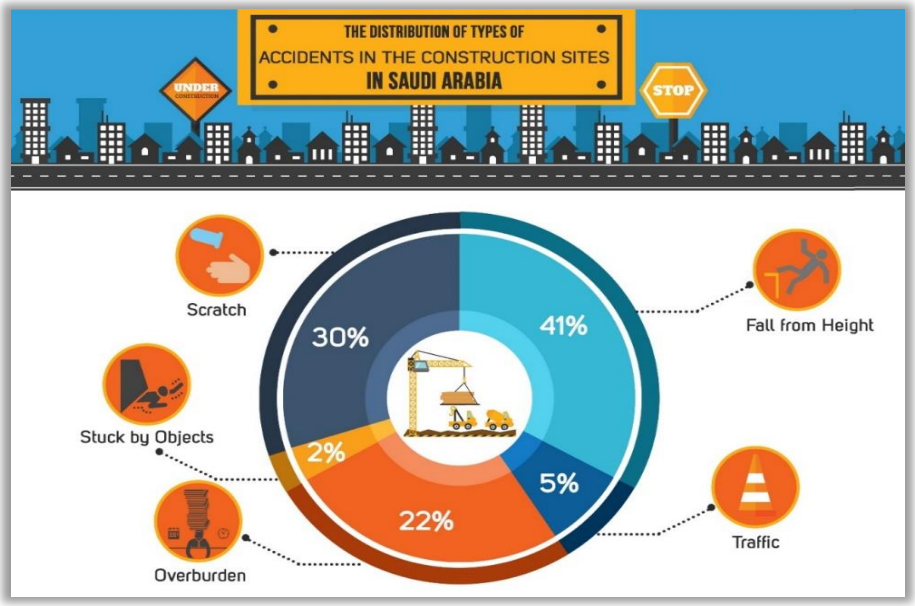

Figure 3.7: Distribution of accident types in Saudi Arabian construction sites (Source: Aldhafeeri, 2014)

The occurrence of a high number of accidents in the Saudi Arabian construction industry is a major concern (Yasir & Saad, 2018). Although various strategic measures have been applied to date to counter the hazards and risks faced by the employee in the industry, critics have been arguing regarding the effectiveness of the policies implemented therein (Ibid). Ashraf (2013) pinned the poor safety performance of the Saudi Arabian construction industry and argues that safety improvement is needed. Saad (2016) implies that the safety performance of the Saudi Arabian construction industry needs to be improved. The occurrence of accidents in the Saudi Arabian construction industry is high as this section revealed. There is a need for improvement in the safety performance in the Saudi Arabian construction industry which is only possible when the causal factors that contribute to the occurrence of the accidents are known.

Section 3.3 revealed that the ratio of occurrence of accidents in the Saudi Arabian construction industry is high and the research study pointed out that in Saudi Arabian construction industry workers' unsafe actions are contributing to many accidents. However, previous chapter pointed out that humans' actions are the result of numerous casual factors influencing humans. To improve the safety performance of the Saudi Arabian construction industry there is a need to explore the role of individuals in the occurrence of the accidents and understand different factors associated with human behaviour and actions.

3.4 Causation of accidents in the Saudi Arabian construction industry due to human actions

Researchers have mentioned numerous reasons for the occurrence of accidents. Individual unsafe actions are pointed out as one of the main causes of accidents. Unsafe acts by the workers are usually caused by different reasons such as limited knowledge and poor judgments. Panuwatwanich, Al-Haadir & Stewart (2016) argue that results from several studies support the notion that the majority of occupational accidents are caused by people rather than unsafe physical working environments. Wilkins (2011) recognised (cited in Erogul & Alyami, 2017) that individuals rather than working conditions as the source of causation of most of the construction accidents. Previous sections opined that workers' actions are influenced by numerous human factors emerging from the workplace, organisation, job and even their personality.

When a worker is involved with unsafe actions by violating the safety rules and neglecting safety precautions it can have a severe impact on the safety of the workplace. Violations to safety rules by the workers not only influence their safety but also put the work system into a vulnerable state (Wang, 2016). In the Saudi Arabian construction industry, violations of safety rules are reported as one of the significant causal factors that influence the occurrence of accidents. Mosly (2015) conducted a study to investigate the safety performance of small-to-medium-sized construction projects in the private sector of Saudi Arabia. It was concluded by Mosly (2014) that violation of safety rules by workers is one of the main causes of accidents in the Saudi Arabian construction industry. Furthermore, Mosly (2015) mentions that 42% of the accidents occur due to worker's violation of safety rules by non-usage of personnel protective equipment. Another study conducted by Awad (2013) mentioned that workers' non-compliance to safety rules causes accidents in Saudi Arabian construction industry. Awad (2013) argued that workers' unsafe attitude is the reason behind workers' non-compliance to safety rules as in Saudi Arabian construction industry workers become more excited when performing their works without safety equipment and this attitude of not obeying safety regulations causes accidents.

Human behaviour was pinned in the domino theory as an originating factor as mentioned in section 2.4 which influences human actions. Safety practitioners hold the firm belief that worker behaviour is one of the main contributors to accidents (Panuwatanich et al., (2016). Balgheeth (2016) also pointed out that human behaviour is a significant contributing factor in the occurrence of accidents in the Saudi Arabian public sector construction industry (Balgheeth, 2016). Negative human behaviour may or may not result in an accident but can put the organisational safety programme at risk and can even have a negative influence on the safety culture. Human behaviour is defined as the way a person reacts to a certain situation. Human behaviour is influenced by various factors: internal and external. Internal factors are associated with the person's own beliefs, attitude whereas, external factors are associated with the culture and environment in which workers are in. Balgheeth (2016) has recognised that human behaviour is influenced by key elements which are: motivation, physical/mental ability, knowledge, and attitude.

In recent times, some reported incidents were caused by various contributing factors including workers' actions. In 2015, one of the deadliest construction accidents in Saudi Arabia happened when 111 people died while 331 injured as a result of crawler crane belonging to the Grand Mosque expansion project toppled and fell on Grand Mosque in Makkah (Arabnews, 2015). The occurrence of this accident happens due to the involvement of various casual factors belonging to the individuals, organisation and even weather conditions. The first factor was the extreme weather conditions as the wind was travelling more than 50 km/h which caused the crane to collapse. The second factor was related to the organisation as the contractor hired an incompetent crane operator who lacked basic crane operation skills and also failed to implement the necessary precautions as the wind was high (Constructionweekonline, 2017). The third factor was a human error as crane operator parked the crane at the wrong position and failed to lower the boom of the crane which is necessary especially in high wind resulting in collapsing of the crane on the ground.

Another accident occurred in 2016 at the worksite of Haramain High-Speed Rail Project, Jeddah when a piece of railway machinery was reversing collided with the workers standing behind the machinery. This accident resulted in the fatality of one worker and injured four workers due to the impact of railway machinery (Saudigazette, 2016). Various reasons led to this accident. The first reason was organization provided defective machinery which did not have a back alarm that rings when it is reversing resulting in the worker not knowing that the machine was reversing. Another reason as workers' violation of safety rules as they are not allowed to stand or work in the proximity of the machine especially when it is operating. In another accident as reported by Saudigazette (2014) in 2014, at a construction site, the crane lost the balance and collapsed resulting in the toppling of the crane in which one worker lost his life. It was reported that this accident occurred due to inadequate lifting operation methods used by the working group.

These accidents show that in Saudi Arabian construction industry, fatal accidents are happening and the involvement behind the causation of these accidents are multifaceted and are not only related to the workers as various casual factors are contributing to the occurrence of the accidents. Researchers have argued that to reduce the occurrence of accidents, human factors need to be managed carefully. The occurrence of the causation of accidents can be prevented by the workers who are involved in it (Sui et al., 2003). Workers' attitudes, behaviour, and actions also influenced by the numerous external factors associated with the workplace, organization, and task. In many cases, an event which is described as a human error is, in fact, not the result of inappropriate behaviours by individuals but something whose cause should be attributed to an administrative flaw of an organizational system (Shi & Shiichiro, 2012). Vondráčková et al. (2016) emphasized the importance of managing the human factors and argued that it is necessary to consider the concept of human factor into organisational culture and safety culture. It is important to understand the factors that influence the attitude, behaviour, and actions of the workers which are impacting their safety performance. Therefore, in the next section, the concept

of human factors and its components will be explored to understand its significance on the safety of the workplace.

3.5 Relationship between human factors and the safety performance of the Saudi Arabian construction industry

In Saudi Arabia, the construction industry is responsible for the highest number of accidents in the workplace as compared to other industries. Research study has revealed that in the Saudi Arabian construction industry various factors are influencing the safety performance. Saad (2016) has identified in his study that workers and management commitment, poor attitude towards safety, lack of training, limited knowledge and awareness as important factors which creates unsafe workplace and causes accidents. In Saudi Arabia, migrant workers coming from different countries are responsible for most blue-collar related jobs. GOSI (2018) reveals that migrant workers are involved with the most number of accidents in the Saudi Arabian construction industry. Many researchers have mentioned that health issues, workload, poor welfare facilities, and unsafe working conditions are some of the casual factors influencing the workers. Workers related to blue-collar jobs experience fatigue and stress emerging from their work which influences their safety. A study from (Alaqaad, 2009) showed that competition among workers, fatigue, and working under pressure had a tremendous impact on safety. Nadim et al. (2016) used a survey to determine the prevalence of depression and to assess its relationship with duration of stay and living conditions. Migrant worker experiences poor health which leads to death or other diseases caused by heavy physical labour, lack of sleep, and no access to proper health care (Nadim et al., 2016).

Saad (2016) researched exploring the safety culture of the Saudi Arabian construction industry to develop a framework on how to improve the safety culture that affects Safety performance in the Saudi Arabian construction industry. Respondents of the study made by (Saad, 2016) admit that there are huge problems in the safety of the construction industry in KSA. The non-engaging attitude of the workers towards safety regulations along with the lack of safety regulations and laws in the country, the poor implementation of existing safety policies are reasons behind the poor safety performance in the Saudi Arabian construction industry (Saad, 2016).

Jannadi (1995) found (cited in Alaqqad, 2009) that the safety performance of each worker is related to his attitude towards his fellow employees and employer. Awad (2013) did research to determine the factors that influence the health and safety in the construction industry of KSA. Results from the data analysis showed that health and safety in the construction process are related to three overlapping factors: Personal attitudes of the workers about the health and safety, and how they deal with the risks and the dangers during the work, HR (human resources) office and the OSH (occupational safety and health) office, and administration of the construction company (Awad, 2013). Al Haadir & Panuwatwanich (2011) did a research to identify the critical factors affecting the successful implementation of safety programs among construction

companies in Saudi Arabia. It was concluded by Al Haadir & Panuwatwanich (2011) that personal attitude, management support, clear and reasonable objectives, teamwork, effective enforcement, safety training, and suitable supervision are the factors that account for 80% of the successful implementation of safety programs in the construction companies.

Jannadi (1995) made research exploring the impact of human relations on the safety of construction workers and found that effective use of human relations would improve safety programs and make safe behaviour a habit for workers (Alaqqad, 2009). Erogul and Alyami (2017) did research is to explore the construction worker's perceptions of the construction site. A questionnaire survey was done in the five construction sites in the city of Najran (Ibid). The result from the study indicates that there is lack of adherence to occupational health and safety regulations by employers, an unawareness among participants in regards to the safety measures endorsed by their companies, a need for construction site safety protocols and enhanced external inspection systems, and indications of leniency due to favouritism by external inspectors (Erogul and Alyami, 2017).

Alrehaili (2016) study observed the influence of safety culture on construction personnel's safety performance on large governmental construction projects in Saudi Arabia. It was concluded by Alrehaili (2016) that as long as construction personnel in Saudi Arabia have excellent awareness about safety culture, construction personnel attitude toward violations tends to decrease. Research findings from the study reveal that safety culture, age, education and nationality in Saudi government construction sites accounted for 7% of the variance in personnel safety motivation to construction safety, 20% of the variance in construction personnel error behaviour and 73% of the variance in construction personnel attitudes toward violations (Alrehaili, 2016).

Accidents can only be prevented when individuals and organizations work together. Alaqqad (2009) recommends that to avoid accidents it is required to identify and eliminate unsafe acts and unsafe conditions. Research findings from the study of (Panuwatanich et al., (2016) also support the notion that good safety behaviours are more likely to reduce accidents and injuries. It is important to realise that human behaviour is influenced by various factors including, workers' knowledge, and working environment. In Saudi Arabia, management needs to increase the create awareness and motivation among employees as worker's motivation helps in the improvement of safety performance. Panuwatwanich et al. (2016) conclude that employees' intrinsic and extrinsic safety motivation can play a major role in influencing the perception of safety climate. Panuwatwanich et al. (2016) also stress that combined extrinsic and intrinsic employees' motivation will effect positive changes in safety behaviour.

This section indicated that accident reasons behind the occurrence of the accidents are multifaceted. Workers are at the front end carrying out the task, therefore, they get most of the blame. However, behind the actions of the workers, different underlying causes influence the workers in carrying out such actions that contribute towards the occurrence of the accidents. Another important information retrieved from this section as researchers have mentioned that the

safety performance of the workplace is influenced by the combination of different factors associated with the components of the human factors: individual, job/task and organization. In the next section, significant factors will be identified that are influencing the safety performance of the Saudi Arabian construction.

3.6 Influencing human factors affecting the safety performance of the Saudi Arabian construction industry

Construction projects are complex which involves the use of manpower of different professions as well as complex equipment to achieve the project targets. The complex nature of the construction sites makes it a hazardous industry. Construction sites are one of the most dangerous workplaces in terms of accident (Alaqqad, 2009). Safety has improved in different industries, but the construction industry is still facing different challenges in reducing accidents. The accident is a tool in assessing the safety performance in an organisation. People and businesses can be affected by the occurrence of accidents due to either injury to the workers or damage to the machinery/structure. Occupational accidents and diseases have many effects on the workers which sometimes lasts for some years and sometimes illness suffered at work not become clear until many years have elapsed (ILO, 2013).

Each phase of the construction project has specific risks and hazards depending on the type and size of the activity. Every activity has a specific risk and the occurrence of an accident depends upon the risk level and nature of the job. Timofeeva et al. (2017) mention that risks of injury rate of construction workers are associated with the specifics of the work, including high-altitude activities (falling from roofs, building timbers, ladders, etc.), earthwork operations (trench collapse, exploitation of earth-moving machinery), the use of lifting equipment (cranes and hauling winches), the use of electrical equipment and manual tools, as well as vehicles on the construction sites.

The occurrence of accidents in the workplace occurs due to two types of main factors: immediate and contributing factors. Jannadi and Assaf (1998) mention that immediate factors include unsafe acts and unsafe conditions while contributing factors include the physical condition of the workers and management policies. Abdelhamid, & Everett (2000) did a study to identify the root causes of construction accidents in the United States of America. Abdelhamid et al. (2000) examined different accidents and revealed that accidents occurred either due to unsafe conditions or individual factors (violation of safety rules and human error). It was emphasized in the study that to reduce the accidents there is a need to consider worker training, worker attitude, and management procedures when efforts are contemplated (Abdelhamid et al., 2000). Wilpert (1994) pinned (cited in Oswald, 2016) that accidents and injuries are caused not only by a single factor but by the long chain of events and interacting factors on several systems levels. Accidents can be only contained if the contributing factors are known and mitigated adequately as Ashraf (2013) emphasise that understanding and determining the factors that lead to accidents are

important to improve the health and safety of the workers. Below contains some of the significant human factors that influence the safety performance of the Saudi Arabian construction industry.

3.6.1 Worker's actions

Workers' actions can have a significant impact on the safety of the project. Construction projects are complex, and mall operating mistakes can usually lead to a grave accident therefore, construction staff should develop good construction practices in the construction process (Zheng & Chen, 2012). Unsafe acts or unsafe behaviour usually caused by either intentionally or with limited knowledge and poor judgments. Workers' unsafe actions have contributed to many accidents in the Saudi Arabian construction industry. Titas (2013) argues that there is a relationship between non-compliance to safety rules and work-related injuries. Titas (2013) mentioned that a large number of work-related injuries is determined by the failure to follow occupational health and safety requirements.

Various researchers (Abdelhamid & Everett, 2000; Saad, 2016; Azmat, 2015) has recognized that the safety violation is one of the main causes of the accident. Probst and Estrada (2010) emphasize (cited in Ashraf, 2013) the importance of strong compliance of safety rules and failure to doing so will cause accidents. Toole (2002) wrote a paper intending to carry the roles of design and construction professionals in site safety. In his research, Toole (2002) pinned eight root causes of construction accidents and mentions that deficient enforcement of safety rules is one of the causes of construction accidents (Ibid). Line managers at the workplace neglect their responsibilities and don't enforce safety rules which become a contributing factor in the causation of accidents (Ibid). Vondráčková et al. (2016) highlighted that one key reason behind the occurrence of accidents is dangerous work practices and actions take without permission or despite explicit prohibition.

Violations to safety rules have led to the occurrence of many accidents as justified by Awad (2013) mentioning that in Saudi Arabian construction industry workers become more excited when performing their works without safety equipment and this attitude of not obeying safety regulations causes accidents. It was concluded by Mosly (2015) that violation of safety rules by workers is one of the main causes of accidents in the Saudi Arabian construction industry. Furthermore, Mosly (2015) mentions that 42% of the accidents occur due to worker's violation of safety rules by non-usage of personal protective equipment by the workers. Sawacha et al. (1999) pinned (cited in Erogul & Alyami, 2017) that workplace accidents occur due to many reasons including, lack of carrying out a task safely, errors in judgment, laziness or negligence.

One of the protections from hazards is the use of mandatory personnel protective equipment at the workplace. Mosly (2015) visited 100 construction projects sites belonging to small and medium-sized private companies in Saudi Arabia and recorded that workers were found not

using the required personal protective equipment at the workplace. Safety glasses, hearing protection, safety harness were not used at all by the workers while hand gloves and safety helmets were used by a small number of workers at construction sites (Mosly, 2015). Zheng and Chen (2012) stressed that construction workers normally have to develop good construction practices of wearing the construction of helmets, seatbelts and other personal protective equipment.

A survey made by Erogul and Alyami (2015) reveals that most of the workers don't use the required Personal protective equipment at the workplace and it was reported that 77% members of the organisation do not wear personal protective equipment such as hard hats, safety glasses at construction sites in Saudi Arabia. Mosly (2015) states that at the construction sites mostly the workers were found using the regular footwear and at only 16% of the construction sites safety shoes were used by the workers. Not using the safety shoes at the workplace is unsafe and provides less protection to the workers. In Saudi Arabian construction industry as reported by GOSI (2017) falling from height is the main source of accidents and Mosly (2015) observed that at the 65 construction sites, none of the workers was found using a safety harness while working at height.

Workers at the workplace have a responsibility for the implementation of safety practices. Unsafe acts not only influence the occurrence of the accidents but can increase risks for the workers working in a team. Zheng and Chen (2012) argue that each of the working staff for the construction has responsibility for the whole project and they need to perform the job well, by completing the project smoothly in a safe and peaceful environment.

3.6.2 Attitude and behaviour towards safety

Unsafe attitude and poor safety behaviours of the workers are some of the reasons for the occurrence of accidents. Human behaviour is a major contributor to construction accidents revealed by much occupational safety literature (Zin & Ismail, 2011). Safety practitioners hold the firm belief that worker behaviour is one of the main contributors to accidents (Panuwatanich et al., 2016). Unsafe behaviour and underestimation of the risk of employees can result in work-related accidents that may cause fatal injuries or even death (Vondráčková, et al., 2016). Stranks (2007) mentions that human behaviour has a direct influence on safety in any aspect of life. Titas (2013) mentioned that one of the main reasons for unsafe behaviour of the workers at work is the poor attitude towards safety i.e. I do not care Lack of knowledge, poor judgments towards decision making can influence the worker to make unsafe actions which can contribute towards the occurrence of the accidents.

Vondráčková, et al. (2016) highlighted that in the majority of cases, work-related accidents occur due to poorly or inadequately estimated risks. Unsafe behaviour, and underestimation of the risk of employees, can result in work-related accidents that may cause fatal injuries or even death

(Ibid). Jannadi et al. (2002) conclude (cited in Balgheeth, 2016) that in the Saudi Arabian construction industry, human behaviour is one of the major sources of causation of accidents. Balgheeth (2016) study has recognized that key elements (lack of motivation, limited physical/mental ability, errors, lack of knowledge and worker's poor safety attitude) are associated with human behaviour which a significant contributing factor towards the occurrence of accidents in Saudi Arabian public sector construction industry.

The safety attitude of the workers will determine the worker's ability to maintain workplace safety. Saad (2016) identified the non-engaging attitude of the workers towards safety regulations is one of the key reasons behind the poor safety performance in the Saudi Arabian construction industry (Saad, 2016). Awad (2013) highlighted that in Saudi Arabian construction industry workers have an unsafe attitude of not obeying safety rules which influence them in working unsafely and causes accidents. Awad (2013) researched to determine the factors that influence the health and safety in the construction industry of KSA. Results from the data analysis showed that health and safety in the construction process are related to three overlapping factors: Personal attitudes of the workers about the health and safety and how they deal with the risks and the dangers during the work, HR (human resources) office, and the OSH (occupational safety and health) office, and administration of the construction company (Awad, 2013).

Research findings from the study of (Panuwatanich et al., (2016) also support the notion that good safety behaviours are more likely to reduce accidents and injuries. Alrehaili (2016) emphasizes that construction personnel's safety performance is measured by their attitude toward violations and error behaviours. In Saudi Arabia, management needs to increase the awareness and motivation among employees as the worker's motivation helps in the improvement of safety performance. Panuwatwanich et al. (2016) conclude that employees' intrinsic and extrinsic safety motivation can play a major role in influencing the perception of safety climate. Panuwatwanich et al. (2016) also stress that combined extrinsic and intrinsic employees' motivation will effect positive changes in safety behaviour.

Al Haadir & Panuwatwanich (2011) did a research to identify the critical factors affecting the successful implementation of safety programs among construction companies in Saudi Arabia. It was concluded by Al Haadir & Panuwatwanich (2011) that personal attitude along with the management support, clear and reasonable objectives, teamwork, effective enforcement, safety training, and suitable supervision are the factors that account for 80% of the successful implementation of safety programs in the construction companies. Jannadi (1995) made research exploring the impact of human relations on the safety of construction workers and found that effective use of human relations would improve safety programs and make the safe behaviour a habit for workers (Alaqqad, 2009). Brauer (2006) argues that to prevent accidents by preventing unsafe acts, one must prevent behaviours that lead to accidents or mitigate the effects of unsafe acts in the causal chain. Report from (IAEA, 1998) recommended that human factors such as employees' perception and attitude towards safety need to be developed and sustained by the

employer as it is one of the factors behind employees' motivation and positive behaviour towards maintaining the safety performance.

3.6.3 Planning

Successful completion of any job requires proper planning where all responsibilities are assigned whereas, risks and conditions at the workplace are kept in mind. Titas (2013) argues that before the start of the job, there is a need for mitigation of the occupational risks emerging from the workplace especially where different mechanisms and tasks are being performed. Titas (2013) pinned that main purpose of the planning works in advance is to create safe zones for each job that is being performed at the construction site as mechanisms operate at the same time on a construction site, dangerous zones around each of them overlap and create a zone where is a risk to be harmed not by one but by several mechanisms at once.

Safety is the responsibility of all entities in any organisation. The project owner, designer, and contractor needs to plan, design and execute the project in a safe manner (Jannadi and Assaf, 1998). Titas (2013) pinned that as several technological processes take place and several mechanisms operate at the same time on a construction site, there is a risk to be harmed by any one of the mechanisms operating. Titas (2013) argued that the importance of the necessity of work solutions to be prepared by the construction team for each specific workplace or area of work. Abdul Rahim et al. (2008) pinned that construction companies use unsafe methodologies at the workplace which contributes towards the occurrence of accidents.

Research studies have shown that lack of proper planning and poor methods of work have influenced the safety performance and contributed to numerous recorded accidents in the construction sites. Saad (2016) mentioned that the project team does not put careful planning ahead of executing the project which creates safety risks at the construction sites. Lack of proper planning is causing materials falling in the workplace, as well as workers colliding with each other, are ever-present in workplaces (Ibid). Saad (2016) recommends that planning is necessary and sufficient planning and proper management are important to the safety and efficiency of the construction site. Zheng and Chen (2012) underline that when sorting and planning at the construction site, construction workers should be introduced the "5S" set management, which is the abbreviation of the five words, collation (Seiri), consolidation (Seiton), cleaning (Seiso), clean (Seikeetsu), and literacy (Shitsuke). Zheng and Chen (2012) stated that by implementing "5S", improvement in the safety performance can be made.

3.6.4 Training

Training creates awareness among the employees and helps the workers in recognizing the risks at the workplace. The main purpose of safety education is to make sure that workers are aware of

the site hazards and to train them in dealing with these hazards (Awwad et al., 2016). Safety awareness and motivation can be seen as a part of the human factor which can lead to certain personnel attitudes and behaviour. Zheng & Chen (2012) pinned that weak safety awareness led to the cause of accidents. Furthermore, weak awareness of safety exhibits certain behaviour and actions including paralysis-seized thinking, short-tempered in work, conceiving fluke mind, superficial in legal concept, loose in discipline, dangerous operation, acting recklessly with regulations breached, and completely indifferent to the accidents (Zheng & Chen, 2011).

Lack of knowledge, poor judgments towards decision making can influence the worker to make such actions which can cause accidents. Lack of safety information is described by Titas (2013) as one of the reasons for the unsafe behaviour of the workers at work. Vondráčková, et al. (2016) highlighted that in the majority of cases, work-related accidents occur due to poorly or inadequately estimated risks. Toole (2002) pinned eight root causes of construction accidents and mentioned that lack of proper training to the workers by the employees is one of the causes of construction accidents (Toole, 2002). Topf (2000) highlighted that limited job knowledge, training, skills and perhaps less sense of responsibility are the reasons why younger workers have increased risk of work-related injuries (Sui et al., 2003). Zou and Zhang (2009) highlighted that workers have limited awareness about the risks and receive little or no training which influences them in the causation of accidents at the workplace. The absence of adequate training is one of the key factors that cause accidents (Berger, 2008). Christian et al. (2009) pinned (Erogul and Alyami, 2015) that safety knowledge and safety motivation are two important factors that influence the safety performance of the workers. Timofeeva et al. (2017) explained the 11.9% of the accidents occur due to, deficiencies in the training and testing of knowledge on labour protection. Chen et al. (2008) highlighted (citied in Fass at el., 2016) unsuitable working platforms, inadequate training is one of the leading sources of accident causations associated with fall and struck-by in the gulf region construction industry. Awaad et al. (2016) find out that lack of safety education, and training for the workers, and lack of awareness of contractor are the weakness observed at the construction firms which have an impact on the safety performance. Kilani (2011) find out that the lack of training of the workers is the main concern for the management of productivity and safety.

Saad (2016) has identified in his study that workers and management commitment, poor attitude towards safety, lack of training, limited knowledge and awareness are crucial factors which creates unsafe workplace and causes accidents in the Saudi Arabian construction industry. Workers who don't have safety training consider taking the risk while completing the work (Ashraf, 2013). Sawacha et al. (1999) pinned (cited in Erogul & Alyami, 2017) that workplace accidents occur due to many reasons including, lack of knowledge, training or supervision. Research made by Erogul and Alyami (2015) reveals that in Saudi Arabia, most of the workers working at construction sites do not receive the safety induction training before the start of the job which is one of the reasons of workers not knowing the safety rules and working unsafely at the workplace. Findings from the study reveal that in Saudi Arabian construction industry: 25%

of the contractors did not give safety orientation to the new workers whereas, 38% had not trained safety personnel at the workplace (Berger, 2008).

Training is mandatory for a worker before initialisation of work at the construction site. Training helps the workers in understanding the worksite, knowing the safety rules and recognizing and mitigation of risks at the workplace. Ashraf (2013) find out the training plays an important role in improving the safety level of the companies and concluded that companies that have a high level of training programs have the highest safety level. Mosly (2015) recommends that companies need to develop the professional skills of the workforce by providing training. Christian et al. (2009) emphasize that safety knowledge should be enhanced through a positive safety climate by delivering the training, meeting and internal discussions (Eorgul and Alyami, 2015). Several accidents could be reduced, if the employees were more informed, i.e. trained to behave safely (Ttias, 2013). Hejduk and Tomczyk (2015) highlighted that the effectiveness of a person is only possible when a person has adequate habits along with knowledge and skills. Tam et al. (2004) recommended that accidents at construction sites can be reduced by the provision of health and safety training to the workers (Awaad et al., 2016). In South Africa, Skeepers & Mbohwa (2015) recommend that to improve safety performance well-entrenched safety management systems are necessary with foundation being, safety leadership, communication, commitment, and employee training. Timofeeva et al. (2017) made recommended that to improve safety performance, mandatory instruction, and on-site training to be conducted. Zheng and Chen (2012) emphasized the importance of awareness among workers and mentioned that to improve safety awareness can effectively minimize security risks.

The success of the training also depends upon the content and the way it is being delivered to the workers. In Taiwan, digital media including digital films and flash technology are being used to share safety information and instructions. The majority of the engineers acknowledged that this system was useful, and training was effective. The development of a good training program with proper content and language that can be easily understood by the participants is of utmost importance. Titas (2013) stated that it is very important to prepare properly for safety training and highlighted the importance of the content of safety training as well as the methods of delivering safety training. Titas (2013) mentioned that in the developed countries workers are encouraged to participate in the various training program through reading on paper; listening to safety training lectures; watching videotapes, and taking online classes. It was concluded by Al Haadir & Panuwatwanich (2011) that the provision of safety training is one of the key factors that account for 80% of the successful implementation of safety programs in the construction companies. Titas (2013) proposed in his study that there is a need of improving the safety training of the construction participants by giving them awareness not only about protecting their own lives but the lives of the persons working nearby. Zheng and Chen (2012) emphasized the importance of safety awareness and said that many accidents can be avoided by improving the safety awareness of the workers.

3.6.5 Workload

Research study has indicated that workers who deal with more work pressure have more chances of involvement in the occurrence of accidents. Ringen and Seegal (1995) mentioned a study of OSHA in which one leading cause of all lost-time injuries mentioned was overexertion which is usually caused by workload. In the study by Glendon and Litherland (2001), they were able to indicate some elements of safety relating to work pressure, relationships, the use of PPEs, communication, as well as rules on safety (Saad, 2016). Workers can be affected by psychological stress caused by work pressure or overload tasks that leads to either errors or violations as (Alsowayigh, 2014) mentions that workplace pressures are one of the factors that influence workers to violate safety regulation. Hoffman and Stetzer (1996) pinned (cited in Sui et al., 2004) that job strains are related to employee safety. Sui et al. (2004) mention that psychological strains are experienced by the employees as part of job strains. Parida and Ray (2015) observed that in India, construction workers belonging to masonry skills suffer most of the risk of musculoskeletal injuries/disorders because they suffer from pain in almost the joints and the risk factors are also critical and versatile. Workers suffer musculoskeletal injuries/disorders in the construction industry due to prevailing manuals, methods of work, workload, repetitive work, and lack of rest affect them mostly (Parida and Ray, 2015).

In Saudi Arabia, migrant workers coming from different countries handle most blue-collar related jobs. Workers related to blue-collar jobs experience fatigue and stress which influence their safety. A study from (Alaqaad, 2009) showed that competition among workers to finish the task on time, fatigue, and working under pressure had a tremendous impact on safety. Nadim et al. (2016) used the survey to determine the prevalence of depression and to assess its relationship with duration of stay and living conditions. Migrant worker experiences poor health which leads to death or other diseases caused by heavy physical labour, lack of sleep, and no access to proper healthcare (Nadim et al., 2016).

3.6.6 Supervision

Workers at the workplace follow the instruction of their supervisors. The supervisor acts as a leader at the workplace so if he or she will be sincere about working safely then subordinates will also work safely. Probst & Estrada (2010) pinned that there is a strong role of supervisors in the enforcement of safety compliance at the workplace. Probst & Estrada (2010) emphasize that extrinsic safety motivation involves the perceptions of supervisor enforcement of safety policies (i.e., enacted safety policy), including the extent to which supervisors provide praise for safety compliance and punish for non-compliance. It was found in the study of Probst & Estrada (2010) that employees who had low extrinsic safety motivation (i.e., supervisors who failed to enforce safety policies) had lower levels of safety compliance and were more likely to experience injuries and accidents at work.

Al Haadir, & Panuwatwanich (2011) pinned the importance of supervision at the construction sites. Sarkus (1996) noted that the safety agenda forever remains short-lived until such a time those supervisors are critical with their duties (Saad, 2016). Fang, et al. (2004) mentioned (cited in Al Haadir, & Panuwatwanich, 2011) that suitable supervisors capable of allocating work that matches worker`s skill, identifying hazard conditions and making the environment safe by communicating with workers and listening to them and be sure all workers follow the safety rules and find a solution for the occurring safety problem. Lack of commitment towards health and safety from the supervisors and managers is a concern in Saudi Arabian construction sites. Participants of the study conducted by Saad (2016) mentioned that some managers and supervisors are violating safety rules, and their violations set poor examples to the other workers.

Research studies suggest that inadequate supervision is a contributing cause of the occurrence of accidents. Chen et al. (2008) highlighted (citied in Fass at el., 2016) that inadequate supervision is one of the leading sources of accident causations associated with fall and struck-by in the gulf region construction industry. Timofeeva et al. (2017) explained the frequency of accidents with objective reasons as mentioned by the experts are due to lack of supervision over the correct and safe work execution. The analysis of the reasons for major accidents on construction sites in European countries has shown that more than two-thirds of the accidents are a result of the poor organization of work, lack of supervision and control, as well as the employees' inability to assess operational risks (Titas, 2013).

In the study made by Probst & Estrada (2010), participants mentioned that supervisors who enforce safety policies their subordinates and workers are involved in fewer accidents. Al Haadir, & Panuwatwanich (2011) mentioned that suitable supervision is one of the seven critical factors in the implementation of the safety programme and recommended that in Saudi Arabian construction industry, successful safety programs implementation would need an effective enforcement plan, proper supervision, and safety training and education. Saad (2016) mentioned in his study that the participants acknowledge and recognize the importance of good supervision and highlighted that by taking the lead in the workplace supervisors would be able to ensure their worker's safety and prevent any accidents from taking place. Zheng and Chen (2012) pinned that there is a need for developing the habit of inspecting the worksite regularly as regular checks can help supervise construction staffs' security.

3.6.7 Project Management

The leadership role is important in occupational safety and Zohar (1980) stresses that the role of management, rather than the worker, affects safety in organizations (Sui et al., 2004). The behaviour of the workers is also influenced by the actions of the management. Jannadi and Assaf (1998) pinned that the prevention of accidents is the responsibility of the top management of the organisation. Sui et al. (2004) emphasize that safety issues and concerns are the common

responsibility of organisational individuals. Ashraf (2013) argues that the management of an organisation has a direct influence on the safety level of the workers. One of the contributing factors that led to the causation of accidents is management polices (Ashraf, 2013). Patankar and Sabin published a safety culture pyramid and described that safety strategies are derived from the organization's mission, the nature of leadership, strategy, and rules (Hejduk & Tomczyk, 2015). Safety culture pyramid shows the fundamental values of the organisation and the employees' behaviour which affects the safety-related activities (Hejduk & Tomczyk, 2015).

Khasawneh (2014) covers the elements in improving occupational health and safety at the Saudi Arabian workplace. Khasawneh (2014) was of the view that employers in Saudi Arabia are found not protecting the workers from risks. Ashraf (2013) investigated safety levels in the six construction companies in Saudi Arabia and concluded that most of the companies don't give importance to safety as there is no safety department and other departments are more interested in their works than the safety of the workers. Jannadi et al. (2002) conclude (cited in Balgheeth, 2016) that in the Saudi Arabian construction industry, poor safety management is one of the major sources of causation of accidents. Mosly (2015) argued that Saudi Arabian construction sites lacked basic safety aspects which reflects the negligence of the construction managers and project owners in terms of safety considerations. Furthermore, Mosly (2015) argued that in Saudi Arabia safety standards were not followed at the workplace and show that safety is not a top priority of the project management and owners.

Ashraf (2013) mentions that in the Saudi Arabian construction industry, safety issues are being ignored by the management which affects the personal attitude of the workers. In Saudi Arabia, management doesn't plan the works and avoid the implementation of safety practices as they believe it will increase the operational cost (Ibid). It appeared in the research made by Sui et al. (2004) that workers who perceive negative safety attitudes displayed by the management or colleague at the workplace would feel distressed, which would cause them to have more chance of involving an accident at work.

Construction sites require different subcontractors to work together to complete specific works. Coordination and communication is an important element when working with different subcontractors at a construction site. Lauver (2007) emphasizes (cited in Erogul and Alyami. 2015) that communication made by the management with workers is closely associated with employee injuries. Mosly (2015) argues that there is a risk of injury when different subcontractor works together. Many employers are hesitant to develop and implement an adequate health and safety system in Saudi Arabian construction projects whereas to reduce accidents there is a need to implement effective safety programme (Erogul & Alyami, 2017). Employers are more interested and concerned about the economic health of the project than the health and safety of the workers working in the Saudi Arabian construction sites (Ibid).

Management support is key to the successful implementation of safety programs. Christian et al. (2009) suggest (cited in Erogul and Alyami, 2017) that management commitment is an important

element, along with safety systems, supervision, support and internal group processes in achieving safety performance. Al Haadir & Panuwatwanich (2011) highlighted that in the Saudi Arabian construction industry, the successful implementation of safety program depends on the management support. Mosly (2015) recommends that management must enforce the safety policy and those who are not neglecting the safety practices must be held accountable. Ashraf (2013) recommends that management must assign a budget for safety to provide the resources to achieve the safety policy. Mosly (2015) recommends that meetings and workshops must be conducted with the different stakeholders working at a construction site to discuss safety issues and increase awareness about safety. Safety performance can only be improved if all organisational individuals are committed to the implementation of safety procedures along with the adequate safety culture provided by the organisation.

3.6.8 Working conditions

Accidents occur either due to unsafe acts or unsafe conditions. Construction sites are complex and change continuously due to ongoing construction works. Zhen and Chen (2012) mentioned that highway construction is a complex task, and its security runs great risks. Construction shifts greatly and the working environment changes frequently (Zheng & Chen, 2012). Parida & Ray (2015) mentions that the construction industry sector experiences chronic problems due to factors such as, improper working conditions and working methods which researchers have identified as important factors that affect construction productivity and overall ergonomic performance of the workers. Sui et al. (2003) highlighted that ergonomic methodology and principles have led to great improvement in industrial safety however many organisation has found that their accident rates level off after periods of continual improvements.

Working conditions failing to meet the regulatory requirements harm the health of the employees (Timofeeva et al., 2017). Hejduk and Tomczyk (2015) highlighted the importance of technology used at the workplace and argued that Human behaviour and life decisions not only depend upon their knowledge and competence, but technology plays a secondary role that can be used to increase the decision-makers ambition. Jannadi and Assaf (1998) mention that unsafe conditions are the physical conditions which if left uncorrected will cause an accident. Jannadi and Assaf (1998) recognised unsafe working conditions as the immediate cause of the accidents.

The construction industry is unique and consists of difficult work-site conditions which are one of the major causes of accidents (Kilani, 2011). Unsafe site conditions have been recognised as one of the causes of accidents in the construction industry (Toole, 2002). Hallowell and Gambatese (2009) pinned (cited in Awwad, Elsouki, & Jabbour, 2016) that high injury rates associated with construction works are due to necessitates work under unfavourable conditions. Poor housekeeping is one of the reasons for accidents as Timofeeva et al. (2017) also mentioned that construction sites are often a mess and cluttered, which causes different accidents. It was

revealed in the study that workers operating in a more collective and higher uncertainty avoidance environment, are more likely to have safety awareness and beliefs, which can exhibit safer on-site behaviour (Mohamed et al., 2009). Rospotrebnadzor (2016) mentioned (cited in Timofeeva et al., 2017) that at the workplace due to unfavourable working conditions such as, increase the level of noise, dust, chemicals, results in a loss in workers' health and decrease in their efficiency.

Jannadi et al. (2002) conclude (cited in Balgheeth, 2016) that in the Saudi Arabian construction industry work-site conditions is one of the major sources of causation of accidents. The working conditions of the Saudi Arabian construction industry lacks basic requirements. Mosly (2015) observed that in his site visits of 100 construction sites, poor housekeeping was practised and only 14% of the construction sites in Jeddah made the housekeeping. Poor housekeeping leads to many hazards and risks in the workplace. Construction sites do not have a proper fence around the sites which raises the chances of anyone entering the sites (Mosly, 2015). Falling to the same level is one of the safety concerns at the construction sites. Mosly (2015) states that shaft spaces and open holes were protected by covers at only 6.3% of the construction sites which shows that poor working conditions are available at the construction sites.

The provision of a safe working environment is a legal requirement in some countries. Safety governing health and safety bodies in the developed countries such as the Occupational Safety and Health Administration (OSHA) of United States (US), and Health and Safety Executive (HSE) of United Kingdom (UK), requires the employer to provide a safe working environment for the employees. Safe working conditions are important in keeping the workplace safe. Jannadi and Assaf (1998) recommend that to improve safety at the workplace, unsafe working conditions must be rectified so that accidents can be avoided. Timofeeva et al. (2017) recommended improving the working conditions to reduce occupational risks in building organizations. An organisation focusing on improving safety within their organization should consider changing the work environment to motivate people instead of taking a punitive approach toward those who do not comply with standard work procedure (Alsowayigh, 2014). Zheng and Chen (2012) pinned the importance of having a safe working environment. The clean working environment can keep workers working emotions stable, which will not lead to accidents easily (Ibid). Zhen and Chen (2012) mentioned that the root causes of construction accidents can be eliminated by keeping the construction site in the best condition and by timely maintenance and reparation of the construction sites.

3.6.9 Size of the enterprise

Construction companies consist of different sizes: small, medium and large-sized organisation. In the construction industry, projects are being developed by the involvement of small, medium and large-sized companies. Organization size has an influence on safety performance as

Sunindijo (2015) highlighted that organization size is a major factor that influences the safety performance. The safety performance of large construction organizations is better than a small and medium-sized organization. Jannadi and Assaf (1998) assessed the construction safety in the workplace and described that safety performance is varied according to organization and project size. Large projects constructed by large international firms have better safety performance than small projects constructed by small firms (Jannadi & Assaf, 1998).

Timofeeva et al. (2017) highlighted that occupational injuries are high at the small business of construction firms where there is a low level of production discipline and administrative control over labour (Timofeeva et al., 2017). Walters (1998) suggests (cited in Wamuziri, 2008) that in small and medium-sized enterprise accident occurs due to limited resources, poor knowledge of safety practices, absences of the risk mitigation process. Research from (Cunningham et al., 2014; Ikediashi et al., 2014; Mosly, 2015) indicated (cited in Erogul and Alyami, 2017) that employers and employees of small organizations lack required preventive measures due to lack of resources, and limited perception about the risks which is a reason for poor safety performance in the small organizations. Statistics mentioned by Sunindijo (2015) shows that small organizations constitute more than 90% of all businesses and account for 83.7% of employment in the construction industry. In Europe, 82% of occupational injuries are occurring in small organizations (Sunindijo, 2015). In the UK, a research carried out by HSE (2006) shows (cited in Wamuziri, 2008) that the safety performance of the small and medium-sized enterprise is below average across all industries.

In Saudi Arabia, the safety performance of an organization varies with the size of an organization. Jannadi and Assaf (1998) made a research regarding the safety procedures in the Saudi Arabian construction industry and pinned that safety performance levels differed with the size of the project as well as the companies. Large projects constructed by large companies have better safety performance than the small projects constructed by small companies (Ibid). Ashraf (2013) also pinned that the safety of the workers has a relationship with the size of the project and the company. Safety performance increase when the size of the company increases (Ashraf, 2013). Mosly (2015) did an investigation in exploring the safety performance of the Saudi Arabian construction industry. Small and medium-sized belonging to private sector construction projects were visited and it was observed that the safety performance of the construction projects is low (Mosly, 2015). Erogul and Alyami (2015) researched Construction site safety in small construction companies in Saudi Arabia and concluded that worker's perceptions regarding the construction site's safety climate are limited.

Researchers highlighted different reasons why small and medium-sized companies have lower safety performance than the larger companies. The large organization has better resources that help in achieving the safety policy. In contrary to that small and medium-sized organisations have a limited budget and less safety concern. (Cunningham et al., 2014; Ikediashi et al., 2014; Mosly, 2015) suggests that small enterprises are unable to mitigate the risks at the workplace due to resource deficiency, isolation, low probability of inspection, and inaccurate perceptions about

illness and injury incidence rates (Erogul and Alyami, 2017). Mosly (2015) concluded that construction sites of Saudi Arabia consist of poor safety practices and improvement is needed in the construction industry to reduce the frequency of accidents. The private sector of the construction industry in Saudi Arabia seems to be the primary source of accidents, specifically in small- to medium-sized projects (Mosly, 2015). Small and medium-sized organisations have limited resources, budget, and management commitment which are key reasons for their poor safety performance. Saad (2016) pinned that sometimes safety policy is only documented and not implemented especially in small-sized construction companies due to no accountability by any regulatory authority (Saad, 2016).

3.6.10 Safety Culture

Culture is associated with beliefs and perceptions of the employees and can affect safety. Successful safety culture consists of different elements. Zheng and Chen (2012) pinned that the core concept of safety culture is the combination of safety, security, life, spirit, ideas, behaviour and physical condition created by the construction process. Zheng and Chen (2012) pointed out four main elements of the core concept of safety culture: construction safety is a responsibility of all employees, security knowledge and safety are the basis of production safety, construction safety is a habit and typical security incident is an alarm. Cooper (2000) relates (cited in Smith & Wadsworth, 2009) people's physiological, behavioural and situational aspects are an important part of the safety culture.

Safety culture is an important aspect of any organizational culture that cannot only influence the overall safety of the workplace but also the behaviour and actions are the workers are associated with it. Chib and Kanetiker (2014) mention the safety culture can affect the attitude and beliefs of the staff and it is the belief and values about safety problems. A positive safety culture provides a platform on which to build greater awareness, understanding, and compliance with safety rules and regulations (Wamzuiri, 2008). Safety culture is considered an important influencing element in different fields. In the nuclear industry, good safety culture is recognized as an integral part to avoid accidents and can improve productivity (International Atomic Energy Agency, 1998). Zheng & Chen (2011) describes that the core concept of safety culture in highway construction is the sum of safety values and safety standards.

Safety culture needs to have many elements to make it successful, Figure 3.8 Samtrac (2014) shows different elements that create a successful safety culture such as worker's training, good communication scheme, and management/manpower commitment. A study in the UK conducted by Health and Safety Executive (2005) suggested (cited in Alsowayigh, 2014) five key factors that influence safety culture which is: leadership, two-way communication, employee involvement, learning culture, and attitude toward blame.

Figure 3.8: 3 steps to creating a Safety Culture (Source: Samtrac 2014)

Safety culture is important as it influences the workforce attitude and behaviour which influences safety performance (Azmat, 2015). Various researchers described that safety culture interlinked with the safety performance and prevention of accidents can be done through good safety culture (Chen et al., 2017; Saad, 2016; Azmat, 2015; Chib & Kanetiker, 2014; and Titas, 2013). In Saudi Arabia, construction companies are lacking safety culture and there is a need from the management to understand and strengthen the safety culture. A study by Saad (2016) suggests that Saudi Arabia many construction organizations do not integrate safety culture into organizational culture whereas, the influence of the safety culture on construction projects has been recognized as one of the most important aspects of construction companies. Implementation of safety culture is a challenge and there is a considerable disparity when it comes to the implementation of safety culture among different employees in the Saudi Arabian construction industry (Saad, 2016). Alrehaili (2016) study observed the influence of safety culture on construction personnel's safety performance on large government construction projects in Saudi Arabia. It was concluded by Alrehaili (2016) that as long as construction personnel in Saudi Arabia have excellent awareness about safety culture, construction personnel attitude toward violations tends to decrease. Alasamri et al. (2012) mention that one of the key reasons behind the occurrence of accidents in Saudi Arabia is employees' safety culture. Erogul & Alyami (2017) pinned that ineffective safety culture by the firms is one of the reasons which resulted in poor safety performance in the Saudi Arabian construction industry. Research findings from the study reveal that safety culture was one contributing factor in Saudi government construction sites which accounted for 7% of the variance in personnel safety motivation to construction safety, 20% of the variance in construction personnel error behaviour and 73% of the variance in construction personnel attitudes toward violations (Alrehaili, 2016).

Results from the study by Alahmadi (2010) suggest that in Saudi Arabia safety culture is yet to be fully developed, as there are several areas for improvement including error reporting, response to errors, communication, leadership, and teamwork. Awad (2013) mentioned (cited in

Saad, 2016) that many project leaders in Saudi Arabia in the past have been unsuccessful because they have failed to consider the importance of making safety a part of the organizational culture in a manner that forms a safety culture for the construction companies. Organizational safety culture requires strong commitment and dedication along with an adequate safe work system, but importantly successful safety culture relies on individuals to effectively plan and implement safety policy. Hale (2000) states (cited in Nielsen, 2014) that safety culture can be understood as the aspects or parts of the organizational culture that influence attitudes and behaviours, which have an impact on the level of safety in the organization.

The safety culture of an organisation has been recognised as a contributing factor for accident prevention as the Institute of Occupational Safety and Health [IOSH] (2009) states that nowadays organisations are accepting the role of corporate safety culture in safety performance and accident prevention. The importance of safety culture is recognised in different sectors such as aviation, nuclear and construction as it improves productivity and avoids accidents by integrating safety values and standards in the workplace (Zheng & Chen, 2012). Wamuziri (2008) is of the point that to make safety improvement the organization needs to bring cultural change. Organizations that have a strong safety culture observes are more effective in preventing workplace accidents (Chib, Kanetiker, 2014). An organization with a strong safety culture is preventing accidents and workers injury with an effective approach (Wadsworth & Smith, 2009). The role of safety culture is more important in those countries in which there is a lack of implementation of national laws associated with safety. Zou, Redman, and Windon (2008) mentioned that in the Saudi construction industry, there is a need to develop and integrate a conservative Saudi safety culture into the design of the construction industry (Saad, 2016).

3.6.11 Safety policy

Safety policy in an organisation is the most significant factor that influences safety performance in the construction industry (Panuwatwanich et al., 2016). Adequate safety climate must be kept at the workplace where safety be the top priority (Ibid). Importance of safety policy needs to be understood by employers as well as the employees in any organization to make the successful implementation of its implementation. Saad (2016) mentioned that the poor implementation of existing safety policies is one of the reasons behind the poor safety performance in the Saudi Arabian construction industry.

Erogul and Alyami (2015) mention that safety policy is available in most of the companies, but safety policy is in English or the Arabic language and most of the workers cannot understand as the workers working in Saudi Arabia are from foreign countries. The survey reveals that 42% of the workers cannot read and understand the safety policy which results in a lack of implementation of safety policy (Ibid). Saudi Arabian construction firms lack safety enforcement and to achieve overall safety targets safety rules need to be followed by the employees (Alaqqad,

2009). Lack of implementation of safety practices within the construction industry is causing a high number of accidents in Saudi Arabia (Mosly, 2015). Erogul and Alyami (2015) study reveal that 71% of the employers do not inspect the site and review the implementation of safety policy which shows neglect and carelessness of employers towards the implementation of safety policy.

Safety policy must be reasonable and realistic with current working conditions and management commitment. Al Haadir & Panuwatwanich (2011) argue that a successful safety program needs to have clear and reasonable objectives. Erogul and Alyami (2017) emphasize that there is a need for construction site safety protocols to enhance health and safety practices in the Saudi Arabian construction industry. Titas (2013) recommended that the current state of the occupational health and safety in the construction sector can be improved by the integration of legislative requirements into the internal documents of a company.

3.6.12 Resources

Limited or inadequate provision of resources is a concern at the construction sites. The provision of limited resources to the workers by the employer creates hazards and risks for the job. In Saudi Arabia, as per Saudi labour law, it is employer responsibility to provide required safety personal protective equipment to the workers before the start of work. Parida & Ray (2015) mentions that construction industry sector experiences chronic problems due to improper tools which researcher have identified as one of the factors that affect construction productivity and overall ergonomic performance of the workers. At the workplace, some of the employers failed to provide the required safety equipment and resources to the workers. Berger (2008) findings reveal that in Saudi Arabian construction industry: 25% of the contractors did not provide personal protective equipment to the workers whereas, 25% of the contractors did not provide first-aid kits at the workplace.

Mosly (2015) did a site visit at 100 construction sites and find out that construction sites lacked basic information signs, boards, and emergency contacts. Moreover, fire extinguisher which is necessary equipment at the workplace was not available at all 100 visited construction sites (Ibid). A survey made by Erogul and Alyami (2015) reveals that most of the workers don't have the required resources to work safely at the workplace and only 21% reported that they had the resources to complete their job safely in the Saudi Arabian construction sites. In construction sites, falling from height is the main accident source type recorded. Mosly (2015) observed that damaged or unsafe scaffold being used at the construction sites which is hazardous for the workers working on it. Excavation is an important activity of the construction sites and worker requires safe access/egress to enter/exit the excavated area safely. Mosly (2015) observed that only two out of the 28 construction sites have safe excess into excavations which shows that how fewer resources the employer is providing at the construction sites. Ashraf (2013) recommended that construction companies need to provide the required safety equipment to the workers.

Timofeeva et al. (2017) recommended that to improve safety performance, workers need to be provided with means of collective and individual protection. Saad (2016) advised that organizations with poor safety performance need to expend their resources to rectify safety records.

3.6.13 Accident investigation and record-keeping

Accident investigation and record-keeping help in keeping the track of the accidents and safety performance while identifying the gaps existing in the current system of the construction firm. Zheng and Chen (2012) pinned that safety construction records are effective evidence for the process of review, thinking, summary and for the corresponding increase of construction safety. Accident investigation techniques should identify the cause of the accidents so that workers can learn the lesson and avoid the reoccurrence of the accidents. AbdelHamid and Everett (2000) state that the accident investigation should determine the factors that contributed to the accident causation and why the accident occurred. Zheng and Chen (2012) mentioned that one purpose of accident investigation is to educate the staff to learn the lessons, to always remind themselves safety tops the list, and improve their identification towards dangerous sources with the vigilance of potential accidents.

Jannadi and Assaf (1998) state that the injury frequency rate is the number of lost-time injuries per million manhours and is one of the ways to measure safety performance. Construction firms that don't have the adequate safety program lack proper accident investigation techniques and as a result, underlying causes of the accidents remain unknown. Abdelhamid et al. (2000) asserted that construction accident investigations stop at a premature level or are missing important steps to identify the root causes of accidents. In the workplace, previous studies show that many accidents and injuries are not reported to the relevant authorities. Probst & Estrada (2010) argue that most organizations would claim that the occupational health and safety of employees are of paramount concern but still, accidents and the under-reporting of accidents remain all-too-prevalent occurrences. Data results of the study made by Probst & Estrada (2010) revealed that 71% of experienced accidents went unreported (i.e., a ratio of unreported to reported accidents = 2.43:1).

Accident record-keeping helps in the identification and mitigation of deficiencies in the safety system which allows for the continuous improvement in the safety performance of the construction firm (Awaad et al., 2016). Zheng and Chen (2012) emphasized the importance of accident investigation and analysis. There is a need to conduct a detailed analysis of the typical cause of the accident, to learn lessons from the accidents and take necessary measures to prevent them (Zheng & Chen, 2012). Reporting of an accident by the workers or the management is important so that the investigation can be made and causes of the accidents can be known to avoid the repetition of such accidents in the future. Abdelhamid et al. (2000) recommended that

in the accident investigation efforts could be directed at the root causes of accidents and not symptoms, leading to more effective accident prevention.

3.6.14 National Safety Regulations

The government has a crucial role in the improvement of safety performance through the development and implementation of safety regulations. In the developing countries, one of the challenges that hinder the safety performance is the lack of existence of national safety regulations. King and Hudson (1985) and Recarte Suazo and Jaselskis (1993) highlighted that poor safety performance in the developing countries is due to the wither non-existence of safety regulations or if safety regulations are available then it is not being enforced strictly (Awwad et al., 2016). Bust and Gibb (2006) mentions (cited in Awaad et al., 2016) that poor safety performance in the developing countries is due to improper enforcement of regulations. Ineffective national safety regulations and lack of enforcement is the cause of poor safety performance in developing countries (Alkilani, Jupp, and Sawhney, 2013).

A study from Saad (2016) pointed out that the Saudi Arabian construction industry lacks well-publicized legal provisions and standards for employers which can be seen as a barrier to improving the safety performance of the industry. In Saudi Arabia, there is no government health and safety regulatory authority (Saad, 2016) so construction companies have the freedom to plan and implement a safety policy of their choice and sometimes safety policy is only documented and not implemented especially in the small and medium-sized construction companies due to no accountability by any regulatory authority. Erogul and Alyami (2017) pinned that in Saudi Arabia, lack of clear national policies, systems, and programs is a reason behind the lack of safety practices in the construction industry as employers are found ignoring their responsibilities in the provision of the safe working environment. Saad (2016) mentioned that the lack of safety regulations and laws in the country is one of the reasons behind the poor safety performance in the Saudi Arabian construction industry.

Rules, regulations, and management systems have their role to play in improving safety performance (Wamuziri, 2008). Enforcement of safety regulations by the government at the workplace reduces the number of accidents. It was reported by Chen et al. (2017) that due to the enforcement of an increasingly more comprehensive construction safety act that brought about greater safety awareness resulted in a steady decrease in the fatality rate. Almutairi (2012) indicates (cited in Erogul and Alyami, 2017) that strict implementation and enforcement of occupational health and safety requirements are needed in the small domestic construction sites. Mosly (2015) recommends that the Saudi Arabian government needs to start creating awareness about safety and ensure that safety policies are implemented to improve safety performance. The Saudi Arabian government must form a safety regulatory body to prepare and enforce safety standards. The private sector needs to be held accountable for safety deficiencies in construction

sites (Mosly, 2015). In Saudi Arabian construction industry, ineffective safety culture by the firms and lack of clear national safety policies resulted in poor safety performance (Erogul & Alyami, 2017) which needs to be addressed to reduce the safety challenges in the country. Saudi Arabia requires safety legislation which needs to be strictly enforced in the construction workplaces (Ibid).

3.6.15 Weather conditions

Environmental conditions have a strong influence on safety performance in the construction sites. McLay and Anderson (2018) argue that extremes in the environment of use (heat, cold, altitude, smoke/air pollution, vibration, noise, darkness, infrared lighting, etc.) can have substantial effects on human performance and safety. Tixier et al. (2016) and Yoo et al. (2014) classified that environmental conditions and natural factors such as weather and temperature, influence the psychological and physical conditions of workers and should not be ignored (Zhang et al., 2019). Rowlinson et al, (2014) pinned (cited in Saad, 2016) that general working conditions especially the climate conditions such as, heat stress due to extreme weather is one of the factors that influence the safety performance of the workers. Increasing the frequency and intensity of extremely hot weather due to changing climate, workplace heat exposure is presenting an increasing challenge to occupational health and safety (Xiang, 2013).

Xiang (2013) identified several contributing factors increase the risk of heat-related illness and injury in the building industry which are, the constant use of machinery and powered tools, working on elevated surfaces, heavy workload, simple accommodation conditions near work sites, being temporarily employed by a sub-contractor on a daily payment basis, and constant and direct exposure to sunlight. Various researchers have mentioned that exposure to an excessive heat load over time causes significant heat strain, which impedes work performance and increases the risks of accidents, heat-related illness, and fatality (Al-Bouwarthan et al., 2019). Erogul et al. (2015) found out the workers' health issues are related to the nature of the job and weather conditions. In summer workers suffer more stress due to high temperature which impacts their safety performance (Ibid).

At workplaces in Saudi Arabia workers are exposed to hot weather especially between May to September. The temperature rises to 50 degrees Celsius between May and September. Figure 3.9 by Al-Bouwarthan et al. (2019) shows the average temperature for the residential construction sites in Al-Ahsa Province of Saudi Arabia, between June and September 2016. The hot weather, especially during the summer ministry of labour, made it mandatory that workers must not work outside under the sunlight between 12 pm to 03 pm (Bbc, 2014). Many construction sites are not implementing the rule to not let their workers work between 12 pm to 3 pm. Al-Bouwarthan et al. (2019) concluded that construction workers in Saudi Arabia were exposed to excessive heat

stress, indoors and outdoors over a large part of the workday whereas, complying with a midday outdoor work ban (12–3 p.m.) was not effective in reducing heat stress risk.

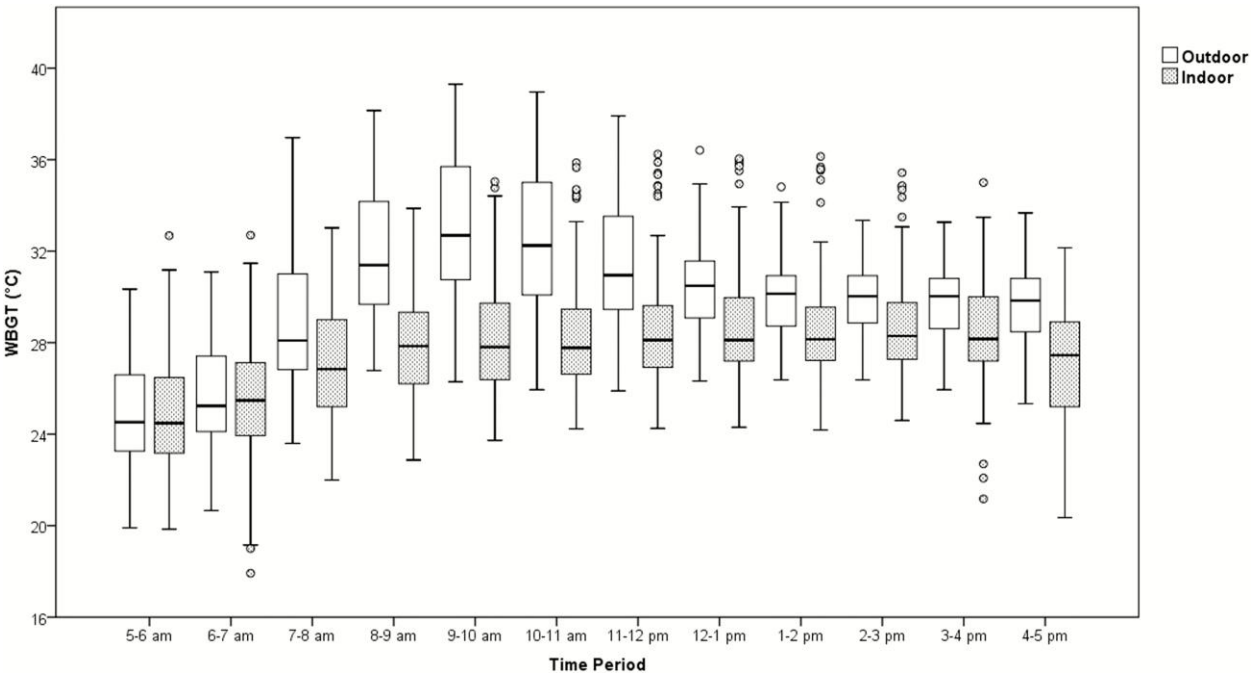

Figure 3.9: Hourly WBGT averaged for 10 residential construction sites in Al-Ahsa Province, SA, June–September 2016. Grey shading indicates indoor measurements; white indicates outdoor measurements. (Source: Al-Bouwarthan et al., 2019)

Working under the sunlight creates mental and health risks for the workers. Excessive heat exposure poses significant risks to workers in hot climates (Al-Bouwarthan et al., (2019). The extreme hot temperature has numerous effects on the body which impact the attitude, actions, and health of the workers. Erogul and Alyami (2015) revealed that workers in Saudi Arabia are having health issues due to hard work, high temperature, and tough working conditions. At construction sites, workers are often exposed to extreme working conditions which may cause health injuries and reduces the productivity of the workers (Parida and Ray, 2015). Construction companies lack basic welfare facilities such as the provision of rest places, drinking water and toilets. Nadim et al. (2016) state that in Saudi Arabia, extreme hot temperature creates difficulties for the workers as some of the workers come from cold temperature places.

Common effects of hot temperatures on the workers are extreme sweating, dizziness, and dehydration. Xiang et al. (2013) mentioned short-term and long-term health effects of heat exposure. Short term acute extreme heat exposure can cause a rise in core body temperature and may result in direct heat illnesses whereas, adverse long-term health effects of chronic workplace heat exposure have also been reported such as cardiovascular diseases, mental health problems, and chronic kidney diseases (Ibid). Xiang et al. (2013) mentioned that workers who are at risk of illness due to heat are farmers, construction workers, fire-fighters, miners, soldiers, and

manufacturing workers working around process-generated heat. A study by Al-Bouwarthan et al. (2019) reveals that the indoor environment was sheltered from direct sun exposure, this study found that workers with moderate and heavy workloads were at risk of heat stress in Saudi Arabian construction sites. Al-Bouwarthan et al., (2019) visited different construction worksites in Saudi Arabia and noticed that all the worksite lacked necessary welfare condition such as air-conditioned resting facilities, onsite toilets, and nearby sources of water for refilling drinking water containers. Al-Bouwarthan et al., (2019) stated that the severity of heat stress and its impact are projected to increase due to climate change, therefore there is a need for immediate improvement of the current required protective measures and the development of occupational heat stress exposure guidelines in Saudi Arabia.

3.7 Gaps in the literature

A literature review of this study revealed that workers' actions whether involving unsafe actions or simply errors and mistakes have contributed towards the occurrence of many accidents. However, it is important to understand why workers are involved with such actions which result in the occurrence of the accidents. Previous sections indicated the involvement of many factors that are influencing the behaviour and actions of the workers that are mostly associated with the task and organisation. As defined by World Health and Organisation and Health and Safety Executive, human factors refer to environmental, organizational and job factors, and individual characteristics that influence the safety of the workers by influencing the behaviour and actions of the workers. Therefore, it is necessary to understand, explore and identify human factors that are influencing the safety performance of the Saudi Arabian construction industry. Currently, in the Saudi Arabian construction industry, there is a lack of research studies available that focused on the identification of various human factors that influence the workers in carrying out the unsafe act and also affect the safety performance of the Saudi Arabian construction industry. Therefore, this research study is focused on exploring the human factors which affect the safety performance of the Saudi Arabian construction industry. Moreover, identifying the human factors that are influencing the workers to carry out such actions which result in the occurrence of the accidents. In additions to that in this study will explore the existing H&S issues of the Saudi Arabian construction industry. This research study will contribute in filling the existing gap in the literature with the identification of the human factors which influence the workers to work unsafely and explore the underlying human factors that affect the overall safety performance of the Saudi Arabian construction industry through the use of mix methods with the combination of archival reports, interviews and questionnaire survey. This research study will facilitate the practical field by providing guidelines to overcome existing H&S challenges which will help enhance the safety practices in the Saudi Arabian construction industry and developing countries.

3.8 Summary

In this chapter, it was revealed that the construction industry is inflicted with the occurrence of many accidents and like many developing countries Saudi Arabian construction industry is facing poor safety performance. Accident causation theories explained that behind the occurrence of accidents multiple contributing factors are involved. In the Saudi Arabian construction industry, there are many issues related to H&S. Saudi Arabian workforce is mostly migrant workers who are hired directly from respective countries or through recruiting agency. In the Saudi Arabia construction industry, migrant workers are involved in the occurrence of most numbers of accidents and reports suggested that workers' unsafe actions and violations were the primary reasons behind the occurrence of these accidents. Research studies also pointed out that workers' errors or unsafe actions have contributed to the occurrence of major accidents in different fields. However, workers' actions and behaviour are influenced by many factors that are related to the task and organisation. The meaning of human factors and how it is influencing the actions of the workers and the overall safety of the workplace was discussed in this chapter. It was argued that workers' actions are influenced by the three main components of human factors: individuals, job and organization. Therefore, it can be concluded that human factors have a key role in the safety of the workers. However, there is no clear evidence about the role of human factors in influencing the safety of the workers in the Saudi Arabian construction industry. Hence, there is a need for exploratory research that will investigate the influencing human factors affecting safety at the workplace and contributing towards the occurrence of the accidents.

To achieve the research aim and objectives, in the next chapter, research methodology will be discussed. Chapter 4 will mention the research methodology, data collection and data analysis techniques that will be utilized in this research study.

Chapter 4

Research Methodology

4.1 Introduction

In this research study, mix methods are being utilized to achieve the research aim and objectives. The research methodology deployed in this research study is "Research Onion" by Saunders. In this chapter, research techniques and strategies will be discussed. Justification for using mix methods will be explained. Data collection and data analysis methods will be part of this chapter. In the end, ethical consideration will be explained in this chapter.

4.2 Research Design

Research methods and methodology are two distinct concepts. The research method is defined by Wahyuni (2012) as a set of specific procedures, tools, and techniques to gather and analyse data. According to Kohthati (2004), research methods refer to the behaviour and instruments used in selecting and constructing research techniques. The research method is a practical application of doing research i.e. interviews and surveys that can be used in different research methodologies (Wahyuni, 2012). Whereas methodology refers to a model to research within the context of a particular paradigm and comprises the underlying sets of beliefs that guide a researcher to choose one set of research methods over another (Wahyuni, 2012). The research methodology is defined by Kohthati (2004) as a science of studying how the research is done scientifically and a systematic way to solve the research problem. Leedy & Omrod (2001) defined (cited in Williams, 2007) research methodology as the general approach the research takes in carrying out the research project. Dawood and Underwood (2010) argue that research methodology is one of the nightmares a researcher has to endure because it is derived from philosophy and philosophy itself is hard to comprehend and explain even by experts in the field.

The function of the research design is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money (Kohthati, 2004). The researcher selects the research design considering different aspects of the research problem. Anderson (1990) mentioned that without the systematic procedure for gathering data that can be used in answering questions it can be difficult to generalise, explain or predict what the outcome of the issues could be (Saad, 2016). Williams (2009) explains the frameworks and guidelines provide researchers with an indication of what to include in the research, how to perform the research, and what types of inferences are probably based on the data collected. Saunders et al. (2009) developed the "Research Onion" which provides stepwise clarification of how the research process can be conducted and it consists of six components which include: Philosophy, Approach, Strategies,

Choices, Time horizons, and Techniques and procedures (Figure 4.1). In this study Research Onion developed by Saunders et al. (2009) has been used to constitute the research framework.

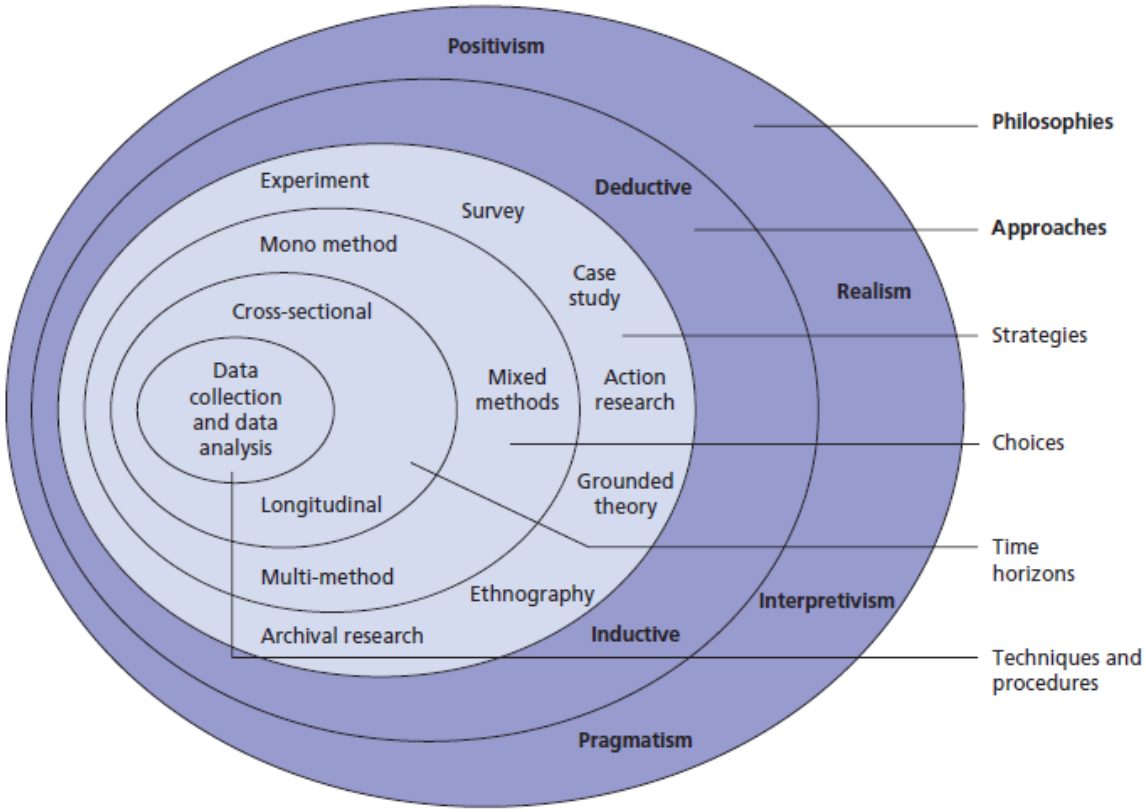

Figure 4.1: The Research Onion (Saunders et al., 2009)

4.3 Research Paradigm

Jonker and Pennink (2010) define research paradigm as a set of fundamental assumptions and beliefs as to how the world is perceived which then serves as a thinking framework that guides the behaviour of the researcher (Wahyuni, 2012). Research paradigm defined by Saunders et al. (2009) as the basic belief system or world view that guides the investigation, not only in choices of a method but in ontologically and epistemologically fundamental ways. According to Wahyuni (2012), research paradigms address the philosophical dimensions of social sciences. A research paradigm answers ontological questions about the nature of reality, addresses epistemological questions about how people can know about reality and methodological questions about legitimate ways of investigating reality and how to confirm that the knowledge generated is valid (Johannesson & Perjons, 2012).

Table 4.1 shows the basic beliefs related to research paradigms (Wahyuni, 2012). Research onion developed by Saunders et al. (2009) mentions four types of research philosophies that can be adopted by researchers: Positivism, Realism, Interpretivism, and Pragmatism.

Table 4.1: Fundamental Beliefs of Research Paradigms in Social Sciences (Wahyuni, 2012)

Fundamental Beliefs	*Positivism (Naïve realism)*	*Postpositivism (Critical Realism)*	*Interpretivism (Constructivism)*	*Pragmatism*
Ontology: the position on the nature of reality	External, objective and independent of social actors	Objective. Exist independently of human thoughts and beliefs or knowledge of their existence, but is interpreted through social conditioning (critical realist)	Socially constructed, subjective, may change, multiple	External, multiple, view chosen to best achieve an answer to the research question
Epistemology: the view on what constitutes acceptable knowledge	Only observable phenomena can provide credible data, facts. Focus on causality and law-like generalisations, reducing phenomena to simplest elements	Only observable phenomena can provide credible data, facts. Focus on explaining within a context or contexts	Subjective meanings and social phenomena. Focus upon the details of situation, the reality behind these details, subjective meanings and motivating actions	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical applied research, integrating different perspectives to help interpret the data
Axiology: the role of values in research and the researcher's stance	Value-free and etic Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Value-laden and etic Research is value laden; the researcher is biased by world views, cultural experiences and upbringing	Value-bond and emic Research is value bond, the researcher is part of what is being researched, cannot be separated and so will be subjective	Value-bond and etic-emic Values play a large role in interpreting the results, the researcher adopting both objective and subjective points of view
Research Methodology: the model behind the research process	Quantitative	Quantitative or qualitative	Qualitative	Quantitative and qualitative (mixed or multi-method design)

4.3.1 Positivism

Positivism was originated in the 19th century by the philosopher named, Auguste Comte (Johannesson & Perjons, 2012). Positivism was introduced as a reaction to theological and metaphysical world views that embraced authority, divine revelation and tradition as legitimate knowledge sources (Johannesson & Perjons, 2012). Positivism is value-free research concerned with quantification of observation and supported with analysation of large data (Saunder et al., 2009). According to Wahyuni (2012) positivist researcher conduct value-free research to measure social phenomena. Johannesson & Perjons (2012) states that positivism only accepts the knowledge that is based on sense, experience and positive verification. The positivism philosophy is associated with scientific reasoning as well as conclusions from a legal perspective which are also eventually able to support knowledge (Saad, 2016). Wahyuni (2012) argues that the common belief of positivist is the existence of a universal generalisation that can be applied across contexts, which is now called naïve realism. Saunders et al. (2009) explain another important component of the positivist approach to research is that the research is undertaken, as far as possible, in a value-free way. Ontologically, positivism assumes a reality that exists independently of human actions and experiences whereas, epistemologically, positivism claims that objective knowledge about the social world is obtainable, but only through observation and experimentation (Johannesson & Perjons, 2012). Wahyuni (2012) argues that positivist scholars believe in the power of replication research.

4.3.2 Realism

Realism is similar to positivism as it assumes a scientific approach to the development of knowledge (Saunders et al. (2009). Theory of realism is quite independent of the mind and opposed to idealism (Ibid). Phillips (1987) points out that realism is the belief in entities having an independent of other entities or that these entities have varying related theories (Saad, 2016). The essence of realism is that what the senses show us as reality is the truth: that objects have an existence independent of the human mind (Saunders et al., 2009). Saunders et al. (2009) mentioned two types of realism: direct and critical. Direct realism says that what you see is what you get: what we experience through our senses portrays the world accurately. On the other hand, critical realism says that what we experience are sensations, the images of the things in the real world, not the things directly (Ibid).

4.3.3 Interpretivism

Interpretivism was originated in the 20th century by the sociologist named, Max Weber (Johannesson & Perjons, 2012). Interpretivism advocates that the researcher must understand the differences between humans in our role as social actors (Saunders et al., 2009). May (2011) mentions that the ideal is that researching an issue objectively would lead to different

interpretations of the social roles of the actors on the issue under research (Saad, 2016). Saunders et al. (2009) state that crucial to the interpretivism philosophy is that the researcher has to adopt an empathetic stance. Johannesson & Perjons (2012) emphasis that the researcher can only achieve a deep understanding of a social phenomenon by actively participating in that phenomenon together with the people who create it. Saunders et al. (2009) explain it is crucial to the interpretive epistemology that the researcher has to adopt an empathetic stance, but the challenge is to enter the social world of our research subjects and understand their world from their point of view. Wahyuni (2012) mentions that interpretivists believe that reality is constructed by social actors and people's perceptions of it. Furthermore, Wahyuni (2012) states that interpretivists recognise that individuals with their varied backgrounds, assumptions and experiences contribute to the on-going construction of reality existing in their broader social context through social interaction.

4.3.4 Pragmatism

Pragmatism argues that the most important determinant of the epistemology, ontology and axiology you adopt is the research question – one may be more appropriate than the other for answering questions (Saunder et al., 2009). Moreover, if the research question does not suggest unambiguously that either a positivist or interpretivist philosophy is adopted this confirms the pragmatist's view that it is perfectly possible to work with both philosophies (Saunders et al., 2009). Pragmatist researchers favour working with both quantitative and qualitative data because it enables them to better understand social reality (Wahyuni, 2012). Researchers have recommended pragmatism approach for the research as Tashakkori and Teddlie (1998) contend (cited in Saunders et al., 2009) that pragmatism is intuitively appealing, largely because it avoids the researcher engaging in what they see as rather pointless debates about such concepts as truth and reality. Creswell (2007) implies that pragmatism goes against the argument that a researcher would need to state, explicitly, that which they feel would influence their research (Saad, 2016). According to Wahyuni (2012) pragmatist start with the research question to determine their research framework, instead of questioning ontology and epistemology. Pragmatist emphasises that one should view research philosophy as a continuum, rather than an option that stands in opposite positions (Wahyuni, 2012).

4.3.5 Justification for the use of Interpretivism

Saunders et al., (2009) highlighted that the adoption of philosophy largely depends on the focus of the research, as this determines which is appropriate for a study. This study is exploratory in nature and focused on the identification of the human factors which cause accidents in the construction industry, understanding the reasons behind workers unsafe actions and unsafe practices, and exploring the challenges and barriers the Saudi Arabian construction industry is

facing in maintaining safe worksite. Saunders et al., (2009) suggests that assumptions based upon the research paradigm will underpin the research strategy and the methods which the research choose as part of that strategy. Howe concluded that mix methods interpretivism is when the quantitative experimental methods are in descriptive form and qualitative interpretation methods are providing causal explanation because they can answer, "why" question (Mertens & Hesse-Biber, 2012). Use of mix methods will address the research problem and achieve the overall aim and objective of the research. Saad (2016) and Mertens & Hesse-Biber (2012) argued that mix-methods in intrepretivism provides the explanation of the research problem through use of qualitative and quantitative interpretive methods. In this study, results and conclusion will be extracted by the interpretation of data and information collected through various research techniques which will contribute to the knowledge and practice by providing useful knowledge and recommendations. This study will derive in-depth information, participants' opinions, identification of the human factors and other influencing factors from the qualitative data source. Whereas quantitative data source will provide useful information related to the H&S issues and practices which will be interpreted and presented in the descriptive form. Therefore, interpretivism is the research paradigm used in this research study within fundamental beliefs of *epistemology* which is concerned with what constitutes acceptable knowledge in a field of study.

4.4 Research Approach

The strengths and weaknesses associated with the various research approaches are not absolute but rather relative to the context and how researchers aspire to address the phenomenon under study (Williams, 2007). To carry out the research, researchers pointed out three approaches: quantitative, qualitative and mix methods. Williams (2007) mentions three common approaches to conducting research are quantitative, qualitative, and mixed methods. Saunders et al. (2009) state that researchers will use either a single data collection technique and corresponding analysis procedures (mono-method) or use more than one data collection technique and analysis procedures to answer your research question (multiple methods). Researchers typically select the quantitative approach to respond to research questions requiring numerical data, the qualitative approach for research questions requiring textural data, and the mixed methods approach for research questions requiring both numerical and textual data (Williams, 2007). Saunders et al. (2009) argue that a single research study may use quantitative and qualitative techniques and procedures in combination as well as using primary and secondary data. Multiple methods, the researcher can use a combination of qualitative and quantitative techniques.

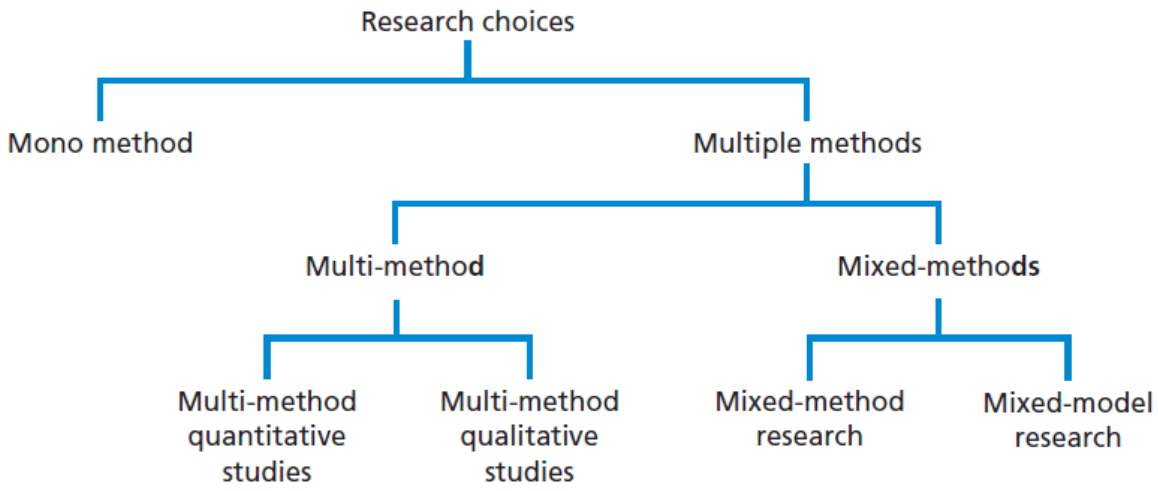

Figure 4.2: Research choices (Saunders et al., 2009)

4.4.1 Qualitative

Qualitative is used as a synonym for any data collection technique (such as an interview) or data analysis procedure (such as categorising data) that generates or uses non-numerical data (Saunders et al., 2009). Qualitative can refer to data other than words, such as pictures and video clips (Saunders et al., 2009). Researchers have mentioned several advantages of using qualitative research methodology. Creswell (2003) states that qualitative research can also be described as an effective model that occurs in a natural setting that enables the researcher to develop a level of detail from being highly involved in the actual experiences (Williams, 2007). Williams (2007) argues that the strong correlation between the observer and the data is a marked difference from quantitative research, where the researcher is strictly outside of the phenomena being investigated. This empirical research is data collected from the senses and is used to explain phenomena relevant to social behaviours in new and emerging theories (Williams, 2007). In the research, qualitative research methodology is one of the methodologies that is being adopted as it will enable in getting answers along with their detailed insights and opinions related to different questions and will add rich information for the research.

4.4.2 Quantitative

A quantitative research method involves a numeric or statistical approach to research design (Williams, 2007). (Creswell, 2003) mentions (cited in Williams, 2007) that quantitative research involves the collection of data so that information can be quantified and subjected to statistical treatment to support or refute alternate knowledge claims. Quantitative is predominantly used as

a synonym for any data collection technique (such as a questionnaire) or data analysis procedure (such as graphs or statistics) that generates or uses numerical data (Saunders et al., 2009). Quantitative research also involves data collection that is typically numeric, and the researcher tends to use mathematical models as the methodology of data analysis (Williams, 2007). Trochim (2006) argues that based on quantitative research methodology, it may be possible to secure some physical representation of the data by using tables, charts, resulting in logical conclusions, and are based on evidence (Saad, 2016). The quantitative research methodology will be used in this research as the numeric data will help the research in using descriptive statistics and physical representation with the use of tables, charts, and figures.

4.4.3 Mix Methods

The mixed-methods approach is the general term for when both quantitative and qualitative data collection techniques and analysis procedures are used in a research design (Saunders et al., 2009). In Mixed methods, researchers collect or analyse not only numerical data, which is customary for quantitative research but also narrative data, which is the norm for qualitative research to address the research question(s) defined for a particular research study (Williams, 2007). The mixed-methods approach to research provides researchers with the ability to design a single research study that answers questions about both the complex nature of phenomenon from the participants‟ point of view and the relationship between measurable variables (Williams, 2007). In this research, a combination of qualitative and quantitative research methodology will be used to achieve the research objectives.

4.4.4 Justification for using Mix Methods

This research aim is to improve the safety performance of the Saudi Arabian construction industry. Research aim will be achieved by identifying the influencing human factors that cause accidents, explore why workers are involved with unsafe actions, examine the challenges Saudi Arabian construction industry is facing in maintaining safe worksite and provide recommendations which will be helpful for the practical field. These aim and objectives need in-depth, detailed and combination of various sources which can be only possible using mix methods as single method technique will not yield necessary information which will identify and explore the influencing human factors. Tashakkori and Teddlie (2003) acknowledge that multiple methods are useful if they provide better opportunities for the research to answer the research questions and where they allow better evaluation to the extent to which your research findings can be trusted and inferences made from them (Saunders et al., 2009). An advantage of a mixed-method approach is that it allows a rigorous investigation phenomenon by the use of quantitative and qualitative data to achieve research objectives. Use of multiple sources will help in

understanding the research problem through different perspectives and provides a broader level of information which will eventually contribute to the knowledge and the practice.

4.5 Research Strategy

The purpose of the research is to create reliable and useful knowledge based on empirical evidence as well as logical arguments (Johannesson & Perjons, 2012). Johannesson & Perjons (2012) argues that the research strategy includes the general set-up of the context in which the research is undertaken and data generation and analysis methods are never used in isolation but always in the context of a research strategy, i.e. an overall approach to answering a research question. Saunders et al. (2009) mention that the choice of research strategy will be guided by the research question(s) and objectives, the extent of existing knowledge, the amount of time and other resources you have available, as well as your philosophical underpinnings. Several research strategies are being developed to enable the researchers in carrying out the research. However, in this research, research objectives will be achieved by using three research strategies: survey, case study, and archival research.

4.5.1 Case Study

A case study is defined by Creswell (2003) as the researcher explores in depth a program, an event, an activity, a process, or one or more individuals (Williams, 2007). Saunders et al. (2009) explain that case study strategy is the complete opposite of the experimental strategy, where the research is undertaken within a highly controlled context and it also differs from the survey strategy where, although the research is undertaken in context, the ability to explore and understand this context is limited by the number of variables for which data can be collected. Johannesson & Perjons (2012) states that the purpose of a case study is to paint a rich picture of a single object or situation as a basis for obtaining a deep and comprehensive understanding of some general phenomenon. The data collection for a case study is extensive and draws from multiple sources such as direct or participant observations, interviews, archival records or documents, physical artefacts, and audiovisual materials (Williams, 2007).

The case study strategy has considerable ability to generate answers to the question ‘why?’ as well as the ‘what?’ and ‘how?’ questions, although ‘what?’ and ‘how?’ questions tend to be more the concern of the survey strategy (Saunders et al., 2009). According to Johannesson & Perjons (2012) case study investigates in detail one specific case of the general phenomenon under investigation, e.g. one organisation, one system development project, or one mobile application. Data collection techniques that can be used by the researchers in the case study strategy include interviews, observation, documentary analysis, and questionnaires. Johannesson & Perjons (2012) argue that case studies are time-consuming, their outcomes depend heavily on the competence of the researcher and they can also be biased by her interests and preconceptions.

Furthermore, a case study is always carried out in a single local practice, which can limit the generalizability of the results (Ibid).

4.5.2 Survey

The survey strategy is usually associated with the deductive approach and is most frequently used to answer who, what, where, how much and how many questions (Saunders et al., 2009). According to Johannesson & Perjons (2012), a survey starts by generating data from a large group of objects (people, organisations, systems, etc.) often through the use of questionnaires or document studies. In the survey research method, Williams (2007) mentions that the researcher tends to capture phenomena at the moment. It tends to be used for exploratory and descriptive research and is often obtained by using a questionnaire administered to a sample, these data are standardised, allowing easy comparison (Saunders et al., 2009).

The survey strategy allows the researchers to collect quantitative data which you can analyse quantitatively using descriptive and inferential statistics (Saunders et al., 2009). The main data generation method of the survey is questionnaires distributed among a sample of managers and users of workflow systems (Ibid). The survey method is used for sampling data from respondents that are representative of a population and uses a closed-ended instrument or open-ended items (Williams, 2007).

4.5.3 Archival Research

An archival research strategy allows research questions that focus upon the past and changes over time to be answered, be they exploratory, descriptive or explanatory (Saunders et al., 2009). Saunders et al. (2009) mention that an archival research strategy mustn't be conflated with secondary data analysis. Using an archival research strategy, therefore, necessitates you establishing what data are available and designing your research to make the most of it (Ibid). Administrative records and documents are the sources used by the researchers in the archival research.

4.5.4 Justification for using multiple strategies

This research is focused on understanding the human factors which influence the occurrence of human-related accidents intending to provide recommendations to minimise the occurence of the accidents in the Saudi Arabian construction industry. Due to the exploratory nature of this research, a combination of different research strategies is selected for this study. Various research strategies employed in this research will enable the exploration and examination of cross-sectional issues connected to the human factors and challenges that the Saudi Arabian

construction industry is facing in the implementation of safety practices in a detailed manner. This research study has adopted the use of multiple research strategies involving archival reports, interviews and surveys. Archival reports will provide a better understanding of the main causes of accidents at the Saudi Arabian construction industry and which human factors are directly/indirectly contributing to the occurrence of the accidents. In addition to that, interviews will provide broader knowledge in investigating the underlying reasons behind why the workers are involved with unsafe actions and what other human factors is influencing the safety performance at the construction sites. Saunders et al. (2009) pointed out that mix methods have different benefits especially for the exploratory studies as through its broader level of information and opinions can be gained and helps in understanding the research problem and issues better with information gathered through different sources. Surveys and interviews will help in getting construction professionals' opinions about the existing H&S issues and control measures present in the Saudi Arabian construction industry. Table 4.2 shows the research methods that are deployed in this study.

Table 4.2: **Research method followed in this research**

Research Objective	**Research Strategy**	**Research Technique**	**Type of Data**
Identify human factors that cause accidents in construction.	- Literature Review - Survey - Case Study	Archival Reports, Interviews and Questionnaire	Qualitative
Explore influencing human factors that lead to the occurrence of accidents in the Saudi Arabian construction industry.	- Literature Review - Survey - Case Study	Interviews and Questionnaire	Qualitative and Quantitative
Examine the challenges and barriers the Saudi Arabian construction industry is facing in maintaining safe worksite.	- Literature Review - Survey - Case Study	Interviews and Questionnaire	Qualitative and Quantitative
Propose recommendations that will improve the safety performances of the Saudi Arabian construction industry.	- Literature Review - Case Study - Survey	Archival Reports and Interviews	Qualitative

4.6 Data Collection

The collection of appropriate data is important to step into research to achieve the research objectives. In this research study, the research aim is to improve the safety performance of the Saudi Arabian construction industry by minimizing the humanly related accidents through

providing recommendations. Data collection can be carried out in different ways and there are many ways of collecting data depending upon the researcher (Kohthari, 2004). In this research study, mix methods have been used as a research strategy to collect data. Mix methods includes combination of quantitative data as well as qualitative data collection methods to answer specific research questions. Saunders et al. (2009) pointed out different reasons for the use of deploying mix-methods in the research study (Figure 4.3). This study is exploratory in nature and investigating the human factors so a mixed-method approach will allow a rigorous investigation of the phenomenon. In this research, mix methods will help in filling the gaps of information that will be in either qualitative or quantitative data collection methods (Complementarity). Another advantage of a mix-methods will be cross-checking the statements obtained from the interviews with the questionnaire to validate the obtained information and verify the statements (Triangulation). Triangulation will enhance the validating of the information and will give more understanding and meaning to H&S issues in Saudi Arabian construction industry.

Reason	Explanation
Triangulation	Use of two or more independent sources of data or data collection methods to corroborate research findings within a study.
Facilitation	Use of one data collection method or research strategy to aid research using another data collection method or research strategy within a study (e.g. qualitative/quantitative providing hypotheses, aiding measurement, quantitative/qualitative participant or case selection)
Complementarity	Use of two or more research strategies in order that different aspects of an investigation can be dovetailed (e.g. qualitative plus quantitative questionnaire to fill in gaps quantitative plus qualitative questionnaire for issues, interview for meaning)
Generality	Use of independent source of data to contextualise main study or use quantitative analysis to provide sense of relative importance (e.g. qualitative plus quantitative to set case in broader context; qualitative × quantitative analysis is to provide sense of relative importance)
Aid interpretation	Use of qualitative data to help explain relationships between quantitative variables (e.g quantitative/qualitative)
Study different aspects	Quantitative to look at macro aspects and qualitative to look at micro aspects
Solving a puzzle	Use of an alternative data collection method when the initial method reveals unexplainable results or insufficient data

Figure 4.3: Reasons for using mix-methods design (Saunders et al., 2009)

To achieve the research objectives, in this research following data collection techniques will be employed:

- Interviews and accident reports review will be used as a Qualitative data collection method.
- The questionnaire will be used as a quantitative data collection method.

4.6.1 Qualitative data collection method

In this research study, interviews and archival reports of the construction companies are being used as a qualitative data collection method. Accident reports are not being used in the previous studies and will provide a better understanding of the direct/indirect causes of the accidents. Whereas interviews will help in getting to know the reasons behind workers unsafe actions and unsafe practices which leads to the occurrence of the accidents. Therefore, interviews and review of accident reports will be suitable data collection methods to achieve the specific research objectives in comprehensively understating the factors behind the occurrence of accidents in the Saudi Arabian construction industry.

4.6.1.1 Accident reports

A review of the accident reports of the construction companies in the first data collection method deployed in this study. A review of the accident reports is being utilised in this study to achieve the research objectives as mentioned in table 4.2. The main purpose of reviewing accident reports was to identify the causal factors that contribute to the occurrence of accidents in construction sites. A review of the accident reports will be done from eight construction companies working in Saudi Arabia. Out of eight construction companies, one company belongs to the government while seven companies are privately owned. GOSI (2018) statistics show that the western region of Saudi Arabia is in the top three regions where the number of occurrence of accidents is high. Therefore, in this research study accident reports of the construction projects of the western region have been studied which will help in understanding the current situation of the reasons behind the occurrence of the accidents in the construction sites. These eight construction companies are operating in the western province of Saudi Arabia comprising of cities named as, Jeddah, Makkah, King Abdullah Economic City, and Al Madina. These cities are experiencing significant development in the infrastructure, building and transport sectors which is showing the current construction situation of the country.

In Saudi Arabia, as per the General Authority of Statistics (2019), there are four types of registered companies in Saudi Arabia depending upon the number of employees being employed. The first type contains 1-5 employees, the second type contains 6-49 employees, the third type contains 50-249 employees and the fourth type contains 250+ employees (GAS, 2019). In this data collection method, three companies belonging to the second type containing 6-49 employees, three companies belong to the third type containing 50-249 employees while two companies belong to the fourth type containing 250+ employees (Table 4.2). The literature

review highlighted that the size of the enterprise has an impact on the overall safety of the companies due to many reasons. In this research, therefore three different types of companies are selected depending upon their workforce size to explore the ratio of occurrence of the accidents by comparison.

Table 4.3: Size of the companies

Site location	Project Duration	Total number of employees	Actual Manpower	Saudi Manpower	Foreign Manpower
Makkah	1 year	6 to 49	14	6	8
Makkah	4 years	50 to 249	210	22	188
Jeddah	5 years	50 to 249	148	15	133
Jeddah	4 year	6 to 49	41	12	29
Jeddah	3 years	250+	800	56	744
KAEC	5 years	50 to 249	192	21	171
Al Madinah	4 years	250+	680	77	603
Al Madinah	3 years	6 to 49	31	1	30

4.6.1.2 Interview

After completing the study of the organisational archival reports, interviews were conducted. Interviews are being deployed in this study to achieve the research objectives as mentioned in table 4.2. One purpose of the carrying out the interviews is to explore the influence of components of human factors in the occurrence of accidents in the Saudi Arabian construction industry. Furthermore, to investigate human factors affecting the safety performance of the Saudi Arabian construction industry. Another purpose of the interviews is to get answers to the questions that emerged from the multiple case studies done in the previous data collection method.

Interviews can be conducted either through video call or face-to-face. In this research study, interviews were conducted face-to-face. Interviews with the managers and engineers were conducted at their office in the time that was decided by the participants. For supervisors and workers, the interviews were conducted at an at the construction site during the lunch break. The duration of the interview was a maximum of 45 minutes whereas, some interviews lasted for no more than 30 minutes.

4.6.1.2.1 *Interview Design*

A review of the accident reports of the construction companies provided guidelines in designing the questions for the interviews. Interviews were conducted in English as all participants other than workers understand and can speak the English language. For workers, interview questions

were translated into the Urdu language from the English language as workers were from Urdu speaking countries. The native language of the author of this research study is also Urdu so he did the translation and conducted the interviews in Urdu by himself. In the interviews, participants were asked about their position, working experience, and education. Participants were asked about the human factors that cause accidents in the Saudi Arabian construction industry. Participants were asked about different factors that influence the workers which later leads to the occurrence of the accidents. Participants were also asked about the role of the Saudi Arabian government in the development of safety practices in the country and it was followed by the question about the existing health and safety legislation in the Saudi Arabian construction industry (Appendix E).

4.6.1.2.2 *Interview sample*

For interviews, participants were carefully chosen based on their experience and position that can help in achieving the specific research objectives. In this data collection technique, a total of 23 construction professionals participated. For interviews, initially, permission was taken from the company's project manager through email. In the email, the company's project manager was informed about the purpose of this research and how confidentiality will be maintained. After receiving permission from the company project manager. The first interview was conducted with the project manager of the company depending upon his acknowledgement. In the next stage, interviews were conducted with the construction professionals belonging to senior and mid-senior level management. The rest of the interviewee was contacted through the snowball sampling technique. In the snowball sampling, project manager and mid-level managers were informed about the samples that are needed for this study mainly senior, mid-level and line managers, safety experts, engineers, supervisors, technicians and workers. Project manager and construction managers provided a list of potential samples to the researcher that can participate in the interviews based upon researchers' provided list of positions. Interviews were conducted with the list of selected samples as provided by the project manager. Saunders et. al (2016) suggested the minimum sample size of 10-25 interviews so the researcher believes that a sample size of 23 participants will be sufficient to achieve specific research objectives. The interviewee who participated in the research mainly belonged to the profession: Project manager, construction manager, health and safety manager, engineer, supervisor, and workers. Table 4.4 contains the information of the interviewee who participated in the interview.

Table 4.4: Interviewee information table

Participant ID	Position	Experience	Education
X1	Signalling Supervisor	5 Years	Masters
X2	Electrical Engineer	10 Years	Bachelors

X3	Architect Engineer	6 Years	Bachelors
X4	Project Manager	8 Years	PhD
X5	Quality, Health, Safety, and Environment Engineer	5 Years	Bachelors
X6	Health and Safety Manager	15 Years	Bachelors
X7	Health and Safety Manager	15 Years	Masters
X8	Health and Safety Manager	10 Years	Bachelors
X9	General Manager	17 Years	Bachelors
X10	Administration and Planning Manager	10 Years	Masters
X11	Quality Manager	10 Years	Masters
X12	Deputy Project Manager	12 Years	Masters
X13	Signalling Supervisor	11 Years	Bachelors
X14	Project Engineer	9 Years	Masters
X15	Project Engineer	11 Years	Masters
X16	Technical Engineer	4 Years	Masters
X17	Construction Manager	13 Years	Bachelors
X18	Quality, Health, Safety, and Environment Engineer	15 Years	Masters
X19	Quality, Health, Safety, and Environment Engineer	16 Years	Masters
X20	Signalling Engineer	38 Years	Bachelors
X21	Construction Manager	10 Years	Bachelors
X22	Civil Worker	8 Years	Primary School
X23	Electrical Technician	3.6 years	High School

4.6.2 Quantitative data collection method

For the quantitative data collection method, the questionnaire was used as a data collection technique. Kohthari (2006) argue that the questionnaire is used extensively in the various economic and business survey.

4.6.2.1 Questionnaire Survey

The questionnaire survey is being deployed in this study to achieve the research objectives as mentioned in table 4.2. One purpose of carrying out the questionnaire survey is to explore the relationship between human factors and the occurrence of accidents in the Saudi Arabian construction industry. Furthermore, to investigate human factors affecting the safety performance of the Saudi Arabian construction industry. Another purpose of the questionnaire survey is to validate the findings of the interviews regarding the human factors that are affecting the safety performance of the Saudi Arabian construction industry.

4.6.2.1.1 *Questionnaire design*

The questionnaire survey helps the research to understand the opinions of the participants. For the questionnaire survey, questions must be planned carefully to achieve the research objectives. Results from the interviews and literature review were used to prepare the draft version of the questionnaire survey.

The questionnaire survey used for this research study consists of four sections containing different choices to answer the questions. The first section contains the demographic information of the participants such as age, gender, education. In the second section, participants were provided with multiple choice answers to understand the participant's perceptions about human factors and their impact on the occurrence of the accidents in the Saudi Arabian construction industry. The third section contains the questions with a 5-point Likert scale. One question was to understand the satisfaction and dissatisfaction level of the participants regarding the safety practices and safety measures in their workplace and the Saudi Arabian construction industry. In this question the five-point Likert rating scale consisting of "strongly satisfied", "satisfied", "neutral", "not satisfied" and "strongly not satisfied". Another 57 questions were exploratory and were deduced from the interviews. These questions consist of the five-point Likert rating scale with response options of "strongly agree", "agree", "neutral", "disagree" and "strongly disagree". In the last section of the questionnaire survey, there were different questions in which the participants were asked to tick the casual factors that are responsible for accidents. The selection of these casual factors emerged from the literature review, accident reports, and interviews. In addition to that in one question, participants were provided with the option to rate the impact of components of the human factors: individual, job and organizational factors on safety of the workplace (Appendix D).

4.6.2.1.2 *Pilot Study*

A pilot study was initially conducted to verify the relevance of the questions used and to eliminate inadequate wording or questions in the questionnaire survey. Kohthari (2006) explains that a Pilot study is used for testing the questionnaire is conducted which reveals the weaknesses, if any, of the questionnaire (Kohthari, 2006). To carry out the pilot study, initially, five personnel were contacted. Three participants agreed to participate in this study. Among the three participants, one participant was an academics teacher who made a research on the topic of health and safety in Saudi Arabia. Whereas, the second participant was a project manager of a public company in Al Madina and the third participant was a safety manager of a construction project in Jeddah. Participants were contacted via telephone and after their consent of participation, they were sent the questionnaire survey via email for review. The appointment was made with the participants in advance via telephone and later interview was conducted at the time and location of the participant's choice. The interview was conducted only after receiving consent from the interviewee. Participants of the pilot study had some minor comments regarding the type of questions to be part of the questionnaire survey. Alteration in some of the types of questions was also recommended by the participants. One example is in the submitted questionnaire survey for the pilot study the majority of the questions were based upon five Likert ratings. In response to that majority of the participants argued that a more effective way is to ask questions involving more types of questions containing different options to select such as, select for those factors that lead to accidents in the Saudi Arabian construction industry. In addition to that, it was also mentioned by the participants mentioned that it will be beneficial for the research to add those questions in the survey that were pointed out by the majority of the interviewees as it will help in validating those statements.

After receiving the feedback and comments from the participants regarding the questionnaire survey, modifications were made in the questionnaire survey. Types of the questions were changed with some questions were provided options of "Yes" or "No" while other questions were provided with options to "Select", and "Tick". New questions were also added based upon the results of the interviews. After completing the modifications in the questionnaire survey, an updated questionnaire survey was shared with the participants via email. A questionnaire survey was shared with the participants after getting their consent via telephone. Participants were asked about their comments on the updated questionnaire survey. Participants were satisfied with the updated questionnaire survey and no more modifications were required from the participants.

4.6.2.1.3 *Survey sample*

In the questionnaire survey, participants with the job positions of senior managers, mid-level managers, safety professionals, engineers, supervisors, and foremen were targeted. Reason for

the selection of these job roles because these professionals observe worker's attitudes and actions on regular basis and can provide a better understanding of the different factors that influence the worker in the occurrence of the accidents. In addition to that these selected participants are an important part of the organization and they can provide better views about the organizational practices and other contributing factors that are affecting the safety performance.

After the completion of the pilot study, the collection of questionnaire survey was carried out in two ways. In one way the research used his contacts in the construction sites and visited those construction sites in which the researcher knew the senior managers and safety managers of the companies. Later the senior managers and safety managers organized the meetings with the construction team in their construction sites. The researcher explained to the participants' the purpose of the research and questionnaire survey and provided the details about the confidentiality and ethical considerations that will be utilized in this research. Participants were told that they can skip any questions and stop the questionnaire survey anytime if needed. After getting the consent of the participants, a questionnaire survey was distributed to them and it was filled while the author was there. The researcher collected the questionnaire survey by himself one by one after completion. An overall number of completed questionnaire surveys collected from onsite visits were 66 questionnaire survey.

Another way of collecting the questionnaire survey was through a web link. The survey link was distributed to construction professionals through emails and LinkedIn. The survey questionnaires were distributed to 150 construction professionals working in different projects in Saudi Arabia. Out of 150 questionnaires sent to construction professionals through web links, an overall 84 questionnaire survey was completed and sent back to the researcher by the participants. In total out of 216 questionnaire survey distributed, the research received the responses of a total of 150 questionnaire survey through onsite visits and survey links which is 69% of the response rate and will be providing useful information related to research objectives in addition to the archival reports and interviews. Saad (2016) mentioned that survey return rate of more than 20% is practical for obtaining research findings which ensure and promote fairness and validity in the data collection, as issues of preferences for responses were done away with.

4.7 Data Analysis

Kohthari (2004) defines analysis as the computation of certain measures along with searching for patterns of relationships that exist among data-groups. The data analysis techniques refer to the techniques or methods applied in analysing, presenting, and understanding the research results (Saad, 2016). Kohthati (2004) pinned that the analysis of data requires several closely related operations such as the establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences. Johannesson & Perjons (2012) mentions that when data have been generated, they need to be analysed and for this purpose, there exist both quantitative and qualitative data analysis methods. Quantitative data analysis

focuses on numeric (quantitative) data and uses mathematical approaches, in particular statistical ones, to investigate, interpret and structure data whereas, qualitative data analysis is about interpreting data of any form (both qualitative and quantitative) by discovering themes and patterns in them, thereby using the personal skills and understanding of the researcher who undertakes the analysis (Johannesson & Perjons, 2012). Williams (2007) argues that in mix methods researchers collect or analyse not only numerical data, which is customary for quantitative research but also narrative data, which is the norm for qualitative research to address the research question(s) defined for a particular research study. Data analysis of quantitative data will be made through descriptive statistics and factor analysis by using SPSS software. Meanwhile, data analysis of qualitative data will be made through thematic analysis by using MXQDA software.

4.7.1 Qualitative Data Analysis

Qualitative data analysis gives insight into the opinions and information collected from the qualitative data. Qualitative data analysis is being made for the data collected through research strategies such as case studies, observation, and grounded theory. As a qualitative data collection, interviews and archival reports were the two techniques used to achieve the research objectives. Thematic analysis is used for the analysis of collecting qualitative data. Thematic analysis will be done for the archival reports as well as the interviews.

4.7.1.1 Interviews

The interviews were semi-structured and some of the interviews were audio-recorded. Transcription of the main points of the in-depth views of the participants was noted down by the researcher. Later, bullet points were made to summarise the information recorded from the interviews. This helped the researcher to extract the important points discussed by the participants that will be useful to answer the research questions. Furthermore, in this study, the researcher used thematic analysis to extract the data linked with the research objectives. For each participant, a distinct code was generated to maintain the confidentiality of the participant. All interviews were carefully examined, and data analysing was done separately to answer the research questions. Themes were formed by the researcher of the data that was closely related to the research objectives. These themes were also included in the research where the participant's views or insights were similar. Kohthari (2004) explains that coding is necessary for efficient analysis and through it, several replies may be reduced to a small number of classes that contain the critical information required for analysis. Themes along with the transcriptions were gathered and put into sub-categories depending upon their properties. The literature review was also conducted during the data analysis phase.

4.7.1.2 Accident Reports

Eight construction companies working in Saudi Arabia were selected to review the accident reports. This research used a detailed study of construction accident reports from the construction companies to identify the influencing factors associated with the human factor that causes of accidents in the construction industry of Saudi Arabia. Data gathered and analysed from the accident reports help in understanding the process of accident causation and finding out the underlying and immediate cause of accidents that answered the research objectives. Accident reports from eight construction companies were carefully examined and data analysing was done to answer the research questions. In the next chapter, the results obtained from the data analysis of the qualitative data are presented. Quantitative data analysis is another scheme utilised in this research which is explained in the next section.

4.7.2 Quantitative Data Analysis

In quantitative data analysis, a collection of numerical data is being used to analyse the data. The research itself is independent of the researcher and as a result, data is used to objectively measure reality (Williams, 2007). In quantitative data analysis, participant's responses are used which is raw data to establish the understanding of the specific research objectives.

4.7.2.1 Questionnaire Survey

A questionnaire survey was the research techniques used to conduct quantitative data. In this research, quantitative data analysis was done by using IBM SPSS statistics software version 25. In the first step, the collected data will be gathered in a sheet using a Windows excel file. Later on, the collected data of the questionnaire was converted into numerical form and will be input into SPSS to create graphs, tables, and charts. To analyse the quantitative data, descriptive and factor analysis techniques were deployed in this study.

The demographic information of the participants was depicted through graphs and tables. In total 150 questionnaire survey responses were collected. A questionnaire survey was filled out by construction professionals working in Saudi Arabia belong to the following professions: senior managers, mid-level managers, safety professionals, engineers, supervisors, and foreman. Questionnaire participants were working for public companies as well as private companies in Saudi Arabia. Findings from the questionnaire survey will be used for two purposes: firstly, to identify the human factors that influence the safety performance of the Saudi Arabian construction industry. Secondly, to evaluate the comments made by the interviewees related to the relationship of human factors and the occurrence of accidents in the Saudi Arabian construction industry, and investigate human factors affecting the safety performance of the Saudi Arabian construction industry.

4.8 Ethical Considerations

In the research study, it is important to know the importance of ethical guidelines. The ethical aspect is of high importance and it is necessary to follow the required ethical guidelines. The confidentiality of the participants and the organisation must be maintained. In this research study, the researcher has strictly implemented the necessary ethical steps. In the below sections, it is mentioned how the ethical guidelines were implemented in this research study.

4.8.1 Accident Reports

Science & Technology Research Ethics Panel has approved archival reports review as one of the research techniques to be deployed in this study. A review of the organisational archives was made only by getting permission from the senior management. Permission was first sought from the senior management of the construction companies to collect the data. Senior management was contacted through emails and phone calls. After getting the initial intent from the senior management to be part of the research, the management was provided with information explaining the information related to the research and its purpose (Please refer to Appendix A). In addition to that, the letter was being sent through email to the senior manager of the construction sites to access the archival reports of the construction sites. The letter explained the information related to the research (Please refer to Appendix B).

After receiving permission from the senior management to carry out the study in their construction sites, they were contacted by email and phone calls to arrange the schedule of visiting their construction office. After visiting the company's office, senior management and safety officers were met and they were briefed about the scope of this research and how confidentiality will be kept related to the company, construction site, and individuals. It was told that the name of the construction company, injured workers and construction sites will be kept confidential and will not be disclosed. All information will be mentioned with unique codes and IDs.

4.8.2 Interviews

Science & Technology Research Ethics Panel has approved interviews as one of the research techniques to be deployed in this study. Interview participants were contacted through emails and phone calls before arranging an interview with them. After getting the initial intent from the participant to be part of the research, participants were provided with information explaining the information related to the research and its purpose (Please refer to Appendix A). Participants were provided with the consent form explaining the rights of the participants for participation in this study and the confidentiality of their personnel information (Please refer to Appendix C).

Interviews were conducted only after getting consent from the participant (Please refer to Appendix C). Before the interview, participants were provided with interview questions (Please refer to Appendix E) that will be answered by them. Participants were explained about the research technique and the confidentiality process. Participants were told that they can ask any questions to the researcher at any time of the interview process. Participants were told that they are allowed to skip any questions or withdraw from the study anytime during the research without giving any reasons. Participants were asked about the permission to make the audio recording of their interviews and audio recording were made only after getting permission from the participants.

4.8.3 Questionnaire Survey

Science & Technology Research Ethics Panel has approved the questionnaire survey as one of the research techniques to be deployed in this study. After getting the initial intent from the participant to be part of the research, participants will be provided with an information sheet explaining the information related to the research (Please refer to Appendix A). Also, participants will be provided with the consent form before the survey (Please refer to Appendix C). For onsite survey will be conducted only after getting consent from the participant (Please refer to Appendix C). Participants will be provided with a questionnaire survey (Please refer to Appendix D) mentioning the questions that will be answered by them. For an online survey conducted through a weblink, google forms were used and at the start of the questionnaire survey first section contains the consent which the participants need to agree to continue. This consent survey contains the required information about research and confidentiality. Participants will be explained about the research technique and the confidentiality process. Participants will be allowed to skip any questions or withdraw from the study without giving any reasons. Participants will be allowed to meet the researcher by a person or contact the researcher through email or phone.

In the next chapter, the results of the three research strategies deployed in this research study will be mentioned. It is hoped that the results of the three research techniques will provide detail and in-depth information related to the research topic of this research topic.

Chapter 5

Results

5.1 Introduction

In this study, qualitative and quantitative tools were deployed to analyses accident reports, interviews and surveys. Results were derived after descriptive statistics, thematic analysis and factor analysis of the archival reports, interviews, and surveys. Microsoft Excel, SPSS and MXQDA are the three-software utilized in this study.

5.2 Accident Reports

Purpose of using accident reports to explore the accident rates in the construction sites of Saudi Arabia. In addition to that, identifying the factors associated with the human factors responsible for these accidents in the construction sites. All eight construction companies provided the accident reports of their construction sites containing the information related to the injured worker (name, age, etc.), time/date, location, injured body part, description of the incident, and direct/indirect causes of the accidents. The researcher made a summary of the eight accident reports collected from eight construction companies.

Table 5.1 shows that cities of Jeddah and Madina recorded the highest number of accidents. Table 5.1 also confirms the statistics mentioned in the literature review that Jeddah experiences the highest number of accidents in the western region of Saudi Arabia. Another information Table 5.1 shows that most of the accidents 74.42% (n=64) resulted in injured workers losing three days or less due to accident whereas, 25.58% (n=22) were the accidents in which workers lost time due to accidents were more than three days. No fatality was reported in eight six studied accidents.

Table 5.1: General summary of the eighty-six accident reports

Site location	Project Duration	Total number of employees	Actual Manpower	Total number of accidents	Accidents involving LTI more than three days	Accidents involving LTI less than three days
Makkah	1 year	6 to 49	14	1	0	1
Makkah	4 years	50 to 249	209	20	3	17
Jeddah	5 years	50 to 249	148	9	2	7
Jeddah	4 year	6 to 49	41	5	1	4
Jeddah	3 years	250+	800	17	6	11
KAEC	5 years	50 to 249	192	8	3	5
Al Madinah	4 years	250+	680	23	6	17
Al Madinah	3 years	6 to 49	31	3	1	2

Construction companies containing more employees have more recorded accidents as table 5.1 shows. However, one important information above table 5.1 suggested that small and medium-

sized companies containing workers less than 250 have a high-frequency rate for the occurrence of the accidents as compared to the large construction companies employing 250 or more workers. This information conforms with the statement of Jannadi & Assaf (1998) and Timofeeva et al. (2017) that small and medium-sized companies are involved with more accidents.

5.2.1 Source of accident

Findings from the accident reports of the construction companies revealed that accidents occurred due to different circumstances such as Slips, trips, and falls, hitting by machinery, caught in machinery, falling of material, trapped between material, car accident, hitting by material, and cuts. GOSI (2018) statistics show that most of the accidents occur due to falling from a height, slip, trip and falls, and struck or hitting.

The study of the accident reports shows that struck by machinery/material 37.20% (n=32) was responsible for more than one-third of the occurrence of the accidents in the eight construction sites. Other sources of accidents were slips, trips, and falls 17.44% (n=15), followed by vehicle/machinery accident 16.28% (n=14), falling of material 12.79% (n=11) and hitting by material 12.79% (n=11). Whereas, hot work 0.86% (n=1) and chemical exposure 0.86% (n=1) were responsible for the least number of accidents as shown in Figure 5.1.

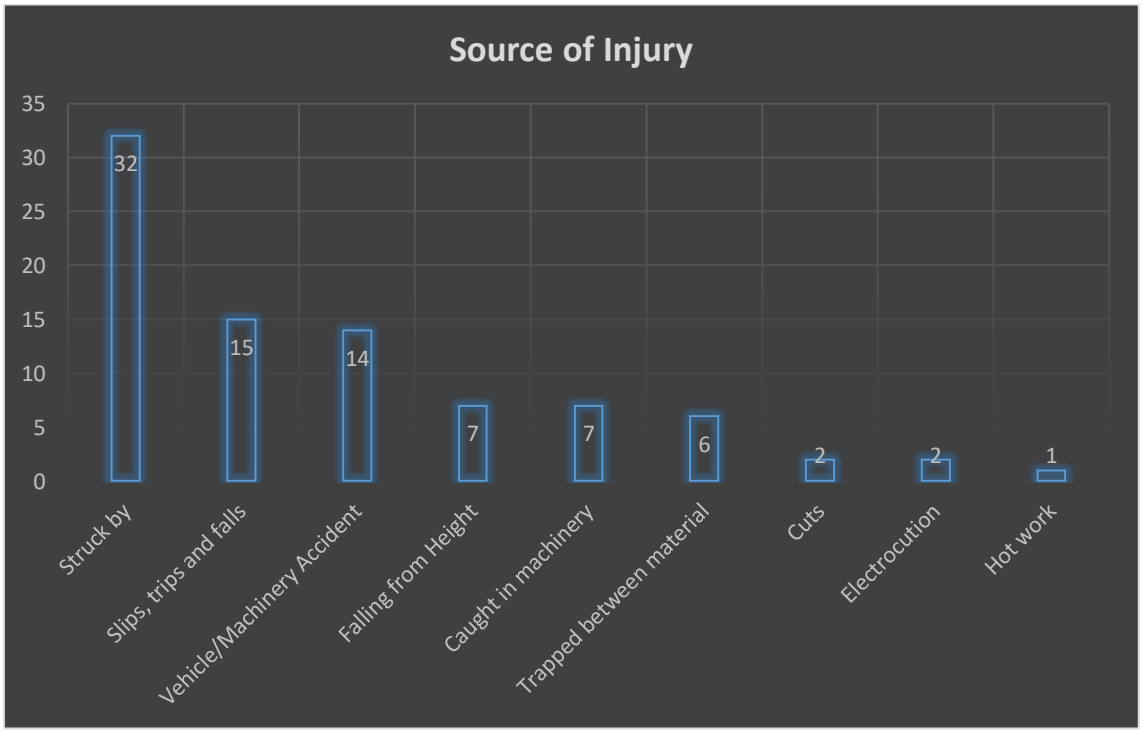

Figure 5.1: Accident Source

5.2.2 Injury to the body part

Figure 5.2 shows that as a result of studied accidents at the construction sites, most of the workers suffered injuries in their hand 33.72% (n=29), and leg 22.09% (n=19). Hip 0.86% (n=1) and shoulder 0.86% (n=1) accounted for the least amount of injuries as a result of accidents.

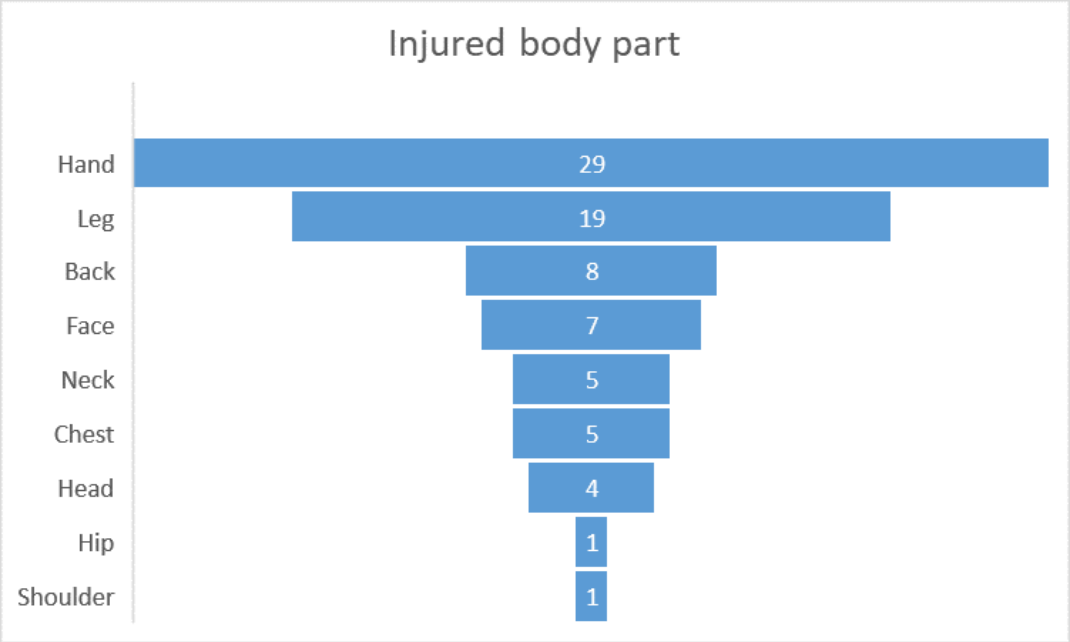

Figure 5.2: Body part suffered due to injury

5.2.3 Day and month of the accidents

Figure 5.3 shows that most of the accidents occurred in the month of April 12.79% (n=11), February 8.60% (n=10), May 8.60% (n=10), June 8.60% (n=10) and July 8.60% (n=10). Whereas, in August 5.81% (n=5) and September 4.65% (n=4), the least number of accidents occurred in the eight construction companies. May, June & July are some of the three months which reported the most number of accidents and in these months the weather is hot exceeding 40 degrees. In the literature review, it was highlighted that hot weather conditions make workers uncomfortable and even they remove necessary safety equipment.

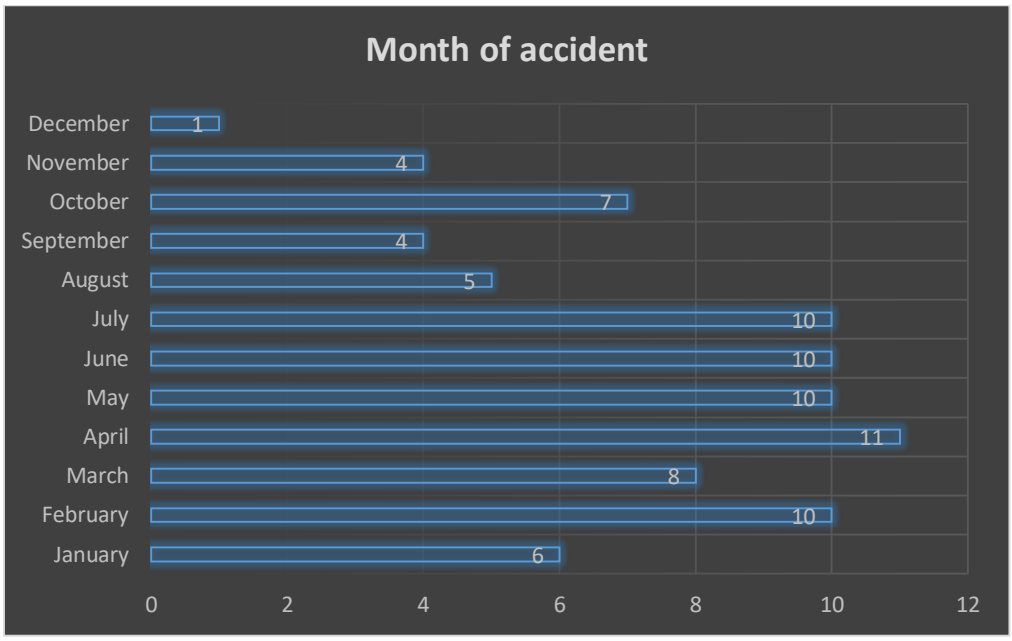

Figure 5.3: Month of Accidents

In terms of weekdays, Monday 22.09% (n=19) and Thursday 19.77% (n=17) recorded the highest number of accidents, followed by Saturday 15.11% (n=13) and Wednesday 15.11% (n=13). The least number of accidents occurred on the weekend day of Friday 4.65% (n=4).

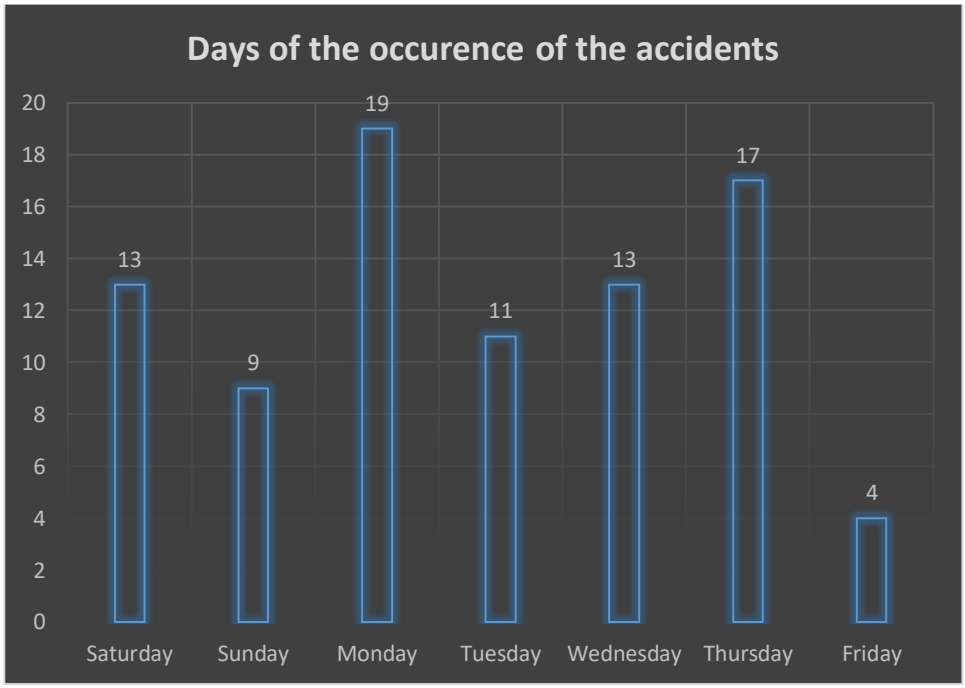

Figure 5.4: Days of Accidents

5.2.4 Influencing human factors causing the accidents

In the literature review, research studies and accident causation theories suggested that accident occurs with the involvement of more than one factors and there is a link between one contributing factor with another. The study of the accident reports from eight construction companies revealed similar information as the majority of the accident reports were caused by more than one factor. In the accident reports, the causes of the accidents were mentioned as direct and indirect. Health and Safety Executive (HSE) mentioned that there is a relationship between individual, task and workplace factors. Health and Safety Executive also pointed out that workers' behaviour and actions are influenced by the factors arising from the characteristics of the individual itself, task and workplace. To understand the relationship between various influencing factors affecting the behaviour and actions of the worker, it is significant to identify the influencing factors arising from various sources. In the study of the accident reports, it was unveiled that eight six accidents in eight construction companies occurred due to twenty-eight influencing factors associated with the human factors (Table 5.2). The study of the accident reports also revealed that individual factors led to the occurrence of most accidents as they are one carrying out the task and their actions have a direct influence on the output of the event resulting in the occurrence of the accident. It also suggests that individual actions and behaviour have a strong impact on the occurrence of accidents in Saudi Arabian construction sites.

The study of the accident reports shows that the "carelessness of the workers for not looking into surrounding for risks" (n=54) has directly influenced the causation of the most number of accidents. One accident report mentioned that one worker was working at night at a railway site containing different tracks. Between different tracks there contains a ditch, this worker along with the group passed this ditch while crossing the tracks. While returning, the injured worker did not realise the presence of the ditch resulting in falling in the ditch and hurting his elbow. "Carelessness of the worker for not looking into surrounding for risks" was mentioned as a direct cause of the accident as the workers did not pay attention to this ditch which he already crossed earlier. It was also highlighted that the indirect cause of this accident was associated with the design issues involving no cover on the ditch to avoid falling of any person. This is one example of the accident was caused by the failure of the combination of influencing factors coming associated with individual and workplace, and this is one of many accident reports which indicates accidents are happening due to the involvement of combination of various influencing factors emerging from human factors involving individual, task and workplace.

Workers lack awareness about risks present at the site (n=36), lack of training about work procedures, safety requirements and safety induction (n=34), and shortcuts made by the workers to work fast and finish the job as early as possible even by bypassing safety rules (n=34) have contributed second and third most number of accidents at the eight construction companies. One studied accident mentioned that one worker had to perform an inspection on the cables located at a 3-meter height ceiling cable tray. This worker did not place the ladder at the stable surface and on another worker available holding the ladder because of being in a hurry resulting in ladder slipping and causing him to fall on the ground resulting in him injuring his back. Wrong

instructions by the supervisor (n=1), workers health issue (n=1) and poor housekeeping (n=1) were the factors that contributed towards the causation of the least number of accidents in eight construction companies (Table 5.2).

Table 5.2: Influencing human factors causing the accidents

	Influencing human factors	No. of accidents	Rank
Individual	Shortcuts	34	3
	Failure to follow work instructions	20	8
	Not following safety rules	23	7
	Unsafe actions	7	13
	Improper use of machinery	6	14
	Carelessness	54	1
	Ignoring the warnings	23	7
	Lack of attention	10	12
	Overconfidence	7	13
	Lack of working experience	14	9
	Health issues	1	18
Task	Lack of communication	4	15
	Lack of training	34	3
	Lack of awareness	36	2
	Unsafe work methods	11	10
	The improper procedure of work	9	12
	Lack of supervision	27	6
	Wrong instructions by supervisor	1	18
	Pressure of work	2	17
	Rush at work	1	18
Workplace	Unsafe working conditions	31	4
	Poor housekeeping	1	18
	Lack of planning	29	5
	Incorrect design	3	16
	Lack of personnel protective equipment	11	10
	Inappropriate materials	3	16
	Improper tools	3	16
	Defective Machinery	2	17

5.2.8 Summary

Eight construction sites operating in the western region of Saudi Arabia were selected to review the accident reports. The research objective of conducting the study of accident reports from the

construction companies was to identify the human factors that cause of accidents in the construction industry of Saudi Arabia. Data gathered and analysed from the accident's reports helped in understanding the influencing factors associated with the human factors which answered the research questions. Data analysis of the accident reports revealed that out of eight-six accident reports, fatality did not occur in any of the studied accident. It was also revealed that out of eighty-six studied accident reports, the majority of the studied accidents were of minor type in which the worker had a minor injury and was given rest by the doctor of no more than three days. It was also revealed that most of the accidents occurred in the cities of Jeddah and Medina. The literature review also pointed out that the city of Jeddah is responsible for the highest number of occupational accidents in Saudi Arabia (GOSI, 2018; Mosly, 2015). This result from the accident report confirms the statistics mentioned in the literature review that Jeddah experiences the highest number of accidents in the western region of Saudi Arabia.

Another significant information collected from the accident reports were the source of the accidents and it was revealed that *struck by* was responsible for more than one-third of the occurrence of the accidents followed by slips, trips, and falls, and vehicle/machinery accident. In the literature review, statistics by (GOSI, 2018) also reveals that most of the occupational injuries occurred due to *struck by,* falling from a height, and rubbed and abraded. The result indicates that similar sources that *struck by are* one of the main sources of accidents. The literature review highlighted that small and medium-sized company are more involved in the occurrence of accidents as compare to large-sized companies. The result from the accident reports revealed that most of the studied accidents occurred in the companies which are largely sized containing more than 250 employees. Hence, this result indicates that large-sized companies are also inflicted with the occurrence of many accidents and the occurrence of accidents is a common problem for all sized companies.

The literature review suggested that at the workplace, accidents are occurring due to the involvement of numerous factors. The literature review also pointed out that workers' actions and behaviour are influenced by different casual factors associated with the workplace and task. Therefore, in this study, the main purpose of conducting the document analysis was to identify those factors that are influencing the workers directly or indirectly in the occurrence of accidents in the construction sites. Based on the provided accident reports it can be concluded that accidents are occurring due to the involvement of multiple influencing factors associated with individuals, tasks, and workplaces. Study of the accident reports of eight construction sites revealed that most numbers of accidents were caused by five influencing factors associated with the human factors: carelessness of the worker for not looking into surrounding for risks, workers lack awareness about risks present at the site, lack of training about work procedures, safety requirements, and safety induction, and shortcuts made by the workers to work fast and finish the job as early as possible even by bypassing safety rules, unsafe working conditions provided by the management and lack of planning done by the project and site management and supervisors (Table 5.2).

5.3 Interviews

Interviews strategy is deployed in this study to achieve the research objectives as mentioned in table 4.1. Interviews were conducted to discuss with the participants the twenty-eight influencing human factors mentioned in table 5.2 to have an in-depth understanding of these influencing human factors. Another purpose of carrying out the interviews is to examine the challenges and barriers the Saudi Arabian construction industry is facing in maintaining safe worksite-based upon the opinion knowledge of the interviewee participants. The interviewee was asked to provide their recommendations which will help in improving the safety performance of the Saudi Arabian construction industry.

Results from the interviews were extracted by deploying qualitative thematic analysis. In this research, six steps of thematic analysis were followed which are mentioned by Braun and Clark (2006). Braun and Clark (2006) pointed out that if thematic analysis needs to be performed properly it is important to follow six steps: familiarising yourself with your data, generating initial codes, searching for themes, reviewing themes, defining and naming themes and producing the report. To understand the data, the researcher converted audio-recorded data to written transcriptions by keeping in mind the information required for this research-based upon the research objectives. In the next step, different codes were formed of the transcribed data by the use of Standard version 12 of MAXQDA (2015). Different codes were further linked with the themes which are related to the research objectives. Themes were further assessed to select which themes and codes containing related information and if some codes are not related, they were excluded and put into other themes or dropped. Themes were given the title based upon the extracted data and codes. In the last step, analysis and the results were pinned down.

5.3.1 Opinion about the involvement of human factors in the occurrence of accidents in the Saudi Arabian construction industry

Interview participants were asked about the role of human factors in the occurrence of accidents in the Saudi Arabian construction industry. Most of the interview participants were of the view that influencing factors that cause accidents are related to the components of the human factors. Many interviewees including, X1, X4, X10, X16 have mentioned that "most of the accidents are happening due to the human factors". X3 emphasized the importance of Human factors and stated that "*Human behaviour is important towards safety*". X6 states that "*a lot of accidents are influenced by the human factors*". X13 also stated that "*most of the accidents are caused by people*".

5.3.2 Discussion on the sixty-eight influencing human factors responsible for the occurrence of the eighty-six accidents mentioned in Table 5.2 with the participants of the interview

The study of the accident reports shows that the occurrence of the accidents in the construction companies occurred due to twenty-eight influencing human factors as mentioned in Table 5.2. Analysis of the accident reports revealed that the occurrence of the accidents in Saudi Arabian construction projects is associated with human factors. Numerous influencing factors were pointed out in the study of the eighty-six studied accident reports. In most of the accident reports, individual factors involving worker's actions were mentioned as the direct cause of accidents such as non-compliance to safety rules. Task and workplace factors such as unsafe working conditions acted as the indirect causes of the accidents. Twenty-three participants of the interviews were provided with influencing human factors as mentioned in table 5.2 to try to explore the reasons behind the involvement of these influencing human factors which is eventually becoming the source of the occurrence of the accidents at the construction sites.

5.3.2.1 Factors associated with the Individuals

Table 5.2 suggests that individual factors contribute to the occurrence of numerous accidents. The literature review also suggested that many accidents are occurring due to individual factors. Individual factors involve the workers who are directly carrying out the job as well as the team that is involved in the construction activities. Studies of the accident reports of the project reveal the non-compliance to safety rules, carelessness and lack of attention are some of the significant factors that cause the accidents.

a) Not following safety rules

Data analysis of the accidents of the construction sites shows that worker's actions such as *not following safety rules, unsafe actions, improper use of machinery or tools and failure to follow work instructions* were responsible for any accidents (Table 5.2). Some of the participants emphasized that safety must be a priority and were of the same view that safety is not a different issue and needs to be part of normal life. It's a common sense and cannot be done through force and worker needs to realise and act upon it. Whether people are warning it or not.

X4 stressed the importance of following the safety rules. Many participants mentioned that non-compliance to safety rules by the worker's influence the occurrence of human-related accidents. X9 mentioned the importance of following safety rules and added, "*If the workers will not follow safety rules, then they will have accidents*". Another interviewee had a similar response that "*If a worker will not follow the safety instruction and continue with the non-compliance to safety rules then will experience accidents at the workplace*".

Interview participants provided different reasons why the workers are carrying out unsafe actions or not following the safety rules. X13 mentioned that one of the reason worker's carry out unsafe actions are due to ignorance and lack of awareness.

"*Most of the labour is ignorant, don't care about safety and if there is no supervision than they don't need to follow safety rules*."

He added that the company has safety rules, but they need to have proper awareness among workers related to the importance of safety rules and its benefits. Some interviewee mentions that some of the safety measures are not practical and see it as a burden or job delaying so as a result worker ignore the safety measures and work unsafely. X4 mentioned one of the reasons workers don't follow safety rules that, "*Sometimes workers feel uncomfortable in wearing safety equipment, so they don't follow safety rules*". X6 participant states that sometimes newcomers don't follow safety rules because "*if we are working in a group if a senior member is not following the safety rules than newcomers also follow them*". X19 argued that the sometimes organisation implement many things but due to workers not following the safety rules accident still occurs.

"*You can do a lot of things, but they need to understand, respect and follow safety*".

X6 mentioned that workers act to comply with safety rules because of the safety department. If the safety officer is inspecting the area, they wear safety equipment and work safely otherwise they like to take unnecessary shortcuts. When asked why workers don't follow safety rules, X8 said that Saudi Arabia is a hot country as sometimes workers don't wear safety equipment as they feel uncomfortable.

In one of the construction sites, one participant said that the penalty system is in place and if a worker is found not following safety rules, the penalty is applied and deducted from their salary. X6 said that the penalty system improved the compliance of safety rules by the workers as they are scared of getting their salary deducted due to penalties. He added that sometimes these types of systems are necessary to make sure workers follow safety rules. X11 emphasized the importance of following the safety rules, "*It's a common sense and cannot be done through force and worker needs to realise and act upon it*". Another interviewee participant was of the view that "*Workers should take into serious and work properly according to the necessity of all safety rules*".

b) Shortcuts

Shortcuts by the workers are pointed out as one of the significant influencing human factors that contributed as a direct cause of the most number of the studied accidents. X5 also mentioned that shortcut is one of the reasons behind the occurrence of accidents. X5 mentioned that workers work with shortcuts when they have limited time or wanted to finish the task soon. X9 shared the same view and stated that "shortcuts by the workers to finish the task in a short duration".

X7 mentioned that management pushes the worker to complete the task in a short time and as a result workers take shortcuts. These shortcuts performed by the workers let them bypass safety precautions and rules, resulting in creating unsafe situations and which later contributes to the causation of the accident.

X7 suggests that management needs to provide the workers time to finish the task. X10 mentioned that safety must be a priority for each worker and "but they need to understand, respect and follow safety" to avoid an accident.

c) Overconfidence

Overconfidence was considered an important factor as highlighted by the majority of the participants which also caused some accidents at the construction sites. It was mentioned by the participants of the interview that the most important thing about the workers is overconfidence as some experienced people think that accidents "never happened to me as I am performing this task for some time". X5 and X6 mentioned that overconfidence is one of the elements of an individual that causes accidents. X2 highlighted that accident occurs due to overconfidence of the workers and stated that "people take less concentration to safety due to having overconfidence". X2 mentioned that one reason behind the overconfidence of the workers, "nothing will happen to me, as I did this task a lot of times and I have a lot of experience and did not experience any accident".

X7 states that "accidents don't usually occur in the first years of getting training as you are very careful but as time passes then you get overconfidence and lose concentration, so accidents occur".

One participant stated that he witnessed some accidents due to the negligence of humans, shortcuts, and overconfidence. He added that:

"*Sometimes, the company is implementing safe worksite, but workers still commit unsafe behaviour due to carelessness, laziness, or poor attitude*."

d) Carelessness and ignoring the warning

Another factor that was revealed in the study of archival reports was *carelessness and ignoring the warnings*. Many participants also considered worker's carelessness as one of the factors that influence the individual in the occurrence of accidents. X3 stated that "carelessness" causes workers to neglect safety rules which become a reason behind the cause of the accident. X5 and X15 stated that the "*careless behaviour of humans*" are causing accidents. X9 states that "*humans are capable of making mistakes*" and workers are found "*not taking care of preventive measures*" as a result they are involved in the accident.

"*This is a foreign country for us as we are away from our country, there are people from different nationalities here so people must not only take care of our safety but also take precautions with the actions of other workers or companies as their actions can also cause an accident*." X1

Some of the interviewee participants pointed out the main reason for the carelessness of the workers towards safety is due to lack of concentration, attention, and laziness. X10 and X13 stated that lack of concentration and lack of attention are the two main elements that cause human-related accidents. X4 states that workers are involved in unsafe behaviour due to carelessness and laziness. X4 added that "*In Saudi Arabia, most of the labour is ignorant and have limited care about safety*". X7 pinned one of the reasons behind the carelessness of the workers is, "*due to management pressure to finish the task soon, workers lose consciousness and give less concentration to safety and neglect the safety rules*".

X5 recommended that employers must "create awareness among the workers to avoid negligence" which will help in reducing the causation of accidents.

e) Lack of working experience

Analysis of the accident report shows that 14 accidents occurred involving causal factor "*lack of experience*". Most of the interviewees thought were that experienced workers are involved in fewer accidents than fewer experienced workers. Experience workers have seen the occurrence of accidents involving themselves or team members so they realise the importance of safety. But in contrary to that, some interviewee expressed their view that:

"*Sometimes experience workers who did not involve in any accident feels that he cannot have an accident whether they work with safety or not and then this attitude makes them relax and can influence them in working unsafely*."

On the other hand, it was described that young people with less experience sometimes lacks attention and awareness and end up making a mistake which causes an accident.

X4 states that most of the workers in Saudi Arabia are ignorant. X5 pinned the "*incompetence of the workers*" as one of the reasons behind the occurrence of accidents in Saudi Arabia. X7 and X8 shared the same view that "*lack of experience*" of the workers causes workers to not recognise the risks and work unsafely. X12 also mentioned that the low competence of the workers is an influencing factor and emphasized the importance of competence of skill and experience of the workforce by saying that, "*it is important to have staff who know what do and how to do*". "Lack of education" and "inexperience" was mentioned by X14 and X16 respectively as a reason behind poor safety performance.

X21 described that in their company fewer experienced workers are not allowed to work alone without experienced team members until they get three months of experience at the job. This

practice helps the less experienced workers in understanding the worksites, practices, and hazards.

"*Companies need to not place inexperienced workers to high-risk jobs as it will bring more risks to the workers. Critical jobs such as working at height must be carried out by experienced workers*."

X4 insisted that employees can improve safety performance by hiring a competent workforce or increasing the competence of the workers.

f) Workers' health and behaviour issues

Poor health conditions of the workers also led to the causation of the accidents at the construction sites as literature reviews suggested. X6 mentioned that personnel and health issues are the reasons behind the causes of some reported accidents (Table 5.2). X6 added that if the worker is feeling sick or have family issues then he/she will be unable to concentrate on the work properly and there is a chance that he will do a mistake which can cause an accident. X11 also pinned that personal issues affect human behaviour:

"*When the worker has some issues in his mind out of the business, he will make some faults, If the worker is in stress and there is some pressure, probably he/she will make mistakes*." X11

One interviewee mentioned that job site workers are exposed to different hazards such as paints, chemicals or welding works. These works create a lot of health risks and the company does not implement safe methodology while working with chemicals or hazardous materials and as a result worker health is being affected. Medical examination of the workers is not being done regularly. Workers only get to go to the doctor if the situation is critical.

Some of the interviewees described that workers' inadequate living conditions and food provided by the employer also affect their health and they get sick.

X14 mentioned that workers' behaviour and actions are affected by "*sleeplessness, homesickness, and personal reasons*". X16 also suggested that in the occurrence of accidents, individual factors play a role and stated that "*physical factors, stress, and psychological factors lead to the majority of the accidents at worksites*".

X17 and X19 shared the same view that when workers get sick and continue to work at the workplace results in a lack of energy and concentration which influences them in neglecting safety practices.

g) Lack of Attention

X3, X5, X10, and X13 mentioned that "*lack of attention*" by the worker caused many accidents and is one of the individual factors that cause an accident. X8 pinned that most of the accidents

occur at the first half of the day as workers are still adjusting to the site and not having proper attention so the workers are unable to recognise, report or manage the risks. X9 mentioned that one of the reasons behind workers' lack of attention is “sleepy while reaching the workplace”. X16 states the “due to inattention” accident occurs.

“Sometimes, the company are implementing safe worksite, but workers still commit unsafe behaviour due to carelessness, or laziness” X4

X9 recommended that management must create awareness among the workers regularly. X10 suggests that “Workers should rest well, sleep enough. If not, they cannot concentrate during working hours. This may cause them to make mistakes and lead to accidents”.

5.3.2.1 Factors associated with the task and the workplace

Participants of the interview pointed out many factors associated with tasks and work that contribute towards the occurrence of accidents in the construction sites. The study of accident reports revealed that task and workplace-related factors were responsible for the occurrence of the second most number of accidents in the construction companies.

a) Inadequate materials, tools, and machinery

Tools and machinery are an important part of the completion of any task. If the tools and machinery are not appropriate or in bad conditions this may lead to major accidents where chances of major injuries or fatalities are higher. When accident reports were analysed it was revealed that at construction sites, *inappropriate materials, improper tools, and defective machinery* caused numerous accidents. X19 mentioned that some workers remove the protective guards of the cutting or grinding tools to carry out their tasks which poses a big risk to the workers.

“*It is important that the required tools be provided to the workers as a necessity. So that workers should not remove any guard*.”

It was described by X13 that in Saudi Arabia, most of the machinery is hired through sub-contractors and this machinery in most of the time is not maintained properly and lack the necessary system and parts. Sometimes, the back alarm of the machinery is not working. In lifting equipment, the lifting accessories are damaged, and the company is not concerned a lot about it as their preference is the completion of the task.

“*Each equipment must be controlled and approved by the supervisors or safety officers before the start of the job. If the machinery is in good condition, then only they need to be allowed to operate at the site.*”

b) The improper procedure of work

Procedures are important for each work as they give guidelines on how to carry out the work in a systematic way. Procedures also contain the safety information which helps in the identification and mitigation of the risks. Data analysis of the accident reports suggests that *improper procedure of work* caused issues that were mentioned as a factor in 9 accidents. X8 interviewee mentioned that for each task their project is using a specific method of the statement which consists of production, quality and safety information related to that task. Safety information is a risk assessment. But the issue is that this document is just a formality as it is required by the client, but this method of statement is not communicated to the work team who is carrying out the job.

Subcontractors do not have their risk assessment or safety plan and rely on main contractor documents which are practically different from their works.

"*It is important that subcontractors must develop and implement their risk assessments as each subcontractor works are unique*."

X15 told me that they have experienced many issues due to a lack of necessary procedures. They are carrying out urgent works as per the client's instruction, but the company failed to develop any procedures related to these activities.

c) Lack of personnel protective equipment

Workers need to have all the necessary resources to carry out the job in a suitable manner. The accident report shows that some workers were not provided with protective materials and adequate personnel protective equipment. One issue as reported in accident 9 was that the worker was not wearing a working dress and was wearing his traditional loose dress which creates more safety hazard especially working with machinery and steel bars. It was mentioned in the report that the worker was not provided by his employer the required working dress. It was mentioned by X7 that the company does not provide them with good quality safety equipment which is safer. Sub-standard and low-cost safety equipment is being provided to them by the employer.

Another issue was mentioned by X14 that one company only replace the safety equipment after six months and if a worker safety equipment got damaged at work then he has to wait and use that damaged safety equipment until six months are completed. X23 complained about this problem and mentioned that some workers are working at the site with damaged safety shoes.

X11 who shared his own working experience said that the main hazards are while working at height on a scaffold. Sometimes the scaffold does not have proper edge protections and ladder to access/egress the scaffold which makes it difficult to work. Management is more concerned about production than providing safe working platforms for the workers.

d) Lack of planning and incorrect design

Any work that is properly planned had more chances of being completed on target duration with risks mitigated. The study of the accident reports shows that *lack of planning* has contributed to the occurrence of 29 accidents. In accident no. 5, it was reported that two-man lifts machinery with workers on it were working close to each other and the cable drum of one man lift which was higher fell on another man lift which was lower and hit a worker resulting in injuring the worker.

Interviewee raised their concern about the lack of planning especially when different work teams and subcontractors work together or proximity of each other. It is important that responsible management plan with their subcontractors all the works and inform them of the risks associated with the workplace.

"*Plannification is important, a good definition of all works and we need to know where we are going and how we are going. Planification and safety culture are the father figures in terms of safety*."

The incorrect design resulted in the occurrence of 3 accidents at the construction sites. One accident revealed that an engineer who was working in the night fell in the drainage ditch which was not protected or covered. This drainage ditch was without cover because its cover was not part of the design. X18 mentioned that if there would be a cover the worker would not have fallen in it and he recommends having this ditch covered.

e) Unsafe method of work

Unsafe work methods performed by the site team contributed to the occurrence of 11 accidents as mentioned in the analysis of archival reports. X6 mentioned that sometimes some work situations are unique, and, in these situations, some different work methods are involved which are unsafe too. But the purpose is to complete the work.

"*To enforce the 2.5-meter steel bar in the soil, we use hoe of the machinery to stand which is not allowed by the safety department, but we don't have any other option.*"

It was described by X11 that it is important that for each critical activity there is a risk assessment and it must be ensured that this risk assessment is being followed at the workplace. It is seen that safety-related documents are not being followed at construction sites and there is no control from the management to make sure whether it is being followed or not.

f) Unsafe working conditions

Working conditions are one of the key factors in maintaining a safe workplace. The study of the accident reports revealed that there were a significant number of accidents occurring due to *unsafe working conditions* at the construction sites. Unstable support, uneven surface, low

visibility condition, lack of edge protection, poor housekeeping, unsafe conditions, and inappropriate working conditions were the recorded sub-factors of working conditions that influenced the occurrence of accidents at the construction sites. Accident records show that in total 32 accidents were caused by *unsafe working conditions and poor housekeeping*.

It was reported by some of the interviewees that some of the workplaces consist of open spaces and manholes which creates a falling risk for the workers working nearby. Working at night is difficult sometimes due to not proper lighting. One reason the accidents are occurring is due to unsafe working conditions.

It was highlighted that in Saudi Arabia mostly it is hot weather more than 35 degrees and working under the sunlight is very difficult and exhausting. Workers are not being provided with necessary welfare facilities such as, shades from sunlight, drinking water or rests which creates dizziness and fatigue to the workers.

"*If working conditions are good, welfare facilities are good, the material is in good quality, make the worker feel happy and comfortable*."

X2 stress the importance of having a safe working environment where hazards must be mitigated:

"*Safety performance can be improved by fixing the underlying causes. If a worker is wearing a helmet, but still things falling on his head than there are risks. Safety professionals need to assess and mitigate the hazards/risks. Supervisors must remove and control the danger related to personnel at the workplace*." X2

X4 argues that it is the responsibility of the employers to provide a safe working environment for the workers so that accidents can be avoided in the workplace.

X5 also suggests the in a safe working environment, "*mitigating of the risks needs to be done by the management*".

X6 mentions that "*inadequate working conditions*" are of the key reasons behind the occurrence of accidents. X7 shares the same view of X6 and says the accident occurs when the "*working conditions are not good or unsafe*".

X17 and X21 mention that "*lack of proper tools for the task*" generate additional risks and causes accidents. One issue highlighted was the non-utilisation of resources for the safety of the manpower. Hazards are not being properly mitigated because it is believed by the management that it is costly. Accident 46 occurred when machinery fell in a manhole which was not covered with concrete.

"lack of commitment when it comes to implementing safety from top management. The problem of strategy and commitment derails the implementation of policies on the management sector."

X9 suggests that accidents can be avoided when "*working conditions are safe*". X1 and X2 recommend that management needs to provide "*tools and equipment of good quality*" to the workers to work safely.

Some participants of the interviewee pointed out that many times the risky situation is being reported to their supervisor but still that risky situation is not being rectified on time. Workers are not allowed to stop the work if working conditions are unsafe.

"*In unsafe working conditions, workers must not be allowed to work. Workers should have the right to not work in unsafe conditions*."

One recommendation shared by the interviewee that before the start of the job, the supervisor must fulfil a checklist related to working conditions, and if working conditions are suitable as per the checklist then only, the job can be started.

g) Lack of supervision

Supervision can be seen as an important factor. At the construction sites, data analysis of the archival reports revealed that *lack of supervision* and *wrong instruction of supervisors* resulted in the causation of 28 accidents. Many interviewees recognised lack of supervision as the main factor in the occurrence of accidents and stated that workers sometimes involve in unsafe risks when none is watching them and there is no supervision. X13 interviewee mentioned that a close supervisor at the site is very important to protect the worker itself. He added that, in Saudi Arabia, most of the labour is ignorant and has limited care about safety and their mentality is that if there is no supervision than they don't need to follow safety rules.

X1 mentioned that "*workers sometimes involve in unsafe risks when none is watching them and there is no supervision*". X2 stated that supervisors sometimes don't give much importance to safety and this affects the workers too.

"*if site engineer or supervisor don't give much importance to safety and does not follow the safety rules than workers also follow them and continue with unsafe practices*" X2

X4 says that a close supervisor at the site is very important to protect the worker as if there is no supervision workers don't follow safety rules.

X4 provided one of the reasons behind the need for proper supervision at the workplace is that in Saudi Arabia, most of the workers are from developing countries and have limited awareness about safety so supervision is required to ensure that workers don't work unsafely and follow safety rules.

X5 stated that one of the reasons workers work unsafely is because of the negligence of the supervision and safety officers as they don't do their responsibilities and don't make sure safety rules are implemented.

"*Human errors are possible so adequate supervision must be provided to the workers. Sometimes accidents occur as foreman/supervisors provide unsafe and wrong instructions to the workers. Construction personnel must be available for supervision and this foreman is responsible for the safety not only production*." X8

X20 mentioned that lack of supervision and no strict control is one of the most important factors that influence the worker in working unsafely.

X1 insisted that supervisors must provide "*clear instructions to workers*" to work safely. X1 added that management must have strict control over the workers to comply with the safety rules of the organisation.

"*Monitoring and audits must be conducted by the safety department and ensure safety rules are implemented. Adequate supervision must be done by the engineer or safety personnel when high-risk works are ongoing*". X1

X2 suggested that the supervisor must remove and control the danger related to worker safety at the workplace before work.

X5 stated that to reduce human-related accidents, the supervisor and safety department must ensure safety measures are in the plan before or during the job. X6 states that "*workers must be monitored*" to ensure they are following safety rules.

"*The workers are usually considered the last defence in preventing such errors or accidents in the workplace. In other words, it is the ultimate responsibility of frontline employees to prevent accidents*." X4

X7 recommends that supervision can improve safety performance:

"*Supervisors can improve safety performance. Supervision is really important. Workers should not be left alone, and it is the supervisor who should take care of the hazards and should push the workers to work safely and check the working conditions. Supervisors have the main force to implement safety practices*." X7

h) Pressure of work

Analysis of the accident reports revealed that at the construction sites; the *pressure of work and rush at work* contributed 3 accidents. The interviewee was asked about this factor and some interviewees said that in some situations the task needs to be completed on an urgent basis, so workers are told to finish the task on a priority and to finish the task workers bypass safety measures. Most of the interviewee recognised that "overload" has a significant influence on worker's safety. Six participants have identified "*work overload*" as one of the important job factors that influence the occurrence of the accident. X4, X11, X14, X17, X18, and X21 all shared the view that an increase in workload is dangerous for the workers.

"*Workers work an extra hour and management push them to finish the task in short duration which causes them to concentrate more on production and less about their safety or the safety of the people around which become an underlying cause in the occurrence of the accident*". X18

X12 interviewee was of the view that workers who continue to work overtime after 10 hours' normal hours shift make then really exhausted and create more chances of mistakes and lack of concentration which leads to the occurrence of accidents.

"*Rest must be provided to workers before allowing them to work overtime*."

One interviewee said that their construction project is located in three different cities, so they have to travel a lot to carry out their job as they have different sites at different locations of the cities. He added that even before starting the work they feel fatigued as they have to travel up to 400 kilometres.

"*Saudi Arabia is a hot weather country so workers need to be provided with regular rests to refresh their energy which will improve their concentration on safety*."

i) Lack of training & awareness

Analysis of the accident reports shows that *lack of training and lack of awareness have combined* contributed towards the occurrence of 70 accidents at the construction sites. X7, X8, and X20 mention that "*lack of training*" is one of the causes of occurrence of accidents:

X8 says the "*workers have a lot of experience but don't have safety induction training so the worker doesn't recognise and manage the hazards*" and recommends that "*training are very important and regular training must be provided to the workers*".

X12 says that "untrained personnel" causes accidents and suggests that "*regulation is important but what is more important to train people to understand regulations*". X19 mentions that "*in general better-trained personnel has fewer accidents*".

The interviewee was asked about the training programs they participated in their construction sites. Most of the interviewees revealed that they were provided with safety orientation at the joining of the project. Some interviewees mentioned that on-site, occasionally pre-task briefing being provided by their supervisors or safety officers. One of the interviewees shared his recommendation that:

"*Training is a formality. and companies need to provide training that is realistic, real-world and interesting. Training must explain all the information and workers must understand and learn from it. Workers know the risks and they have the experience, but they need to have awareness and care about safety. Toolbox talks to be provided to the workers and it must involve the worker and it must be practical. Good training where workers are involved*." X7

One problem mentioned by the interviewee that to complete the urgent tasks subcontractors sometimes bring new temporary workers and directly start their work without getting safety orientation.

X18 said that their safety department is provided with a safety booklet in three languages (English, Arabic and Turkish) to the newcomers mentioning the risks, control measures and safety rules which are easy to carry and read.

"*The most influential factors are the lack of safety training*."

X8 emphasized the importance of training and stated that people who are more trained and have more awareness involve in fewer accidents as they recognise risks and act safely. It was described that whenever a company prepares new rules, regulations or procedures then it is important to train people on safety, create more awareness regarding safety.

"*In the real world, companies have to earn money and sell at a lower cost. Safety is cost, but it is an investment as the company will save money with direct cost and indirect cost when accidents happen. Workers need to be self-aware about their safety. Workers know the risks and they have the experience, but they need to have awareness and care about safety."*

X1 and X10 recommend that "training" must be provided to the workers.

X5 suggests that "*workers must be provided with safety induction training from the first day they join the company so that they should know the risks, control measures and their responsibilities at the workplace*"

X6 insists that it is important to provide training to the workers.

X4 says the success of safety policy depends upon the commitment of individuals as implementation will be done by them. X5 mentions that one of the reason accidents occurs is due to a "*lack of awareness*" of the workers.

X7 says that "*workers know the risks and they have experience but they need to have awareness and care about safety* but *when a worker loses his safety awareness then an accident happens*" and insists the "*worker needs to be self-aware about his safety and workers needs to take care of his safety*".

X10 emphasized that "*Only rules are nothing. Workers should take into serious and work properly according to the necessity of all safety rules*."

X1 insists that precaution is necessary while at the workplace and instructions must be provided to the workers regularly to increase their awareness of safety.

"*Safety is not a different issue and needs to be part of normal life. It's a common sense and cannot be done through force and worker needs to realise and act upon it. Whether people are warning it or not."* X2

X3 suggests that "*safety must be a priority at each workplace meetings and discussing safety issues, finding the underlying causes of accidents*".

X5 recommends that "*awareness must be provided to the workers regularly as safety awareness to workers helps in avoiding negligence*" to ensure that they understand the importance of safety and act safely.

X8 mentions that "*accidents can be reduced when workers and management mentality towards safety will change and they will take more care about safety*. The w*orker should have the awareness that if a supervisor or the engineer instructs him to do unsafe work he should resist and not follow it*".

X9 mentions that "*this should not be the understanding that to work with safely only if someone is watching us as every person love his life and don't want to put their lives at risk*" and insists that management must create awareness on regular basis:

"*showing the worker through images if some accident happens so that they learn from it. People learn from experiences so it is important to show what will happen if you will not follow the instructions*." X9

j) Lack of communication

Lack of communication was reported as an important factor that caused 4 accidents in the construction sites. When participants were asked about the communication issue. Three of the participants mentioned that communication is a challenge for the workforce working in Saudi Arabia.

X1 stated that "*In this project, there are people from different nationalities, but there are coordination and communication problems. Project documentation is in English but some workers at the workplace don't know English and coordinator at the workplace don't know English. In case of any miscommunication, the risk of causation of accidents is high. I suffered from this thing a lot*."

X4 mentions that "*Poor safety performance in the Saudi construction industry in general, is compounded by the general influx of migrant workers who speak many languages and have communication challenges. In Saudi Arabia, most of the construction professionals are foreigners and workers don't know English or Arabic as mostly they are from Asian countries, so they have a miscommunication or don't understand the instructions properly which is a challenge*."

X14 says that "*language sometimes is a headache during our activities*".

Discussion of this section mentioned that workers' actions are influenced by many intrinsic and extrinsic factors. Workers dealing with the pressure of work or health issues can result in workers acting unsafely or working with a lack of attention. It was also pointed out that workers

with less awareness about the risk will be involved with taking more risk as he/they do not know and understand the consequences of dealing with such risks. It was also highlighted that for a job, there is a necessity to have proper work procedures, safe working conditions, and adequate tools. Chances of the occurrence of the accidents are high when they are not mitigated at project sites in the design, planning and execution phase.

5.3.3 Challenges and barriers Saudi Arabian construction industry is facing in maintaining a safe worksite

The literature review pointed out that the Saudi Arabian construction industry is facing many challenges in maintaining safe worksite. Many challenging factors were highlighted in the literature review. Interview participants were asked about the challenges the Saudi Arabian construction industry is facing keeping the worksite safe. Interview participants mentioned seven main challenges that the Saudi Arabian construction industry is facing in the implementation of safe working practices and affecting the safety performance of the Saudi Arabian construction industry. These seven challenges are as follows:

1. **National H&S regulations and its implementation.**
2. **Management commitment to safety.**
3. **Adequate safety culture.**
4. **Safety policy and its implementation.**
5. **Hot weather conditions.**
6. **Subcontractors.**
7. **Budget.**

In the below section, these seven challenges will be explained based upon participants of the interviewee's opinions and views.

1. National H&S regulations and its implementation

Participants of the interviews pointed out that in Saudi Arabia, there is no H&S regulatory body that develops and implements H&S regulations. Furthermore, H&S regulations are governed by the ministry of labour but there is no regular monitoring by the ministry of labour to ensure the check the compliance to these labour laws which participants identified as one of the challenges that are a reason for poor safety performance.

X1 and X19 stated that in Saudi Arabia there are "*no government regulations of safety*" which is a challenge in achieving good safety.

X2 mentioned that "*In Saudi Arabia, there is no control of the government on-site as there are no written regulations*".

"*In Saudi Arabia, safety regulations do not exist. Governmental role in safety is limited. Lack of safety legislation and the inexistence of a safety regulatory body is one of the barriers. The government in ensuring construction safety has not been considered to a significant extent*." X4

X6 says that "*In Saudi Arabia, safety performance is very low because there are no safety regulations. At this moment, the Saudi government doesn't have laws of any role in HSE*".

X7 mentions that in Saudi Arabia there are "*no safety regulations and regulatory body*".

X8 emphasized that without safety laws in the country safety performance cannot be improved: "*lack of safety regulations inside the country. Without safety laws, safety performance cannot be improved*".

X9 stated that the "*Saudi government before didn't care about safety*".

X12 stressed the importance of H&S regulations, "*The first issue to be considered is regulations. Saudi Arabia is a grooving market and all around the city's construction sites can be seen. But one of the biggest challenges is the proper standard for H&S."*

X14 mentioned that there is no strict control by the government regarding safety and welfare.

2. Management commitment to safety

Nine of the participants mentioned the in Saudi Arabian construction industry, management is not fully committed to the implementation of safety practices.

X1 stated that "*Management don't consider safety as a priority. Management doesn't support the safety department and consider production as a priority over the safety of the workforce*."

X2 mentioned that the role of management is very important in maintaining safety as all issues are related to management.

X4 mentions one of the challenges is "*lack of commitment when it comes to implementing safety from top management. The problem of strategy and commitment derails implementation of policies on the management sector*".

X5 considered that in Saudi Arabian construction industry poor safety performance is due to the "management negligence that they pay less concentration on safety and more on production".

X7 stated that "management doesn't care about the safety of the workers".

X8 pinned one of the problems is "*management does not prioritise safety and does not support safety department*" and as a result, poor safety performance is experienced. X8 added that "*if the management is not involving in safety than the companies will have a lot of problems*".

X9 recognised "*lack of commitment from the management*" is a barrier in the implementation of safety practices.

X16 states the level of importance management gives to safety is the major factor that decides the level of safety practices applied at work sites. So, management's role is very important:

"*The major challenge construction industry faces towards the implementation of safety practices is how the management balances its project constraints mainly productivity and safety. Many in the industry treat them as opposite sides of a coin leading to them compromise on any one of them, mostly safety. Many managers only treat safety practices as formal hurdles in productivity which are not correct. This perception and attitude towards these constraints, in my opinion, is one of the major challenges and barriers the construction industry is experiencing the implementation of safety practices*." X16

X19 pointed out that the "*role of management*" is very critical in ensuring good safety performance and implementing safety practices.

X20 mentioned that "*if management only thinks about production and forget safety, in the end, the companies will lose lives (human beings by accidents) and money. The future for these companies will be complicated*".

3. Adequate safety Culture

X2 pinned that Saudi Arabian construction industry lacks good safety culture and workers and management not taking care of safety.

X3 emphasized that "*safety culture is important*" and "*provision of safety culture*" is a challenge in Saudi Arabia.

X4 mentions that "*without having the safety culture, safety performance cannot be improved, and safety policy cannot be implemented*".

X6 also stressed the importance of safety culture, "*in my experience safety culture is very important because the workers need safety culture and the needs to know about the risks and hazards*".

X7 explains that "*There is no safety culture in this country. Companies don't give importance to safety. Good safety culture consists of good resources and planification. But sometimes resources are not arranged, and control measures are not arranged which shows poor safety culture*.

"*In our company, we have medium safety culture because in our company we have regulations and we do it because of the wrong reasons (not to receive government penalties). We have three generations about the use of safety belts due to driving a car on roads due to penalties. My grandfather never wore the belt while driving because there were no strict regulations and limited awareness, my father sometimes uses a safety belt because he doesn't want to have a penalty from the traffic police but I use a safety belt for my safety and I become habitual of it. In Spain, we sometimes implement safety measures because we don't want to receive a penalty from the government*." X7

X9 recognised safety culture as the main challenge: "*the main challenge is lack of health and safety culture as this country is used with less skilled people and the importance of people is not too much*."

X10 states that the "*safety culture of the company is very important for the sustainability of projects. It will make safety rules indisputable by anyone regardless of his/her position in the organization*."

X12 mentions that "*In Saudi Arabia, people are coming for different countries and some workforce don't have good safety awareness due to not having safety culture in their local countries. For our case, it is hard to live in KSA for someone who came from another culture and gets used to a very different climate and workplaces*."

X14 says that "*lack of safety culture inside the country affects us a lot*".

X17 pinned that "*The biggest barriers are the different nationalities of the workers, some of them coming from countries where there is poor safety culture and safety practices are not implemented very well or not implemented at all*."

X19 and X21 recognised "*lack of a culture of Safety in the works in many of the local companies*" as one of the barriers in the implementation of safety practices. X19 mentions that "*It is the most important factor. In the absence of formal regulations about Occupational Health and Safety, the performance of the companies relies only on their own internal preventive culture*."

X20 says that the key challenge is: "*safety culture in all the companies from the company president till the last worker. My company, it's an engineering company and has a strong Safety Culture from a long time ago, it's dependant on the government and in Spain, the Safety culture is taking into account in all project and construction.*".

4. Safety Policy and its implementation

X1 states that "*Written safety policy is useless unless it is implemented properly. Companies need to prepare and implement safety procedures to ensure that the goals mentioned in the safety policy are ensured. Safety is necessary not for the safety department but every person's safety and life*."

X2 mentions that "*safety policy is important because it gives you target and aims about the safety*" but insists that "*Implementation of safety policy is the hardest part. Companies can copy the safety policy then implementation is hard. Every company and project is distinct so the need is different.*".

X3 mentions that "*safety policy implementation is important*".

"*Problem is the safety policy in the construction projects are adopted from abroad and not matching with the Saudi environment. Safety policy is not being implemented. Without having safety policy safety performance cannot be improved*." X4

X5 suggests that "*safety policy should be practical and related to works*".

X6 explained that "*Policy is very important. Safety policy is like the goals and priorities of the company. Safety policy is the intention on which company wants to implement safety*."

X7 mentions that one of the problems with the safety policy is that it is not practical:

"*In many companies, there is good safety policy with nice words, goals or intentions but the important thing is the implementation and needs to be realistic. The problem is laws require too much which is unrealistic and to have that requirement they have safety policy. In company safety policy should be simple and realist and goal-oriented. Implementation of safety policy is important, and it has to go to the workers. Awareness about safety policy is necessary. Actions are important, reward/penalties need to be implemented. Zero accidents are not practical or one million man-hours without accidents are not practical*." X7

X8 said "*non-implementation of safety policy*" is the main barrier and explains that, "*Safety policy says that company understands the importance of health and safety and you see that company care about safety policy. In safety, the policy is the base of the system and is very important*."

X9 stressed that "*Without safety policy, there is no possibility of having a good safety performance with safety policy as it shows the intention of a company towards safety and provides goals*."

X15 mentions that "*Safety policy is important because it can guide all personnel in a uniform & standard manner which will do the enhancement of safety performance*."

"*In our company safety policy is seriously taken and properly implemented. As an employer, it is every company's responsibility to maintain a safe and healthy workplace. A safety and health management system, or safety policy, will help the company focus its efforts on improving the work environment. Safety policy describes what the people in the organization do to prevent injuries and illnesses at the workplace. Every organization will have its unique system, reflecting its way of doing business, the hazards of work, and how they manage the safety and health of its employees. So, implementation of safety policy is very important, and it surely will enhance safety performance as that is the basic purpose of the policy*." X16

X17 said that "*It is important because it is the only way to plane and control the safety on the works*".

X18 recommends that "*It is the starting point for the implementation of the effective safety management system.*"

X19 says that safety policy is the written principle of the company's safety culture which will be successful when it will be implemented.

X20 mentions that "*safety is like a pillar in each company and is as important as production and quality. The company's intention is defined in the safety policy, which shows how important it is.*"

X21 says the with the implementation of realistic safety policies, accidents can be avoided.

5. Hot weather conditions

X1 and X2 mentioned that extreme hot conditions in Saudi Arabia make it difficult to implement safety practices.

X2 said the "*Workers don't wear helmets because they feel uncomfortable under the sunlight*."

X5 mentioned that "*Our works are related to open sky, due to weather conditions as in Saudi Arabia it is hot, so working is difficult*."

"*Environment conditions in Middle East countries is extremely hotter than the other countries. Saudi Arabia is almost in the centre of these countries. For this reason, the most challenging situation is the weather itself. At high temperatures with similar weather conditions, it causes to slow down the work progress, even stop*." X10

X11 states the extreme temperature and the surrounding of the construction area makes it difficult to implement safety practices.

X14, X15, and X21 have mentioned that "weather conditions" are a key challenge in the implementation of safety practices in Saudi Arabia.

6. Subcontractors

Interview participants pointed out the importance of subcontractors in the Saudi Arabian construction industry. It was highlighted that most of the works in the construction sites are subcontracted and the selection of subcontractors who are not committed to safety creates an H&S challenge for the construction companies.

X4 stated that "*contractors' behaviour was all considered serious factors and challenges to the safety*."

X5 mentioned that "*Generally, most of the construction companies are based on contracting companies. If the client hires the main contractor than they hire more subcontractors. The selection of subcontractor is done based on low bid rather than past safety performances*."

X7 mentions that "*The main problem is the subcontractor, there are many subcontractors in each project. Each subcontractor has a limited budget and in the end, there are limited resources and profit*."

X13 states that "*If all the construction industry in Saudi Arabia are mentioned, I think that the local and foreign companies that work here and the people working in these companies do not have sufficient qualifications yet*."

X19 suggests that "*Government needs to make sure that responsible companies can compete in the same conditions with the rest of the construction market*."

X21 says that "*The main barrier is that the Saudi Companies lack experience and culture with safety practices*."

7. Budget

Three participants were of the view that in each construction project, there is a specific budget assigned for the safety as per the contract with the client. Unfortunately, mostly this safety assigned budget is not used for safety purposes. This part of the budget is to have a safety department and resources to maintain the safety of the workers at the workplace.

X5 says that "Safety needs to have more resources".

X7 mentions that "subcontractor have the limited budget" which affects their arrangement of resources. Companies consider spending on safety as an additional cost."

X13 suggests that companies need to spend more money and effort on safety.

5.3.4 Recommendations for minimising human-related accidents in Saudi Arabian construction industry

One purpose of carrying out the interviews was to ask the participants from their practical experience what measures can be taken that will improve the safety performance and reduce human-related accidents in Saudi Arabian construction industry. In response to that participants argued that the government, construction companies, and the workers have to take responsibility and implement safety requirements to ensure the safety of the workers. From the interviews, 15 significant themes were identified which according to the participants will improve the safety performance of the Saudi Arabian construction industry.

1. **Management commitment to safety**
2. **Government commitment to safety**
3. **Adequate safety Culture**
4. **Training of the workforce**
5. **Provision of safe working conditions**
6. **Realistic safety Policy and its implementation**
7. **Adequate supervision**
8. **Safety Department**
9. **Compliance to Safety Rules**
10. **Rest**
11. **Development and implementation of safety Procedures/Plan/Programme**
12. **Provision of required resources and PPE (Personal Protective Equipment)**
13. **Proper planning**
14. **Reward and Penalty System**
15. **Meeting discussing safety**

1. Management commitment to safety

X1 recommended that "*Mentality of the management needs to be changed towards safety. Safety must be a priority by the management. Management must know the safety laws so that safety laws must be stressed and enforced by the management. Management must have basic training about safety to identify the risks and implement the necessary control measures*."

X2 acknowledged the importance of management and said that "*Safety culture is dependent upon the management. Site personnel follows the instructions of management and responses as per the management or safety department. So, sincerity is required from the management towards safety. Management needs workers happy and you will see how the worker will satisfy the management. When you leave home for work you are at work. Management needs to ensure that workers are happy at the workplace and provide the requirements*."

X3 insisted that whatever the problem on-site, management is being informed and needs to take control measures.

X4 stated that safety needs to be a priority and management needs to be sincere about it. X4 added that: "*Top management role id to guide and implement safety policy. Starting from the top management aware of the safety culture, safety policy, and safety as a priority*."

X5 says that "*Management needs to plan the works and ensure that all risks and hazards are controlled. Before initiating the work, they first see the consequences of the work. Safety is like the spinal code for the project*."

X6 recommended that "*Management is very important, and they are the starting point. It is very important to the workers as safety start from them, becomes a role model for the workers, makes decisions for the works, needs the importance and benefits of safety*."

"Management is the most important team, but they are not on-site and they don't know about the actual execution of the job. It is the management team in the middle that can set the good planification, good budget and set the resources and measures. Press the construction management and supervisors to implement safety practices." X7

X7 stated that management should encourage workers to work safely and stop the worker and if the conditions are unsafe.

X8 argues that management needs to be involved in the safety and implementation of safety is the responsibility of all management not only safety professionals.

X9 suggests that "*The management needs to be a role model. Manager can be committed but he needs to show on time to time that he cares about the safety and shows the company that safety is the most important matter*."

X10 says that "*Management should respect safety rules and support modifications if necessary. By making regular meetings, they should make contributions to the safety department. Management should also provide the necessary tools and instruments*."

X11 says that if the company's management is highlighting the safety issues to all over the actions, they will improve their safety performance.

"*Big Projects are live processes and contain thousands of details. Management may not know every detail and managers cannot control every moment of the process. Management duty is managing all aspects of the project and HSE one of the important ones so therefore what management needs to do for improvement define a process properly, clearly identify standards for application, explain all stakeholders required standard properly and control the whole process*." X12

X13 suggests that management must protect the workers by deploying internal control measures.

X14 recommended that "*Management have to think "First Human", not "First Productivity". To develop the safety performance, management needs to adapt the safety processes and we have to carry out our activities in a safe manner. Management has to help all the workers to involve in this safety participation."*

X15 says that "*by a constant reminder to all employees and keeping the safety whenever visiting the working areas*" the management can improve the safety performance.

X16 says to improve the safety performance, "*management needs to take into consideration their employees well-being financially, career-wise and socially*".

"*The manager is the one who should give example to their workers, is the first one of having safety culture and implement all the safety measures anytime is going to visit the site. Also, review all the implementation and giving new solutions, that the workers can see that are involved in that matter. Also coordinating the interfaces with other parties*." X17

X18 insists that "Management needs to invest more money on safety and should place the safety management system as one of the main core business of the company."

X19 recommends that "*to improve the safety performance of the company Management must be aware that Safety issues have to be integrated into the activities of the company*."

X20 says that "*Managers have to be implicated and they are the first step to teach and keep safety culture. Management needs to introduce safety in all the phases, as a part of the construction activities and management has to be responsible and executors to perform 100%."*

X21 suggests that "*Managers should give example to the workers. They should have regular meetings with Safety Managers to analyse how to improve safety practice on site*."

2. Government commitment to safety

X1 insists that the government has a strong role in the implementation of safety practices:

"*Each workplace, the government must control and implement safety regulations. The government has a strong role in the implementation of safety. In Saudi Arabia, there is a need to have more control from the government officials to implement safety procedures. The government is the one who enforces safety. The government needs to have skilled safety professionals who inspect and ensure safety. The government must have safety regulations and arrange a seminar, training to increase awareness about safety*." X1

X2 says that there is a need for safety regulations by the government and the government must ensure that these regulations are implemented.

X4 mentioned that "*From my point of view, the government has to establish the regulatory body to establish safety regulations and control the implementations. The government needs to have established its safety policy as per their environment. When it will be implemented then safety performance will be improved*."

X5 recommends that "*Government should try to enforce safety as a priority on the contractor. The government applies a penalty if the companies are not following safety rules. Imposing the regulations and applying penalties*."

X6 says that in Saudi Arabia there is a need for HSE laws, regulations, regulatory bodies, inspectors, awareness, to ensure improving safety.

X7 mentioned that "*First of all, there is a need to develop safety laws from the government, branch of the government that develops, inspect to ensure implementation. The government needs to implement a reward/penalization system*."

X8 says that "*It is necessary to have proper safety laws and the department to control and ensure the safety laws are being implemented by the companies*."

X9 says there more commitment is required from the government towards the safety of the workforce. The government needs to apply penalties to those companies where accidents are occurring, who are applying a lack of control measures and poor safety performance is recorded.

X10 stated that "*They should update their safety regulations to be coherent with international safety standard rules. Another point, government HSE responsible must be well educated*."

X12 also stressed the importance of regulations:

"*The first issue to be considered is regulations. The government needs to work hard on this, according to me firstly they need to prepare 5 years to plan to have appropriate regulation according to the KSA environment but in Global standards. Then according to plan, they need to train people, send scholars abroad, open courses in universities and follow up closely*." X12

X13 recommends that the Saudi Arabian government needs to invest more resources in the development of health and safety culture in the country. X13 added that "*Since Saudi Arabia is a customer of construction companies, it decides what to do and how to do it. Health and safety policies should be established at international standards by working with foreign safety companies.*"

X14 says that the "*government should provide a good public health service. They should investigate and analyse the work accidents scientifically. There shouldn't be child labour. They should prevent informal employment*."

X16 believes that the government has a strong role in maintaining safety and recommends that "*Major role of govt is to disincentivise any unsafe practice by heavy fines, continuous inspections and strict actions against the perpetrators or violators of safety codes and practices at workplaces*."

"*The government should push all the contractors to implement safety measures, in any case, not just in big projects, any small constructions also (small repairs or works performed in the city, safety measures are not implemented). And once they pushed and request that to the contractors, they should check that those measures are being performed on-site*." X17

X18 insists that there is a need for a legal safety framework in the country.

X19 suggests that "*Government needs to make sure that responsible companies can compete in the same conditions with the rest of the construction market. It means that the government should complete its Health and Safety regulations, so every company will have the same standard to be followed, and make efforts to enforce these regulations, with the presence of inspectors*."

X20 says that governments through mandatory rules and regulations have to push all companies and stakeholders to improve safety performance.

X21 recommends that "*The government must force companies to have a security plan and must verify that it is implemented on-site*."

3. Adequate safety Culture

X1 and X3 insist that safety culture is very important. X1 added that in the prevention of accidents precautionary measures are necessary while at the workplace.

X5 recommends that the company should ensure and keep the safety culture and make sure that there is no compromise on safety.

X6 stated that "*In my experience safety culture is very important because the workers need safety culture and the need to know about the risks and hazards. It is better formed to improve the safety culture of the company*."

"Safety culture is very important. Safety culture must be integrated with the company culture. Aim of the project to build with a good budget, safety, quality, and planned duration. Safety is like part of a table with many legs, if one leg misses the whole table will be unbalanced. The objective is to execute the project in a safe manner and accidents do happen at the workplace, where works will be carried out chances of occurrence of accidents are present. Accidents occur but with good safety culture, decrease the number of accidents and diminish the consequences. Fatalities can be avoided with good safety culture." X7

X8 mentioned that "*Safety culture is very important. It is important to say that safety is something alive and it is changing every day and needs to be learned each day and procedures and tasks are changing every day. Workers must learn from daily tasks and try to improve their daily performances*."

X9 argues that "S*afety culture is the most important element that can improve safety performance. Commitment from the management and having competent people inside the company who have the commitment, training, and experience towards safety can improve the safety culture and safety performance. With having a good safety culture, accidents can be avoided*."

X12 says that "*If the company has qualified safety culture and they will reflect all their experience on-site, and it will boost their performance and improve safety culture here in KSA as well*."

"*Safety culture of a company is very important in enhancing the safety performance of the company. Companies to overcome the above-mentioned challenges should create a safety culture in its workers and working environment so that the wrong perception towards safety is replaced to prioritise safety and balance safety with other project constraints in all activities. This safety culture will surely enhance the safety performance of the company*." X16

X17 mentions that "*A safety culture is very important for companies. This topic is being improved day by day everywhere. Even in European countries, where it is more established the safety culture; you could see the difference in the last ten years. To improve that culture is not easy is something that requires time; most of the workers get used to implementing safety measures when those are a normal part of their "day by day"*."

X19 says that safety culture is very important to improve safety performance. X19 added that "*In the absence of formal regulations about Occupational Health and Safety, the performance of the companies relies only upon their own internal preventive culture. Companies can improve their safety culture by adopting norms from other countries and dedicating time to train local workers in safe procedures for work*."

X20 mentions that "safety culture among staff" can reduce the accidents.

X21 recommends that "*Safety culture should be very important for all the companies. Work with safety it´s an auto-requirement that every company must make sure to comply and implement in each worker. One of the most important measures to avoid work accidents and improve safety culture is applying training to train workers with good safety practices*."

4. Training of the workforce

X1 and X11 recommended that "*training must be provided to the workers (theoretical/practical).*"

X2 said that "*daily toolbox talks before works*" is important in instructing the workers on the importance of safety and safety procedures. X9 also agreed with X2 that toolbox talks are important in improving safety performance.

X5 says that "*safety induction must be provided to the workers*".

X6, X8, and X12 suggest that "*training*" is one of the key elements to improve safety performance.

"*Training is a formality. and companies need to provide training that is realistic, real-world and interesting. Training must explain all the information and workers must understand and learn from it. Workers know the risks and they have the experience, but they need to have awareness and care about safety. Toolbox talks to be provided to the workers and it must involve the worker and it must be practical. Good training where workers are involved*." X7

X13 says that for high performance and sustainable safety understanding, companies must regularly educate and evaluate their employees.

X14 insists that reducing the employer of the accident has to provide the HSE training to all employees.

X15 mentions that an employer must organize safety training more frequently.

X16 and X17 recommend that "periodic training" must be provided to the workers to improve their safety performance.

X18 mentions that an employer needs to invest more money to arrange training courses for the workers.

"*In general, better-trained personnel has fewer accidents. Providing enough training to the labours and intermediate staff (Supervisors) so they can act as integrated safety resources too*." X19

X20 recommends that "*Training and follow up safety knowledge comprehensive for workers*."

X21 suggests that one of the most important measures to avoid work accidents and improve safety culture is applying training to train workers with good safety practices.

5. Provision of safe working conditions

X1 suggested that "*Company must provide a safe workplace. Provide equipment, resources, tools that are of good quality and safe. Hazards at the workplace must be controlled and mitigated before the start of work. At our project, we have to travel more than 200 km, and the company needs to provide good welfare conditions to the workers. Vehicles must be in good condition. At the workplace, lighting, fans, safety equipment must be provided to the workers which will help them work safely. Saudi Arabia is a hot country so welfare conditions must be provided by the workers*."

X2 mentioned that "*Management needs to provide welfare facilities to the workers which will improve production and safety and improve the reputation of the company. Management needs workers happy and you will see how the worker will satisfy the management. When you leave home for work you are at work. Management needs to ensure that workers are happy at the workplace and provide them with the requirements. Good working conditions make the workers happy and the worker will work in a good manner. In Saudi Arabia due to hot temperatures, good welfare conditions need to be provided. Good cars need to be provided. Coldwater to be provided to the workers. Foods need to be better; accommodation needs to be better. When the access towards the workplace is good and easy than the worker feels better. In this project, it is not easy to have a good working condition*."

X2 suggested that "*If working conditions are good, welfare facilities are good, material are in good quality, make the worker feel happy and comfortable*."

X3 mentioned that safe working condition will prevent accidents and working conditions influence the occurrence of accidents.

X5 recommended that "*Timetable must be flexible and suitable for the workers. Breaks must be provided to the workers. Welfare facilities to be provided to the worker*."

X6 emphasized that accidents are reduced through good conditions. Workers are satisfied with working conditions. Workers must have good working conditions.

X8 suggested that workers at the workplace need to have minimum working requirements at the workplace to work safely.

X9 recommended that "*Working in good conditions will improve safety performance and reduce accidents. Companies need to assess the risk and conditions should be provided accordingly. Preventive measures need to be provided to the workers*."

X11 stated that "*Changing the shift times as shorter and, implementing the welfare conditions. Employers need to check the condition of the safety equipment as they are suitable and easily useful*."

X12 suggested that "*Actually working hours is one of the biggest parts of our life and it is very important for us how we live our life one of the biggest portions. So, it is true that there is a parallel relation between working environment conditions and human satisfaction. But besides that, it is necessary to have a proper status workplace to have efficient, proper quality and risk eliminated work. For our case, it is hard to live in KSA for someone who came from another culture and get used to a very different climate and workplaces. So, it should be considered properly all conditions of KSA before work starts*."

X14 mentioned that accidents can be reduced by the provision of good work/accommodation conditions, for instance, enough lighting, enough air conditions, enough resting periods, less noisy/dusty conditions.

X16 says that "*Provision of a safe and healthy work environment to the workers. As summer has started and it is only going to get hotter, providing cool and safe drinking water for everyone on site will be good in my opinion*"

6. Realistic safety Policy and its implementation

X1 emphasized the importance of implementation of safety policy and said that "*Written safety policy is useless unless it is implemented properly. Companies need to prepare and implement safety procedures to ensure that the goals mentioned in the safety policy are ensured. Safety is necessary not for the safety department but every person's safety and life. Management and safety department must stress to ensure safety policy is implemented*."

X2 and X5 shared the same views and recommends that "*Safety policy has to be practical and needs to be aligned with the work and workers need to be provided with training about it*."

X4 also stressed the need for the implementation of safety policies to improve safety performance.

X7 mentioned that "In company safety policy should be simple and realist and goal-oriented. Different construction companies mention zero accident policy or one million man-hours without accidents is not practical. Implementation of safety policy is important, and it has to go to the workers. Awareness about safety policy is necessary. Actions are important."

X8 mentions that "*strong safety policies*" help in reducing accidents.

"*Workplace safety is important and vital. It's important, now and then, to implement an effective safety policy in the workplace for managing health and safety and consider how we might*

improve them to create and safer, happier and more productive environment for our workers to feel happy." X14

X21 mentions that accidents can be avoided by the implementation of an effective safety policy.

7. Adequate supervision

X1 suggests that "*Adequate supervision must be done by the engineer or safety personnel when high-risk works are ongoing. Workers sometimes involve unsafe risks when none is watching them and there is no supervision*."

X2 and X13 suggest that "*supervision*" is one of the ways to reduce accidents in the construction industry.

X3 says the supervisor needs to ensure safety laws are implemented.

X4 mentioned that "a *close supervisor at the site is very important to protect the worker itself*"

X7 stated that "*For me, supervisors are really important as he is implementing safety practices at the site and workers follow his instructions. Workers should not be left alone, and it is the supervisor who should take care of the hazards and should push the workers to work safely and check the working conditions. Supervisors have the main force to implement safety practices. If supervisors are aware of safety issues and enforce the implementation of safety practices than accidents can be avoided, or consequences can be reduced*."

X8 suggested that supervision is required at the workplace as human error is possible.

X12 recommends that "*monitoring and regular check-up*" by supervision will ensure that work doesn't act unsafely and will help in reducing the occurrence of accidents.

X14 suggests that supervisors need to implement safety practices and management needs to continuously remind supervisors about their safety responsibilities.

8. Regular awareness about safety

X4 suggests that "*awareness about safety rules and risks*" will help in minimising accidents.

X5 recommends that "*awareness must be provided to the workers regularly as it avoids negligence of the workers*".

X6 mentions that "*Saudi Arabian government needs to create more awareness about safety among the companies*".

X7 and X15 say that "*awareness in management and workers*" is important to work safely and understand the importance of safety:

X8 suggests that "*Awareness among government officials and clients is important so that they can know the importance of safety and enforce the implementation of safety. Change the mentality of the workers and management through continuous awareness is needed. You can do a lot of things, but they need to understand, respect and follow safety. The worker should have the awareness that if a supervisor or the engineer instructs him to do unsafe work he should resist and not follow it*."

X9 recommended that "*Awareness is necessary among the supervisors and workers. People learn from experiences so it is important to show what will happen if you will not follow the instructions.*"

X12 suggests that an "*increase in awareness about safety*" will help in improving safety performance.

X13 says that "*all personnel should be aware that safety is different and more important from all the other tasks*".

X17 recommends that companies need to create awareness and try to make people realise that (safety measures are to protect people, not to protect the project).

"*Every worker must be aware that the most important is work with safety and he must protect himself. For that they should check tools, work vehicles, individual safety equipment are correct (boots, security vest, ...) before starting works.*" X21

9. Safety Department

X1 recommends that "*Company needs to have a safety department and company needs to support the safety department and safety department must ensure that safety regulations are implemented. When safety professionals stop the work or don't provide the permit, management must support them. The safety department must monitor, inspect and make sure that safety policy is implemented and if necessary, recommends further control measures to the management. Monitoring and audits must be conducted by the safety department and ensure safety rules are implemented."*

X5 mentions that the supervisor and safety department must ensure safety measures are in the plan before or during the job.

X10 suggests that Safety representatives must inspect the site regularly to ensure that safety laws are implemented by workers.

X15 stated that "*safety representatives at the workplace are important because it can guide all personnel in a uniform & standard manner which will do the enhancement of safety performance*".

10. Compliance to Safety Rules

X1 recommends that "*following of safety rules*" will protect workers from hazards and risks and will eventually reduce the chances of occurrence of accidents.

X3 also suggested that "*compliance with safety rules*" will reduce human-related accidents.

X5 and X15 mention that "*following of safety rules in very important*" to avoid the occurrence of accidents.

X10 emphasized that management should respect safety rules and support modifications if necessary and workers should take into seriously and work properly according to the necessity of all safety rules.

X20 suggested that safety must be implemented in all areas and need to be followed by each personnel starting from top management until the worker.

11. Rest

X1 recommended that "*Accommodation facilities need to be in good condition so that workers can have stress free environment and have enough rest to work safely at the workplace*."

X4 suggests that "*workers need rest while carrying out heavy tasks, so breaks are required*".

X8 mentioned that "*Workers are working in the night or working continuously so the workers need to rest, change the working schedule. After each hour there is a need of having a rest of 5-10 minutes. If no rest, then the chances of accidents are high*."

X10 emphasized that "*Workers should rest well, sleep enough. If not, they cannot concentrate during working hours. This may cause them to make mistakes and lead to accidents*."

X12 stated that "proper resting time" will help reduce the occurrence of accidents.

X14 suggests the "Enough resting periods" to be provided to the workers.

12. Development and implementation of safety Procedures/Plan/Programme

X1 suggests that companies need to prepare and implement safety procedures to ensure that the goals mentioned in the safety policy are ensured.

X5 mentioned that "compliance and implementation of safety program" will improve safety performance.

X10 stated that "*It is very important for preventing injuries and death. The best safety program must be chosen according to conditions' requirements. If a company implements a good safety programme to their works. This will lead a company to overcome or minimize accidents or deaths of workers*."

X12 pinned the importance of safety programme and said that:

"I*t is very important to have guidance on how to implement it. Once you have proper guidance or sort to say programme which describes what to do in detail, then all you need to do follow it closely, monitor progress and do regular checks and training. So, therefore, it is indeed very important to have the programme*."

X16 recommends that a safety and health management system will help the company focus its efforts on improving the work environment.

X17 mentions that the safety management system is important because is the only way to plane and control the safety of the works.

X18 suggests that the development and implementation of a strategic safety plan from the top management down to the individual member will be required to improve the overall safety performance of an organisation.

X20 says that "follow up a completed Safety Plan/Programme with all the staff/ personnel have to do their part" is necessary to achieve safety.

13. Provision of required resources and PPE (Personal Protective Equipment)

X1 and X3 mentioned that workers must use PPE which will protect them from hazards at the workplace.

X2 suggests that management should provide proper good quality PPE to the workers in which they feel comfortable.

X4 recommended that the use of PPE needs to be enforced by the management.

X10 suggested that working clothes be used in the workplace.

14. Proper planning

X1 and X17 suggest that the construction department must plan and organize the works/risk in advance.

X2 mentioned that "*companies can improve by plan and implement safety practices. Before work, proper planning needs to be done"*.

X5 recommends that "*Management needs to plan the works and ensure that all risks and hazards are controlled. Before initiating the work, they first see the consequences of the work*."

X14 mentions that accidents can be reduced by "*by making a risk analysis and by guessing the dangers in advance*". X14 added that "*Companies must protect the health and safety of the*

workers by defining the steps to remove and improve all the risks, by determining the all risks and check the possible effects (if any), and by checking the reasons of these risks."

15. Reward and Penalty System

X5 encourage the management to apply penalties to workers when non-compliance to safety rules are recorded.

X7 mentioned that penalties are necessary sometimes to enforce regulations. He added that: "*Government of Saudi Arabia needs to implement a reward/penalization system. In Spain, we sometimes implement safety measures because we don't want to receive a penalty from the government. Top management needs to give a bonus to workers when they implement safety practices. Bonuses and penalties need to be implemented. I recommend rewards and it works better but the penalty is also necessary. The objective is to execute the project in a safe manner and accidents do happen at the workplace, where works will be carried out chances of occurrence of accidents are present*."

X10 suggests that the government needs to apply penalties to those companies where accidents are occurring, who are applying a lack of control measures and poor safety performance is recorded.

16. Meeting discussing safety

X2 suggested that meetings need to be organised regularly and safety issues and performance to be discussed so that improvements can be made on a timely basis.

X3 mentions that "*meetings to be conducted discussing safety issues and finding the underlying causes of accidents after the cause of an accident*."

X10 recommends that management should conduct regular meetings with site personnel to discuss safety matters.

5.3.5 Summary

Interviews were the second data collection technique used in this study. One purpose of conducting the interviews was to explore the relationship between human factors and the occurrence of accidents in the Saudi Arabian construction industry and to investigate human factors affecting the safety performance of the Saudi Arabian construction industry. Another purpose of the interviews is to get in-depth information from the interview participants regarding the factors that emerged from the study of archival reports that contributed towards the occurrence of the accidents. Qualitative data analysis was performed for the analysis of interviews through thematic analysis.

The interview was conducted with twenty-three construction professionals belonging to small, medium and large-sized organisations. Interview participants work in different professions and belong to different types of construction projects in Saudi Arabia. In the interview, the participants pointed out that the Saudi Arabian construction industry is experiencing many accidents and there is a need for improvement to enhance safety performance. Results from the study of accident reports indicated that in the Saudi Arabian construction industry H&S issues are related to the involvement of multiple factors.

Accident reports suggested that most of the accidents occurred by the worker's unsafe actions. However, interview participants also pointed out that workers' actions, attitudes, and behaviour are influenced by the involvement of numerous factors. Shortcuts by the workers were one of the main causes of the accidents as mentioned in the accident reports. When participants of the interviews were asked why the workers do shortcuts and it was mentioned by the participants that due to work overload and job pressure, workers wanted to finish the job fast and take unnecessary risks.

"*Workers work an extra hour and management push them to finish the task in short duration which causes them to concentrate more on production and less about their safety or the safety of the people around which become an underlying cause in the occurrence of the accident*".

Carelessness was another important cause of the accidents as mentioned in the accident reports. Participants of the interview mentioned that "carelessness" causes workers to neglect safety rules. When asked regarding the reason behind workers' carelessness, participants mentioned that the main reason for the carelessness of the workers towards safety is due to lack of concentration, attention, and laziness.

"*In Saudi Arabia, most of the labour is ignorant and has limited care about safety*".

Participants mentioned that workers neglect safety rules when they are sick and having health issues. "*When workers get sick and continue to work at the workplace result in a lack of energy and concentration which influence them in neglecting safety practices*."

Workers' non-compliance to safety rules was pointed out in the literature review. Results of the accident reports also highlighted that the number of accidents occurred with workers' non-compliance to safety rules. Participants of the interviews also pointed out the importance of compliance to safety rules to maintain safety and revealed that workers' non-compliance to safety rules in due many reasons involving other factors such as limited knowledge, ignorance and lack of awareness. Also, Saudi Arabia is a hot country, so workers feel uncomfortable while wearing helmets as a result sometimes they do not use it. It was also mentioned that the working group also influence the behaviour and actions of the workers. Workers learn from the group in which they are working especially the new workers and if the senior workers do not follow safety rules, the junior workers do the same.

"if a senior member is not following the safety rules than newcomers also follow them."

It was highlighted by the participants that workers are experienced sometimes have overconfidence and end up making mistake or error, as they believe that they are performing this task for some time and did not experience any accident.

"*Accident doesn't usually occur in the first years of getting training as you are very careful but as the time passes then you get overconfidence and lose concentration, so accidents occur*".

Another issue mentioned by participants is the young people with less experience which lacks attention and awareness and ends up making a mistake which causes an accident.

Participants of the interviews also mentioned that in Saudi Arabia, workers have a risk-taking attitude due to their unsafe attitude.

"*Sometimes workers don't care about safety and workers commit unsafe behaviour due to unsafe attitude*".

"*Some workers remove the protective guards of the cutting or grinding tools to carry out their tasks which possess a big risk to the workers*."

One participant mentioned that one reason for the unsafe attitude is due to their limited knowledge and understanding of risks at the workplace.

"*In Saudi Arabia, it is very common in the workforce to have an irresponsible attitude because of their risk perception*".

Participants of the interviews also pointed out many factors that are associated with the task and workplace which have a significant impact on the safety of the workers. It was mentioned that in Saudi Arabia, most of the machinery is hired through sub-contractors and these types of machinery in most of the time are not maintained properly and lack the necessary system and parts. These improper machinery or tools contribute to accidents. It was argued by the participants that workers are not being provided training on work/safety procedures and resulting in workers not implementing those procedures which create unsafe situations. It is employer responsibility to provide safe working conditions at the workplace, but construction sites are filled with unsafe conditions and hazards.

"*Workplaces consists of open spaces and manholes which creates a falling risk. Working at night is difficult sometimes due to not proper lighting*."

In the results of accident reports, many accidents were reported due to lack of supervision or wrong instructions by the supervisors. Participants mentioned that workers work unsafely is because of the negligence of the supervision and safety officers as they don't do their responsibilities and don't make sure safety rules are implemented.

Participants mentioned the necessity of enhancing safety performance by the involvement of measures taken by the government, construction companies and employees. Participants were of the view that the government needs to monitor the activities of the construction sites and ensure

that the safety of the workers is not compromised. It was also pointed out that organizational safety culture and management commitment towards safety is of utmost importance in an organization. Management needs to develop safety policies that are realistic as per their commitment and ensure that these safety policies are implemented. The success of the safety policy is only possible when management ensure measures are in place and there is a shared responsibility in terms of safety among the employees. Participants pinned that when management will take strict actions in implementing safety, workers will also give importance to safety and will follow safety rules.

5.4 Questionnaire survey

A questionnaire survey is the third data collection technique deployed in this study. To analyse the data of the questionnaire survey, descriptive statistics and factor analysis were the two techniques used in this research study.

5.4.1 Descriptive Statistics

Descriptive statistics are applied to explain the views of the participants regarding H&S practices in their construction sites and understand their opinion about the impact of human factors on safety performance. The information gathered from the data analysis was later depicted into tables, figures, and charts.

Size of the organisation

In the literature review, it was revealed that the size of the organisation is one of the factors that have an impact on their safety performance. In this survey, respondents were asked about the size of the organisation in which they are working. Results revealed that the majority of the respondents 44% (n=66) are working with the organization having employees (250+), while 41% (n=61) is working with the organisation having 50-249 employees. Whereas, only 15% (n=23) belong to the organisation having (6-49) employees.

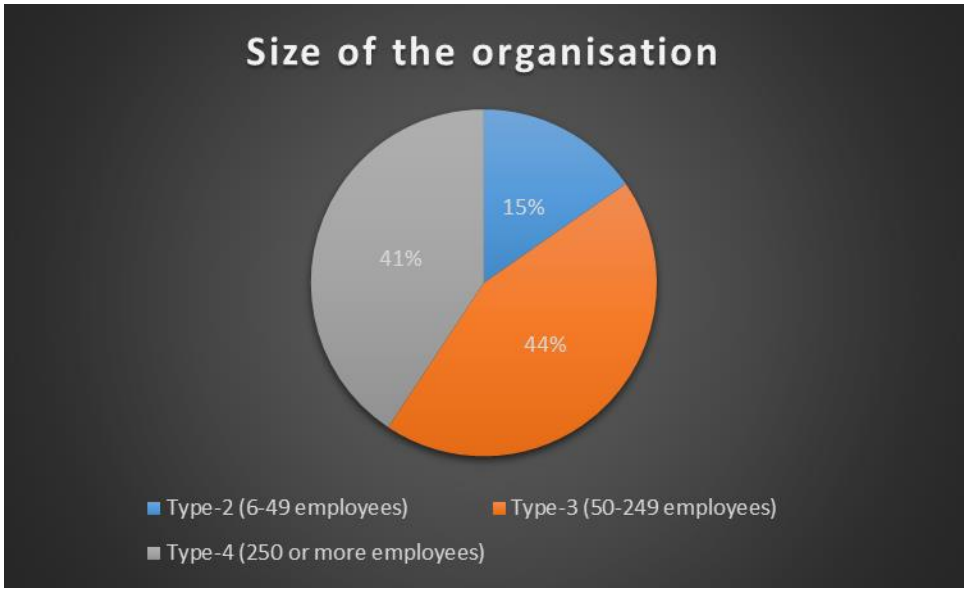

Figure 5.5: Size of the organisation

Managing health and safety

To understand the role of respondents towards managing health and safety, it was asked whether they have the experience of managing health and safety at the construction site at their organisation. In response to that, it was revealed that the majority of the respondents 65% (n=98) had the experience of managing health and safety while 35% (n=52) do not have any experience of managing health and safety at sites.

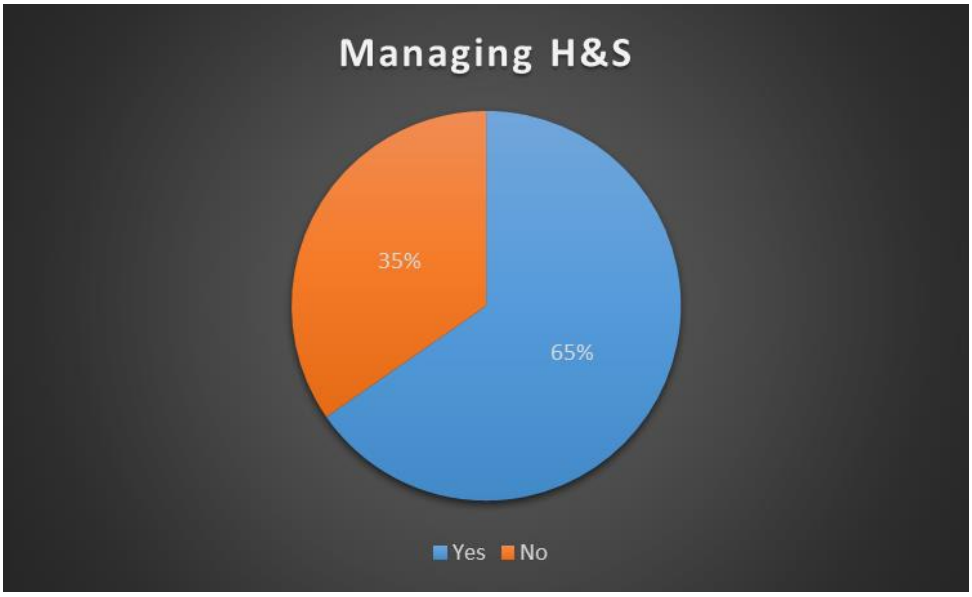

Figure 5.6: Managing H&S

H&S practices

Respondents were asked about their satisfaction level with the H&S being applied in their organisation. The majority of the respondents were satisfied with 48.66% (n=73) with the H&S practices in their organisation while 38.66% (n=58) were not satisfied with the H&S practices in their organisation. To understand the management commitment towards H&S, respondents were asked the satisfaction level with the support management is providing in maintaining safety, and in response, most of the respondents 47.33% (n=71) were strongly satisfied or satisfied while 40% (n=60) of the respondents were strongly not satisfied/not satisfied.

To get more insight about the H&S practices being practised in respondent's companies, it was asked to tick the H&S practices being applied at their workplace. The result from the questionnaire survey reveals that in the construction industry H&S practices are implemented: Newcomers are being provided with safety induction training 69.33% (n=104), required resources are available for each task 48% (n=72), refresher training is being provided to staff on regular basis 44% (n=66), working conditions are appropriate to work 42% (n=63), management and workers are committed to maintaining safety 40.66% (n=61), safety meetings are conducted on regular basis 29.33% (n=44). On the other hand, participants stated that awards and penalization system 26% (n=39) are least implemented in Saudi Arabian construction industry.

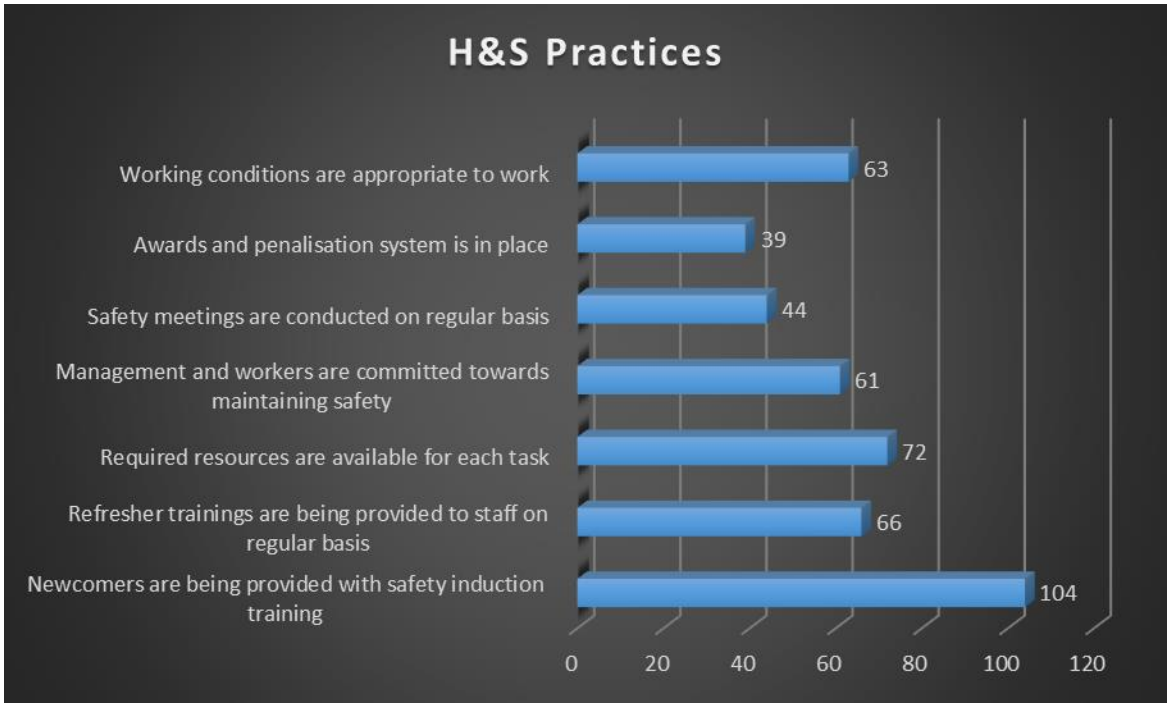

Figure 5.7: H&S practices being applied

5.4.2 Factor Analysis

Data analysis of the interviews revealed 16 significant themes related to human factors which are is a direct or indirect source of the occurrence of the accidents in the Saudi Arabian construction

industry. Hence, in the questionnaire survey, participants were asked about the importance of 16 factors in total as highlighted in the interviews to understand the significance of the factors. One question of the questionnaire survey was to choose one or more important factors that cause accidents in the Saudi Arabian construction industry. In addition to that 16 factors were provided to the participants of the questionnaire survey to choose based upon their importance that has a key impact on the safety of the workers as well as the organisations. The 16 factors which are derived from the interviews are mentioned below:

1. **Not following the safety rules**
2. **Shortcuts**
3. **Overconfidence**
4. **Carelessness and ignoring the warnings**
5. **Lack of working experience**
6. **Workers' health and behaviour issues**
7. **Lack of Attention**
8. **Inadequate materials, tools, and machinery**
9. **The improper procedure of work**
10. **Inadequate or lack of resources**
11. **Lack of planning and incorrect design**
12. **Unsafe method of work**
13. **Unsafe working conditions**
14. **Lack of supervision**
15. **Pressure of work**
16. **Lack of training & awareness**

Factors associated with the individuals

Human behaviour, attitude, and actions have a strong impact on safety performance. It was asked that "Do you think individual factors influence the safety performance at the workplace?". The majority of the respondents 82.66% (n=124) answered with "Yes" and agreed with the statement while 17.33% (n=26) answered "No".

In the next question, it was asked to choose one or multiple individual factors that lead to accidents in the Saudi Arabian construction industry. The majority of the participants selected workers' non-compliance to safety rules as the most significant individual factor that lead to the occurrence of accidents. Results show that 73% (n=109.5) of the participants selected workers' not following safety rules. Workers' carelessness 69% (n=103.5), overconfidence 59% (n=88.5), lack of attention 52% (n=78), and shortcuts 44% (n=66) are other important individual factors that lead towards the occurrence of accidents in Saudi Arabian construction industry as per the participants of the questionnaire survey. Figure 5.8 shows that respondents selected health issues and lack of workers experience 32% (n=48) as the least significant individual factors that lead to the occurrence of accidents.

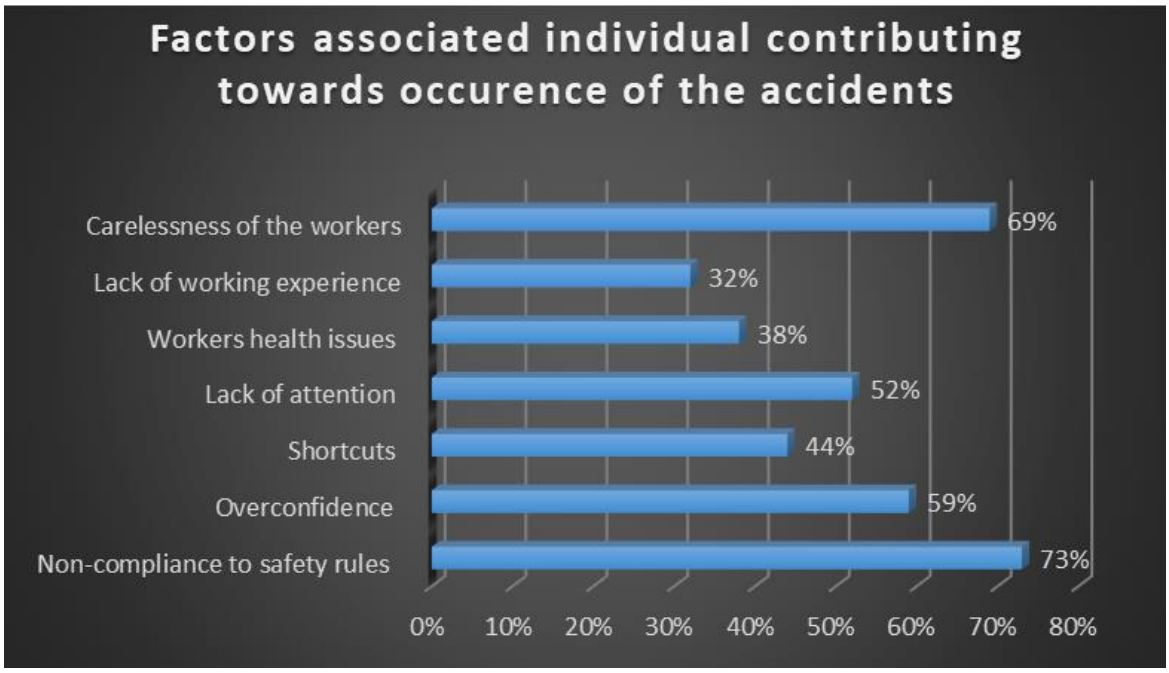

Figure 5.8: Individual factors causing accidents

Factors associated with the task and workplace

Data analysis of archival reports and interviews shows that factors associated with the task and workplace influence the safety of the workers and contributes to the occurrence of the accidents as a direct/indirect source. To validate the role of factors associated with the task and workplace on the occurrence of accidents in the Saudi Arabian construction industry, it was asked that "Do you think factors associated with the task and workplace influence the safety performance at the workplace?". The majority of the respondents 86% (n=129) agreed by selecting "Yes" that factors associated with the task and workplace influence safety performance at the workplace. Hence, this result indicates the significant impact of factors associated with the task and workplace on the safety of the workers and the workplace.

In the next question, it was asked to select one or more factors that are associated with the task and workplace that lead to the occurrence of accidents in the Saudi Arabian construction industry. Participants selected lack of training, lack of awareness and unsafe working conditions were the three most important factors associated with the task and workplace that lead to the occurrence of accidents. Results obtained from the survey revealed that lack of training 68% (n=102), lack of awareness 65.30% (n=98), unsafe working conditions 62% (n=93), the pressure of work 58.70% (n=88), lack of proper planning 55.30% (n=83), lack of or inadequate supervision 55% (n=82.5) are the most important factors associated with the task and workplace that leads to accidents in the Saudi Arabian construction industry (Figure 5.9).

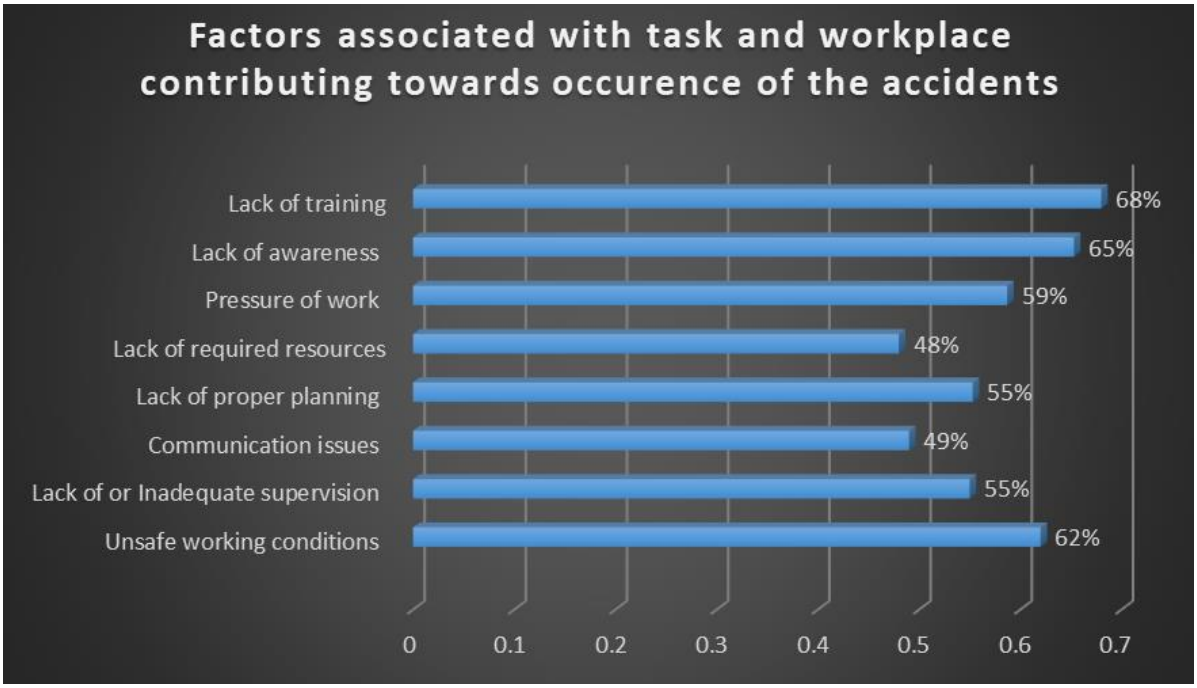

Figure 5.9: Factors associated with the task and workplace that causes accidents

Factors that can reduce accidents

The aim of this research study to help the construction industry in minimising accidents in the construction industry. Therefore, respondents were asked to rate the individual factors that are most important to reduce accidents in the Saudi Arabian construction industry. Most of the respondents of the questionnaire revealed that to reduce the accidents in the Saudi Arabian construction industry, workers compliance to safety rules (Mean Value (MV)=4.1), workers positive attitude and behaviour towards safety (MV=3.94), attention towards safety while performing the task (MV=2.78), following of work procedures (MV=3.72), and rest (MV=3.71) is the most important individual factors.

Figure 5.10: Individual factors that can reduce accidents

Respondents were asked another question to rate the factors associated with the task and workplace that are most important to reduce accidents in the Saudi Arabian construction industry. Figure 5.11 revealed that to reduce the accidents, good organisational safety culture and training of the workforce are two significant factors. Respondents mentioned that training to the workforce (MV=3.92), good organizational safety culture (MV=3.91), regular awareness about safety (MV=3.9), proper planning before work (MV=3.83), government commitment towards safety (MV=3.72), management commitment towards safety (MV=3.67), provision of safe working conditions (MV=3.64), adequate supervision (MV=3.62) are the significant factors that are important to achieve the better safety performance and will reduce the causation of accidents in Saudi Arabian construction industry.

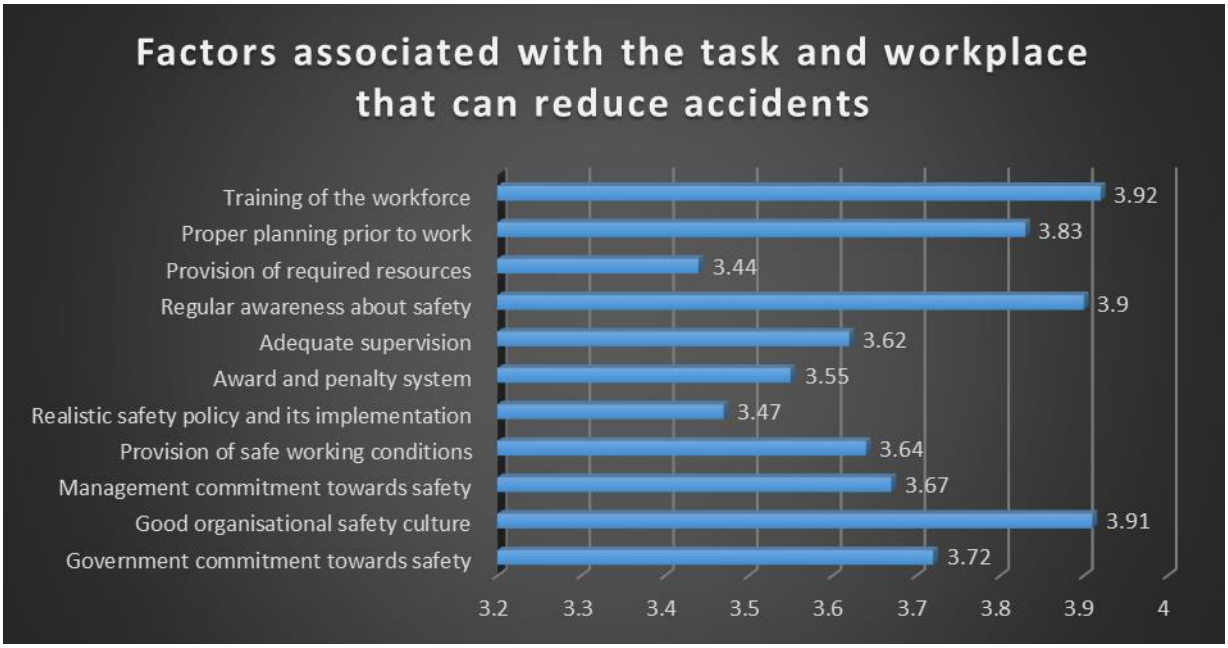

Figure 5.11: Factors associated with the task and workplace that can reduce accidents

5.4.3 Checking interviewee statements with the viewpoint of the questionnaire survey respondents

One aim of the questionnaire survey was to check the opinions of the interviewees by asking them to the questionnaire survey participants. This will help in checking the statement made by the interviewee participants through the opinions of the questionnaire survey respondents. In addition to that, some of the questions were asked that were related to the safety practices being applied in the Saudi Arabian construction industry so it will help in getting to know the construction professional's perceptions about the safety practices in the Saudi Arabian construction industry.

5.4.3.1 Individual Factors

a. Workers actions

From the results of the questionnaire survey, it was revealed that most of the respondents (60.7%) of the survey strongly agreed/agreed with the statement that the laziness of the workers causes them to neglect safety rules. Another question was asked whether the carelessness of the worker increases the chances of the accidents and in response to this question (90.7%) of the respondents answered strongly agreed/agreed with the statement. These results confirm the interview's statement regarding the worker's laziness.

In the interviews, it was revealed that overconfidence is one of the main reasons behind the worker's unsafe actions. When participants were asked whether people take less concentration to safety due to having overconfidence and in response (88.3%) strongly agreed/agreed with the

statement of the questions. This answer shows alignment with the interviewee's statement. In the interview, the interviewee said that accident does not occur in the first year of getting training as a worker is careful but as time passes than a worker get more confidence and lose concentration, so accident occurs. This statement was asked to the participants of the questionnaire survey and in response (72.8%) strongly agreed/agreed with the statement and agreed with the interviewee's statement.

Most of the interviewee participants mentioned that workers who have risk-taking attitudes are more involved in the occurrence of accidents. This statement was asked as a question in the questionnaire survey and it was revealed that 95.30% of the respondents strongly agree/agree with the statement made by the interview participants. This result from the survey shows that workers attitude towards safety is important and if workers will have a risk-taking attitude then it will lead to more chances of the occurrence of the accidents. In the interviewee, it was revealed that one of the reasons workers don't care about safety because is because of an unsafe attitude. Participants of the questionnaire survey shared similar opinions and as of interviewee participants and responded (82%) by choosing strongly to agree/agree. In the interviews, another individual factor revealed by the interviewee participants that causes accidents were shortcuts. In the questionnaire survey, a total of 86% of the respondents strongly agree/agree that shortcuts often lead to mistakes and cause accidents. This result from the questionnaire survey also shows that respondents of the questionnaire survey shared that same opinion with the interviewee participants regarding shortcuts as one of the reasons behind the occurrence of accidents.

In the questionnaire survey, it was asked whether a lack of attention occurs when workers are more focused on finishing the task than safety. In response to this question, most of the questionnaire survey respondents (83.30%) also strongly agree/agree with the statement which shares a similar opinion with the interviewee participants. Another question was asked from the questionnaire survey that whether laziness and carelessness are the reasons behind worker's lack of attention which often leads to accidents. Results from this question revealed that 94.70% of the respondents strongly agree or agree with it. The same point was raised by interviewee participants.

b. Workforce competence

To know the opinion of the questionnaire survey regarding the role of education in working safely, the question was asked whether workers having more education behave better than the workers having less education. In response to this question, 92% strongly agree or agree with the statement, which shows that education has a strong role in influencing workers to work safely or no. In the next question it was asked that at your worksite, education of the workers is below high school. The majority of the respondents (96.70%) strongly agree/agree with the question while only 3.30% disagree which shows that at the workplace, most of the workers have below high school education level.

c. Awareness & training

The majority of the respondents (78%) strongly agree or agree that at their workplace, safety induction is provided to each new employee before the start of the work. Only (16.60%) of the respondents strongly disagree or disagree with the statement. This result reveals the majority of the construction sites are providing safety induction to new workers before the start of the work. Interviewee participants strongly emphasized the importance of training and suggested that one of the reasons behind accidents are untrained personnel. This statement was tested by asking it to the questionnaire survey respondents and the majority (96.70%) of the respondents strongly agree/agree with the statement and shared similar opinions as of interviewee participants. This result also shows the importance of the provision of training to the workers and if workers are not trained then they will have difficulty in identifying the risk and may cause accidents. Creating awareness among the workers is important in reducing the occurrence of the accidents which was pointed out in the interviews. When this question was asked to the respondents of the questionnaire survey than result reveals that 96% of the respondents strongly agreed or agree with it which suggests that it is important for the employer to regularly create awareness among the workers to minimise the causation of the accidents.

d. Supervision

It was highlighted in the interviews that sometimes workers involve in unsafe practices when there is no supervision on them. The majority of the respondents (86.70%) of the questionnaire survey agree that workers sometimes involve in unsafe practices when no one is watching them or there is no supervision. It was asked that whether proper supervision can help in reducing accidents, more than 90% of the respondents (94.70%) strongly agree or agree with the statement. These results show that supervision has a significant influence on the workers and to reduce the chances of the occurrence of the accidents then it is important to have proper supervision on site.

e. Communication

Miscommunication between worker and line-managers or management was highlighted as an important reason that becomes a contributing factor in the occurrence of accidents. The majority of the respondents (95.30%) strongly agree or agree that miscommunication between employees increases the risk of causation of accidents which shows alignment with the interview participants' statement. One of the reasons for miscommunication that was pointed out by the interviewee participants was that in Saudi Arabian most of the workers are from different nationalities and sometimes do not speak or understand a common language. When this statement was asked in the questionnaire survey, the majority of the respondents (94%) strongly agreed or agreed with it and shared the same opinion as of the interview participants.

5.4.3.2 Factors associated with the task and workplace

a. Planning

Most of the questionnaire survey respondents (93.30%) strongly agreed/agreed that proper planning of work is necessary for reducing risks at the construction sites. These results share similar views as of the interview participants who pointed out to minimise the chances of accidents at the workplace it is important that works are being performed with proper planning.

b. Resources

Interview participants shared a concern that workers are not being provided with required resources and this leads to workers working with either limited resources or inappropriate tools which create more hazards at the workplace. In the questionnaire survey, it was asked to the respondents that the provision of lack of resources to the employee can lead to unsafe situations and in response majority of the respondents (82.70%) strongly agreed or agreed with the statement. This result confirms the interview opinion on the significance of the resources.

c. Safety Culture

Most of the questionnaire survey respondents (92%) supported the statement by selecting strongly agree/agree that good safety culture enhances workers' attitudes and beliefs towards safety. In another question, it was asked whether poor safety culture is one of the reasons behind the occurrence of accidents in the Saudi Arabian construction sites. Results show that 99.30% supported the statement. This result indicates that safety culture in any organisation is significant that can help in improving safety performance and reduce the occurrence of accidents.

d. Working conditions

Related to working conditions, interview participants stressed that working conditions are important in maintaining a safe workplace and pointed out that unsafe working conditions are of the cause of the accidents. Majority of the questionnaire survey respondents (98.70%) shared a similar opinion and believed that unsafe working condition is one of the causes of the accidents. Another question was asked in the questionnaire survey regarding the relationship between working conditions and worker's behaviour towards safety. The result shows that most of the respondents (94.70%) believed that suitable working/welfare conditions improve workers' behaviour towards safety. This result shows alignment with the statement of the interview participants.

e. Management commitment

Interview participants pointed out the importance of the role of management in the implementation of safety practices. The majority of the questionnaire survey respondents (92%) strongly agreed/agreed that the role of the management is very important in maintaining safety. During the interview, it was pointed out that the lack of commitment from the management towards safety and management's priority on production over safety are the main reasons that hinder the implementation of safety practices. The result from the questionnaire survey revealed that the majority of the questionnaire survey respondents (87%) strongly agreed/agreed with the statement and verifies the interview viewpoint.

5.4.3.3 National and environmental factors

a. Weather

Concerning the hot weather in Saudi Arabia, most of the interview participants mentioned during the interview that extreme hot weather conditions in Saudi Arabia make it difficult to implement safety practices and sometimes workers don't wear safety equipment because they feel uncomfortable under the sunlight. The result from the questionnaire survey shows that a similar viewpoint is being shared with the majority of the respondents (86.70%) strongly agreed or agreed with the statement. However, just over (95.30%) of the respondents of the questionnaire survey believed that the provision of rest breaks and welfare facilities to the workers will help in improving worker's unsafe practices caused due to hot weather. This result is aligned with the interview participants statement and pointed out that for workers to work comfortably during the hot weather organisation needs to provide proper welfare facilities to the workers such as shaded area, cold water, and regular rests. The provision of these welfare facilities will help the worker in working without stress or exhaustion and will improve his concentration on working safely.

b. Government commitment

Participants of the interview revealed that one of the main problems in improving safety performance in Saudi Arabia is that in Saudi Arabian construction industry there is no strict enforcement by the government related to health and safety legislation, and there is no specific health and safety regulatory body to regulate and enforce the health and safety regulations. When respondents of the questionnaire survey were asked whether there exist national health and safety regulations in Saudi Arabia. Most of the respondents (76%) said, "No". In another question, it was asked that in their construction sites whether government health and safety inspectors are visiting regularly to inspect the safety and welfare conditions of the construction sites. In response to that question, the majority of the respondents (85.30%) said, "No". This result reveals that lack of inspections and enforcement by the government related to health and safety shows limited health and safety role of government related to health and safety management system in Saudi Arabia.

5.4.4 Summary

In the questionnaire survey, respondents were asked to select one or more the H&S practices that are being applied in the Saudi Arabian construction industry. Result of the questionnaire revealed that at most of the construction sites newcomers are being provided with safety induction training 69.33% (n=104) followed by required resources are available for each task 48% (n=72), refresher training is being provided to staff on regular basis 44% (n=66), and working conditions are appropriate to work 42% (n=63). In the interviews, it was mentioned many factors that contribute to the occurrence of accidents. In the survey, respondents were asked to choose one or multiple individual factors as pointed out in the interviews that lead to accidents in the Saudi Arabian construction industry. Workers' not following to safety rules 73% (n=109.5), Workers' carelessness 69% (n=103.5), overconfidence 59% (n=88.5), lack of attention 52% (n=78), and shortcuts 44% (n=66) are the significant individual factors that lead towards the occurrence of accidents in Saudi Arabian construction industry as per the participants of the questionnaire survey.

The result from the accident reports and interviews pointed out numerous factors that contributed to the causation of the accidents that were related to the task and workplace. In the survey, it was asked to select the key factors that are associated with the task and workplace that lead to the occurrence of accidents in the Saudi Arabian construction industry. Results obtained from the survey revealed that lack of training 68% (n=102), lack of awareness 65.30% (n=98), unsafe working conditions 62% (n=93), the pressure of work 58.70% (n=88), lack of proper planning 55.30% (n=83), and lack of or inadequate supervision 55% (n=82.5) are the most important factors associated with the task and workplace that leads to accidents in the Saudi Arabian construction industry.

In the interviews, it was argued that there is a need for different measures to improve the safety performance of the Saudi Arabian construction industry. When respondents of the questionnaire survey were asked about the important factors that can reduce the occurrence of the accidents. Respondents selected that workers compliance to safety rules (MV=4.1), workers' positive attitude and behaviour towards safety (MV=3.94), attention towards safety while performing the task (MV=2.78), following of work procedures (MV=3.72), and rest (MV=3.71) are the most important individual factors. In addition to that, respondents mentioned that training to the workforce (MV=3.92), good organizational safety culture (MV=3.91), regular awareness about safety (MV=3.9), proper planning before work (MV=3.83), government commitment towards safety (MV=3.72), management commitment towards safety (MV=3.67), provision of safe working conditions (MV=3.64), adequate supervision (MV=3.62) are the significant factors that are important to achieve the better safety performance and will reduce the causation of accidents in Saudi Arabian construction industry.

Chapter 6

Discussion

6.1 Introduction

In the previous chapters, it was demonstrated that Saudi Arabian construction is facing poor safety performance due to the failure of multiple factors. Government, construction companies and employees have their role in the implementation of H&S practices. However, it is suggested from the previous chapters that the government has existing some H&S regulations governed by the ministry of labour which are not properly implemented and there are limited monitoring and enforcement from the government. Construction companies are lacking good organizational culture and management's commitment towards safety is limited which is evident from measures: the hiring of incompetent subcontractors which are cheap, lack of necessary resources, lack of training and awareness sessions and unsafe working conditions. Workers limited awareness and knowledge about risks, low competence and training, and pressure of work is affecting their attitude, behaviour, and actions resulting in neglecting safety rules and taking risk which contributes in the occurrence of the accidents. In this chapter, the discussion will be made based upon four research objectives of this research study.

6.2 Accomplishing the research objectives

In the first stage of the study, an in-depth literature review was conducted to explore the safety performance of the Saudi Arabian construction industry, examine the relationship of human factors and the occurrence of accidents, and identify the human factors affecting the safety performance of the Saudi Arabian construction industry. The literature review pointed out that in Saudi Arabia, the health and safety situation is not promising due to the occurrence of the high number of accidents which resulted in fatalities and injuries. Yasir & Saad (2018) pointed out that poor safety performance has always been a significant issue of concern for the Saudi Arabian governmental as well as private organizations. Research studies from earlier research emphasized the need for improvement in the safety performance of the Saudi Arabian construction industry to protect the workers from the causation of accidents (Balgheeth, 2016; Saad, 2016; Mosly, 2015). Accidents can be reduced when causal factors are known which contribute towards the occurrence of the accidents. (Abubakar, Wang, 2019; HSE, 2019; Vondráčková et al., 2016; Zhang et al., 2019) emphasised the importance of identification of the factors to minimise the cause of the accidents. Researchers and accident causation theories have identified that accidents occur due to the involvement of more than one factor. Most of the accidents are occurring due to more than one factor that acts as an immediate or contributing factor towards the occurrence of the accidents.

Accident causation theories pointed out that accidents are triggered by a combination of human factors with the interlinking of the individual factors and job factors which are influenced by the organizational factors (HSE, 2019; Hobbs, 2008; Vykopalová & Cupal, 2014; Reason, 1990). The literature review mentioned that individuals' actions are involved with the occurrence of the majority of the accidents in the Saudi Arabian construction industry. However, there are limited research studies available in exploring the involvement of individuals in the occurrence of the accidents and what are the reasons which influence the individuals in carrying out such acts which led to the occurrence of the accidents. Therefore, in this study, the research aim is to propose recommendations that will improve the safety performance of the Saudi Arabian construction industry and minimize humanly related accidents. To achieve this research aim, four research objectives are part of this study: identify human factors that cause accidents in construction, explore influencing human factors that lead to the occurrence of accidents in the Saudi Arabian construction industry, examine the challenges and barriers Saudi Arabian construction industry is facing in maintaining safe worksite and propose recommendations that will improve the safety performances of the Saudi Arabian construction industry. To achieve the research aim and objectives, three data collection techniques (archival reports, interviews and questionnaire surveys) were deployed in this research study.

1. **Research objective one was to identify human factors that cause accidents in the construction sites.**

To achieve this research objective, archival reports, interviews, and questionnaires were done. It was revealed in the study of the accident reports that the majority of the accidents occurred due to the direct/indirect causes associated with the individuals, task and workplace. In the analysis of the accident reports it was revealed that the majority of the accidents occurred due to involvement of more than one factor and in total 28 factors were identified which caused the accidents in Saudi Arabian construction sites. Out of these 28 factors that contributed in the occurrence of the accidents, six factors caused the most number of the accident which are; the carelessness of workers, shortcuts taken by the workers, unsafe working conditions, lack of training, lack of awareness about risk, and lack of planning before work.

In the interviews, participants provided an in-depth and detail understanding of the involvement of different human factors that contributed to the occurrence of the accidents. Participants of the interviews pointed out that accidents in construction sites are occurring due to 16 factors. However, the majority of the participants highlighted five major factors that are causing accidents: non-compliance to safety rules, overconfidence, lack of competence of the workforce, work overload, and lack of training. In the questionnaire survey, respondents were asked to select the most important factors from the 16 factors retrieved from the analysis of the interviews. The high percentage of the participants of the questionnaire survey selected three

major factors that result in the occurrence of accidents in the Saudi Arabian construction industry: workers' non-compliance to safety rules, carelessness of the worker, and lack of training provided to the workers. By comparing the results of the analysis of the accident reports, interviews and survey, it was revealed that two major factors are common in each of the analyses of the three different data techniques. Two major factors that are influencing the workers to work unsafely and causing accidents are workers' non-compliance to safety rules and lack of training provided to the workers.

In Saudi Arabia, most of the workforce are migrants who are untrained and hired from their countries because of fewer salaries (Balgeeth, 2016). Saad (2016) also pointed out that in the Saudi Arabian construction industry there are untrained workers which are affecting the implementation of safety practices. In the interviews, participants pointed out that one main reason behind workers' unsafe actions including non-compliance to safety rules is due to workers' ignorance of safety rules, procedures, and risks. Hence, it can be argued that there is a relationship between the lack of training and awareness of the workers with workers unsafe actions. If the worker will not have proper knowledge about the risks, safety measures, safety procedures, risk assessment, method of works then he/she will carry out any act due to lack of knowledge and awareness which will end up contributing to the occurrence of the accident.

2. Research objective two was to explore the influencing human factors that lead to the occurrence of accidents in the Saudi Arabian construction industry.

The accident is occurring due to the involvement of immediate and underlying causes. The majority of the accidents are occurring by the involvement of different events. In the literature review, it was mentioned that unsafe acts and unsafe conditions are the two main reasons behind the occurrence of accidents. In the Saudi Arabian construction, industry researchers have pointed out the involvement of numerous factors that influence the safety performance of the Saudi Arabian construction industry (Mosly; 2015, Saad; 2016). In the global and Saudi Arabian construction industry, workers are considered as one of the reasons behind the occurrence of the accidents as they are directly involved with the works. However, HSE (2018; Stranks, 2007) argued that workers' behaviour and actions are influenced by different factors. These factors can be related to the workers, workplace and the task being carried out. In this research study, the second objective was to understand the relationship between human factors and the occurrence of accidents and explore the influencing factors. Responses from the interviews suggested that workers actions, attitude, and behaviour are affected by numerous factors which are originating because of the failure of gaps existing in the procedures, design, management, work methods, etc. It was also pointed out that behind the failure in each factor there is a combination of various underlying factors that create a hazard or unsafe practices at the workplace. Most of the accidents occurred by the combination of more than one factor. The majority of the participant mentioned

that workers' unsafe actions are influenced by their unsafe behaviour and risk-taking attitude which is a result of lack of safety awareness and knowledge, lack of working competence, inadequate supervision, work overload, and health issues. In addition to that risks that are emerged while carrying out the task creates more hazards for the workers which are mainly caused by the poor design which have not mitigated the risk and hazards, lack of planning which failed to identify the risks and apply necessary required control measures to minimize those risks, lack of provision of required resources, poor method of work and miscommunication between employees and line managers. Construction sites are unsafe, and workers are not being provided with the required tools and resources, which is mainly due to lack of management commitment towards safety which is evident from construction sites containing unsafe working conditions with the existence of hazards at the workplace which creates hidden risks for the workers. Balgeeth (2016) also pointed out that in Saudi Arabian construction sites, the majority of the worksites are do not contains the necessary safety precautions which are adding risk to the workers.

3. **Research objective three was to examine the challenges and barriers the Saudi Arabian construction industry is facing in maintaining safe worksite.**

The literature review in this research study indicated that workers' actions and behaviour are influenced by various human factors that are associated with the individual personality, task, and workplace. Furthermore, in the literature review, it was mentioned the Saudi Arabian construction industry is facing various H&S challenges related to the employees, construction companies, environment, and government. Results from the data analysis of the collected data provided similar information that in the Saudi Arabian construction industry H&S issues are multifaceted as mentioned in the literature review.

It was pointed out in section 5.3.3 & 5.4.1 that in Saudi Arabian construction industry, the key factors affecting the safety performance include: non-existence of H&S regulatory body which develops and implements H&S regulations, lack of commitment when it comes to implementing safety from management, lack of organizational safety culture, safety policy is not practical and there is limited implementation of safety policy, extremely hot conditions in Saudi Arabia makes it difficult to implement safety practices, lack of competent subcontractors in the construction industry who take safety seriously and companies providing no or very fewer resources and budget for the safety measures.

Some of the challenges highlighted above as collected from the result of the collected data are also mentioned by other researchers in the literature review. One thing that was revealed in the results of this research study that there are gaps present in the H&S practices within the government as well as the employers. Workers and the supervisors are the ones who get the

blame when the accident occurs, but it is necessary to understand the various causal factors that are hindering in the implementation of the H&S practices.

In developing countries, there is a lack of governing and control of H&S regulations which is termed as one of the main factors that are affecting the safety performance (Awwad et al., 2016). In Saudi Arabia, the Ministry of labour has mentioned some regulations related to H&S but as (Saad, 2016) pointed out that there is limited implementation on these regulations. Participants of the interviews also mentioned that one reason the Saudi Arabian construction industry is experiencing poor safety performance is due to a lack of national H&S regulations. Due to this reason, an organisation which has a poor safety culture does not think safety as a priority and does not commit to the provision of a safe working environment. In the absence of strict control by the Saudi Arabian government on the companies regarding the implementation of the ministry of labour regulations, there is a big responsibility for the employers to show management commitment and provide safety culture. However, it is suggested by researchers and mentioned by the participants of the interviews and questionnaire survey that management is not interested in the safety of the workers and workplace which is resulting in affecting the safety culture of the organisation. Interviewees mentioned that management commitment towards the safety and safety culture of the organisation are two key factors that have a strong influence on the workplace and the workers' behaviour. The literature review also pinned that management has a strong role in keeping the workplace safe as their commitment will inspire the workers who mostly look up to their managers. It was also revealed that management concentrates more on production than the safety and does not invest in safety and does don't act upon the recommendations of safety officers. There is a necessity of creating more awareness among management regarding the importance of safety at workplace and management responsibilities in terms of safety.

Interview participants argued that in Saudi Arabia lack of safety culture is a concern as employers as well as the workers don't care about safety. Safety culture is also important in keeping a safe workplace. Safety culture is employees shared beliefs and perceptions towards safety. Positive Safety culture needs management commitment towards safety, through the provision of adequate safety policy and safe working environment. Workers' safe behaviour is guided by the safety ethics of the organisation in which they work. A positive safety culture provides a platform to build greater awareness, understanding, and compliance with safety rules and regulations (Wamzuiri, 2008). The main contractor is selecting the subcontractors based on their low-price bid and not considering their safety records and these subcontractors are involved with unsafe activities. Unrealistic safety policy is not adding any value to the H&S of the workplace. Safety policies are just written words with a focus on "Zero Accidents" without providing necessary measures, responsibilities, actions, budget, and resources which is the main reason for the failure of the safety policy. Workers are hired from different Asian countries based upon low salaries and with the language barrier, and no or limited experience and knowledge about the works and H&S face difficulty in carrying out work in a safe manner.

4. **Research objective four was to propose recommendations that will improve the safety performances of the Saudi Arabian construction industry.**

The above sections pointed out that in Saudi Arabia, safety issues are emerging from different sources especially the construction companies The Government has a very important role to play in the successful implementation of the H&S practices which will enhance safety performance. In the UK, US and Europe, there is a great improvement in safety performance as compare to other countries. One reason for that is the government's commitment towards safety through the development of the H&S regulatory body which develops and ensures the implementation of the H&S regulations. Government inspectors are conducting regular inspections and monitoring the compliance of the workplaces per their H&S standards. In case of non-compliance, strict actions are being taken including hefty fines. This practice by the government had been the primary reason for the improvement in safety performance. In the results, it was argued by participants that in Saudi Arabia, there is a need for H&S regulatory body which develop, enforce and monitor H&S standards inside the country. In Saudi Arabia, safety culture is weak, and organization needs to improve their safety culture with the involvement of their employees especially the top management because their commitment will ensure that all necessary measures and actions are in place to make sure workplace is safe.

"Mentality of the management needs to be changed towards safety. Safety must be a priority by the management. Management must know the safety laws so that safety laws must be stressed and enforced by the management. Management must have basic training about safety to identify the risks and implement the necessary control measures."

Words are not enough which are only written inside the safety policy. Important thing is to ensure that every employee understands their H&S responsibilities and there are proper guidelines and procedures available to ensure that the monitoring and accountability process in place. In Saudi Arabia, workers have limited knowledge and awareness about the safety and risks at the workplace which is causing many accidents. Therefore, the organisation must conduct regular training and toolbox talks for the workers which will help in improving awareness among the workers. Saad (2016) and Balgheeth (2016) pointed out the significance of the safe working conditions in the Saudi Arabian construction industry, participants of the survey and interviews shared a similar opinion regarding the working conditions. It was mentioned in the results that one reason for the causation of the accident is unsafe working conditions and it was recommended to provide safe working conditions. It was recommended that to improve workers' unsafe actions and poor attitude towards safety there is a need for a penalty system that fine the workers who don't follow safety rules.

"Company must provide a safe workplace. Provide equipment, resources, tools that are of good quality and safe. Hazards at the workplace must be controlled and mitigated before the start of

work. At our project, we have to travel more than 200 km, and the company needs to provide good welfare conditions to the workers. Vehicles must be in good condition. At the workplace, lighting, fans, safety equipment must be provided to the workers which will help them work safely. Saudi Arabia is a hot country so welfare conditions must be provided by the workers."

Improvement in safety performance requires measures and commitment from the government, construction companies, and employees. Section 5.3.4 and 5.4.2 explained different factors and recommendations that will help in enhancing the safety performance of the Saudi Arabian construction industry. From the results, it can be noted that government and construction companies have an important role in maintaining a safe workplace. Literature review and interviewees also highlighted the importance of government and employers towards keeping the workplace safe. The government needs to regulate H&S regulations and implement them. To ensure the workplace is safe and employees are committed to safety, construction companies must create a good safety culture supported by their management with the provision of safe working conditions. In the next chapter, recommendations will be discussed in detail that will help in improving the safety performance of the Saudi Arabian construction industry.

Chapter 7

Conclusion and Recommendations

7.1 Introduction

In this chapter, there will be three sections: conclusion, recommendations, and contribution to knowledge. Conclusion section will mention the summary of the outcome of this research study. The recommendation section will be providing recommendations that will help minimise the occurrence of accidents and enhance the safety performance of the Saudi Arabian construction industry. In the last section of contribution to knowledge and practice, knowledge will be shared that will help in the present and future theory and practice.

7.2 Conclusion

Literature review pinned that Saudi Arabian construction industry is filled with multiple H&S issues. It was also pointed out that the Saudi Arabian construction industry's safety performance is low due to the occurrence of the high number of accidents. The result from the three research techniques verified that the Saudi Arabian construction industry is experiencing a significant number of accidents and need concrete actions to improve safety performance. From the research study, it was noted that Saudi Arabian construction industry H&S issues are multifaceted which are generally related to the government, organization, and workers. This research study also pointed out that there is a link between human factors emerging from the individuals, task and the workplace and when any of the human factors fail, chances of the occurrence of the accidents become significantly high. This current study also confirmed the significant relationship between components of human factors (individuals, task and workplace) and the safety performance of the Saudi Arabian construction industry.

In this study, many human factors emerged that influence the occurrence of accidents. It can be noted that accident occurs due to the involvement of multiple human factors which are interlinked and influence the individuals. These findings share similar results as mentioned by Hide, Atkinson, Pavitt, Haslam, Gibb, & Gyi (2003) that construction accidents arise from a failure in the interaction between different factors associated with the workers, their workplace and the materials and equipment. In the literature review, it emerged that in most cases workers unsafe actions lead to the occurrence of the accidents. The findings of this study also revealed verified that information on the literature review that most of the accidents occur due to the involvement of workers. Individuals are at the front end performing the task and due to their unsafe actions whether intentionally or unintentionally contributes to the occurrence of the

accidents. These unsafe actions by the workers are the result of numerous reasons. Findings from the data analysis also verified that workers' actions and behaviour towards safety were two key factors related to individuals that have a significant impact on the overall safety of the workplace. It is important to note that worker's actions and behaviour are influenced by numerous shaping factors that compel the workers in working unsafely or ignoring the safety rules. Limited awareness about safety and hazards at the workplace, lack of proper training, ill health, work pressure, miscommunication, and inadequate supervision are key influencing human factors emerged from this study which leads to the unsafe behaviour and actions of the workers and as a result contributed towards the occurrence of the accidents.

It was revealed in the findings of the data analysis that there is a lack of awareness about the importance of safety rules among the employees as they assume safety rules as a hurdle in achieving production progress and take the safety rules lightly which is one key reason they disobey the safety rules. Management as well as the workers bypass the necessary safety rules and procedures and continue to work at the workplace which contributes towards the occurrence of the accidents. Not following the safety rules and procedures become a habit as there is no check and balance in the organization. Usually, to perform any task effectively and safely, basic safety requirements are that workers must be trained, work must be properly planned, the workplace must be safe and hazard-free, and the resources must be sufficient. But it was revealed in the research study that these safety requirements are not being followed properly which is evident from the result of the accident reports mentioning that most of the accidents are occurring due to lack of proper training and planning, unsafe working conditions and inadequate resources.

Workers are being provided with the safety induction which contains general information and is being utilized just a formality so that workers can initiate the work. Safety induction is being provided to the workers explaining basic safety rules and risks at the workplace but for workers with more risky jobs involving working at height or working with electrical equipment, there is no additional training explaining them about the risk and control measures associated with their job. Hence, workers dealing with more risky jobs have to learn about the risks by getting involved in the works at the workplace which opens more chances of the worker making an error and creates a potential hazard. Another issue revealed from the research study is workers' limited knowledge about the safety procedures and there is miscommunication within the worker and work team. Supervisors are not providing required information about the procedures and tasks before the start of the activity. Documents are in English and most of the workers are not educated so they have limited knowledge about the English language, therefore, they cannot read and understand the safety and work procedures by themselves. After the provision of basic safety induction, limited training or awareness sessions are being conducted explaining the procedures, policies, alerts or important information related to the construction sites.

In the study of the accident reports, most of the accidents occurred for works involving skilful jobs as there are more risks involved in that activity. In Saudi Arabia, most of the construction

workers are foreigners who mostly came from Asian countries. In most cases, workers are not trained and experienced enough to perform skilful jobs such as masonry, welding, carpenter, etc. which have a higher level of risks. Foreign workers are hired because they are cheap in salaries as compare to the local workers and Saudi nationals prefer not to work as a blue-collar worker. Foreign workers are directly sent to perform the task without proper training about the job or giving them enough time to learn about the worksite or job which create an unsafe situation as they have limited knowledge about the occupational risks associated with task and workplace. Workers are in the early stages of their work and any mistake or error can contribute towards the occurrence of the accident. Therefore, in this study, it was demonstrated that foreign workers are involved with the occurrence of more accidents as compared to the local workers. This information is the verification of the statistics of GOSI (2019) which reported that Saudi Arabian foreign workers suffer more accidents as compare to the Saudi workers at the workplace.

Supervision is an important point in keeping the workplace safe and ensuring workers are working safely. The findings of this study pointed out that inadequate or lack of supervision is influencing the safety performance at the construction sites. If the workers are new to the project or dealing with high-risk activities, there is a need to work under the supervision of the responsible person. However, in many cases works are being performed without the supervision of a responsible person and workers are not following the safety rules as no one is watching them. In Saudi Arabia, organizational safety culture is weak as workers are mostly obeying safety rules if there is a supervision of a responsible person or safety officer. One point raised by the participants of the interviews was that due to work pressure, the supervisor tells them to work fast and even bypass the safety procedures which create risky situations for the workers. It is one reason that many accidents studied in this study were caused by either lack of supervision or wrong instructions given by the supervisors.

The organization has the most important role in maintaining a safe workplace and minimizing the occurrence of accidents. It was revealed that numerous contributing human factors that lead to the occurrence of accidents are related to the task and workplace. Lack of planning, lack of training, lack of awareness, work overload, lack of management commitment in implementing safety, unsafe working conditions and lack of good safety culture is the reason behind poor safety performance at construction sites as reported in the findings. More than half of the studied accidents in this study occurred due to human factors such as lack of planning and design and unsafe working conditions. Construction sites do not mitigate hazards at the workplace and as a result, these hazards contribute towards the occurrence of the accidents. Organisation seems less concerned about the safety of the manpower as they are failing to provide safe working conditions to the workers. This issue was also highlighted by Mosly (2015) who mentioned that construction sites in Saudi Arabia lack basic safety requirements and contain many risks. In developed countries where there are H&S regulations, the government requires employers to provide safe working conditions to the workers and adequate resources at the workplace. In Saudi Arabia, one reason construction companies do not emphasize the safety of the workplace

is as the Saudi Arabian government is not enforcing their H&S regulations which are defined by the ministry of labour and as a result organization feels not obliged to take necessary measures in keeping the workplace safe.

In this study, another important organizational factor that emerged is the lack of a good safety culture. Organizational safety culture has a strong influence on the attitude of the employees, if there is a good safety culture where safety is a priority then employees will also take care of the safety but if there is poor safety culture then employees will take safety policies lightly and perform unsafe acts. In Saudi Arabian construction companies, safety culture is not strong as a result there is less concern about safety among the employees. To develop a safety culture, the role of management is very important. Management has a strong role in the successful implementation of safety policy and safety programs at the workplace which ensure good safety culture. One issue that was significantly highlighted in all three research strategies were management commitment towards safety. In the Saudi Arabian construction industry, there is a need for more effort and commitment from the management inside their organizations as some of the underlying causes of the accidents are directly related to the management. It was revealed that at some sites, works are being carried out without proper planning and workers are not being provided with necessary safety equipment or proper tools for work. Management has big safety responsibility and they must be concerned with improving safety at the workplace. The work team follows the instructions of the management and if the management is not committed towards safety, the workforce will do the same resulting in poor safety performance with the occurrence of the accidents.

In each company, there is a safety policy that explains the employer course of actions based on their safety goals. Successful safety policies are built upon the company's organizational safety culture and principles. It was pointed out that the safety policy used in the construction companies is unrealistic and adopted from the western companies without realising how these safety goals will be achieved. In the safety policy, the target is to maintain a "Zero Accident policy" which is difficult to maintain as the construction companies do not have good safety culture and there is a limited commitment from the employers and employees. In reality safety policy is just a formality to show it to the project client as a project requirement but there is no proper implementation of the safety policy as a company is not investing any money for the safety measures and as a result objectives of the safety policy is not achieved. One important point highlighted in the interviews is the selection of subcontractors that are cheap in providing services but do lack commitment towards H&S. They are concerned about earning a profit than the safety of the employees. They hire unskilled workers for skilful tasks, do not provide adequate personal protective equipment and resources to the workers and lacks good safety culture. That is one of the reasons small and medium-sized subcontractors have a high number of occurrences of the accidents.

7.3 Recommendations

Previous sections suggest that the Saudi Arabian construction industry is facing multi-faceted issues emerging from the government, employers, and employees. Reduction in the occurrence of accidents needs to be the priority of the organization. To achieve overall improvements in the safety performance of the Saudi Arabian construction industry, there is a need for different entities to take responsibility through initiating concrete measures at different levels by the government, construction companies and workers. In this study three-level recommendations are discussed which will enhance the safety performance of the Saudi Arabian construction industry. These three-level recommendations include government, construction companies, and employees.

7.3.1 Government

The government always has a significant role in the enhancing of H&S within the country. The government has the responsibility to make sure that occupational places are abiding by the country's rules and employers are taking care of the employees working within the workplaces. In the United States, the United Kingdom, and the European Union there exist specific frameworks and regulations related to H&S explaining the responsibilities of the employer and employees. Employers and employees are required to fulfil their responsibilities and regulatory authorities are making regular inspections to monitor the implementation of the regulations. In case there are some irregularities, fines are being imposed and further legal actions are being taken. Therefore, to avoid any legal actions or fines by the government employers as well as employees try to fulfil their responsibilities which eventually reduce the occurrence of the accidents and help in improving safety performance.

In Saudi Arabia, there are very basic H&S regulations which are mentioned in the ministry of labour laws. These H&S regulations have mentioned that employers need to provide safe working conditions to the workers and workers have to follow safety laws. However, it was mentioned in the results of the research study that employers and employees have limited knowledge and awareness about their responsibilities as mentioned in the ministry of labour laws. Most of the construction professionals do not know about the H&S regulations and the ministry of labour laws. Another issue is the lack of implementation of their ministry of labour laws including the employer's and employees' responsibilities towards safety. This lack of enforcement by the ministry of labour and limited inspections results in construction companies not fulfilling their responsibilities as they know the government is not going to have a regular check and balance on them resulting in feeling free to provide a safe working condition or not. It is seen that most of the organizations are not taking care of the H&S of the employees, as a result, it is contributing to the occurrence of the accidents. Therefore, the Saudi Arabian government must take responsibility and form the H&S regulatory body which will develop,

monitor and implement H&S regulations inside the country. In other countries such as, Malaysia, South Africa, Singapore development of the H&S regulatory body helped in ensuring right H&S regulations are developed and enforced which improved safety performance. Government H&S regulatory body should exist in every city having different H&S experts supervising the construction projects operating in their respective areas. Regular inspections by the Government H&S experts will slowly improve safety performance and raise the level of compliance and awareness. Fines and closure of sites should be used as a tool during any disciplinary cases.

It was mentioned in the results of the research study that Saudi Arabia as a country lacks safety culture as people relate accidents and actions to destiny and says that, "what is meant to happen will happen no matter how careful you are". Therefore, in Saudi Arabia, there is a need for the development of general safety culture among the occupational workforce. To create a safe attitude, behaviour, and perception among the construction professionals' government institutions must create safety awareness through advertisements, signboards, training, and seminars. Most of the mega projects in Saudi Arabia are government-owned and as a client in those projects, government officials need to ensure that their respective projects have H&S policies and procedures in place. In addition to that, the client must conduct regular meetings with the project officials in stressing the importance of H&S and monitoring the H&S performance of the project. In this way, project contractors will feel pressure to improve their safety practices and performance. Government-owned clients must conduct regular inspections and audits related to H&S and review the implementation of H&S standards.

7.3.2 Construction companies

Employers have a great responsibility in the provision of a safe workplace at the worksite for the employees. The safe worksite is possible only when there exists a strong safety culture in which all employees from top management to workers are committed to H&S. In Saudi Arabia, construction companies need to improve their organizational safety culture in which "Safety First" should not only be a slogan but there should be proper measures in place in the prevention of risks and safety of the employees. The provision of H&S at the workplace should be the top priority of the construction companies and to achieve that there should be zero tolerance to any personnel who try to harm the safety culture. Management needs to show positive commitment towards safety through actions as only words are not enough. Management needs to provide the required resources, safe working conditions, and raise safety awareness among employees. Employees follow the instructions of the senior management and if management is committed towards safety, employees will also follow their footsteps. When management says that safety is the priority and there is no compromise it means that whether there is pressure dealing with client requirements or cost still health and safety of all employees comes first without any compromise.

Senior management writes down their commitment towards H&S in organizational safety policy. It is important that safety policy must be realistic and is aligned with the safety culture of the organization. To achieve the targets of the safety policy senior management must assign resources and budget to ensure that a safe system of work, safety and work procedures and practices are in place. All activities at construction sites must fully comply with organizational H&S rules and procedures. Before the construction work begins at any construction site, the design is being built by the designer. The design of the project must also consider the hazards that are going to exist through the building phase, and hazards and risks must be controlled in the design phase.

Planning of an activity is an important part of a safe system of works. Many risks at the workplace can be minimized in the planning phase even before the initiation of the work. Management needs to ensure that the planning process is in place before the start of the activity. It is recommended that in the planning process safety officers are also part of, who will advise about the risk assessment associated with that activity and raise awareness about the risks and control measures. Risk assessment is an important element of risk management and each task must have specific risk assessment developed before the task is being initiated. Before the start of the work, adequate planning must be done by the management in which risks are being assessed and control measures are in place against those risks, required resources are in place, the workplace is safe enough to work, workers have required training and resources, workers are being communicated with the information related to risk assessment as workers must be aware of the risks associated at each task and before each activity.

Workers' unsafe behaviour is one important influencing human factor that compels them to work unsafely and break safety rules. Therefore, construction companies need to raise awareness of occupational health and safety and to sustainably improve health and safe behaviour. Awareness among employees at construction sites must be raised through safety signs installed at different places of the sites in the languages understood by the most workforce. Regular safety meetings must be conducted with senior management, line managers and safety officers in which safety issues are discussed and resolved. Safety officers and management needs to develop and communicate safety alerts when there are some unsafe conditions or incidents so that employees are aware of the situation and should take care of it. Supervisors have a very important role in keeping the workplace safe. In Saudi Arabia, inadequate or lack of supervision is a concern that is contributing to the occurrence of accidents. Construction companies must ensure that at each activity where there is more risk, supervisors are in place who ensure that the workplace is safe, and workers are following safety rules. At sites, where there are new workers adequate supervisors should be necessary as workers need more guidance and information. The supervisor needs to be provided task briefing to the workers. It is important that daily task briefing must be conducted in which workers are explained the risks and their control measures.

Training is of utmost importance in improving the safety performance in the construction companies. In the findings of the data analysis, it was visible that there is a lack of adequate

training in the Saudi Arabian construction industry. Therefore, there is a need for regular training conducting on various topics explaining the risks and control measures. Construction companies need to develop and implement training programs. The training program will provide guidelines, information and training topics that need to be carried out on a timely basis. This training program will help in tracking the training completed or pending. This training program should be updated on at least once a year and topics can be added which are needed depending upon project needs. Each worker when joining the company, it is mandatory that he/she must receive a safety briefing. It is important that this safety briefing must contain all required information in terms of safety rules, risks and their control measures, organizational safety policy and procedures and responsibilities of the employees. Furthermore, if there are workers who will carry out risky works such as, working at height or confined space there must be additional training conducted for them in which risks associated with such activities are explained. Another important point is the training material that is being utilized while conducting the training. It is usual that workers get bore to just see presentation so it is recommended that training material must be of different kinds such as PowerPoint presentations, and video training. After the training, it is important to know that whether workers have understood the training and one way of measuring is by having a quiz or exam. It is recommended to have either a small quiz or exam after the training and if the worker did not pass the exam, then he/she must be provided with the training again. It is recommended that the safety department conduct "Toolbox Talks" at least once a week for all workers working at the workplace. These toolbox talks must cover different topics depending upon the necessity at the workplace.

In Saudi Arabia, most of the works are being carried out by subcontractors. For different types of works, there are different subcontractors selected. The most common way of selecting the subcontracting is through a bidding process. In the bidding process, those subcontractors are preferred who provide low prices even if there track record of H&S is not good. These subcontractors who provided low price bids with no H&S commitment when selected and started to work, often work without fulfilling H&S requirements as for them they do not have enough budget for H&S. For these subcontractors earning maximum profit is the main goal and to do that they hire low salaried unskilled workers for skilful jobs and not providing necessary resources and safety equipment to the workers. These factors create many unsafe situations and contribute to the occurrence of accidents. Subcontractors must hire competent workers for skilful jobs and provide adequate resources depending upon the nature of the job. Besides, construction companies must understand the strong role of subcontractors in the enhancement of safety performance and should select the subcontractors that have good safety culture and are committed to the H&S of their workers.

Monitoring and inspections need to be performed regularly by the management and EHS officers to monitor the compliance of the employees and the subcontractors. A key element of managing hazards and risks will be pro-active procedures requiring HSE observations to be reported and actioned, plus a wide range of daily walk-downs, site tours, site inspections, and audits. It is

recommended that once a month senior management conduct safety walk at construction sites to understand the safety practices ongoing at the workplace and show commitment towards safety to all employees. The line manager must perform inspections every week by inspecting their work areas and subcontractors' activities and report it to Senior management and H&S officer. H&S Officer should conduct weekly tours of the work areas and subcontractors' activities and monitor the adherence to established rules and procedures. Project HSE representatives should conduct regular audits of the worksite to check compliance based on organisational EHS procedures and plans. Findings need to be shared with the site Project Manager and Project team during a meeting. Action plan to be prepared to contain all the necessary measures to be applied and sent to the responsible managers for the implementation.

The accident occurs in the construction sites, but the important matter is that the causes of the accidents are to be known so that the reoccurrence of the accidents can be stopped. The accident investigation is one important tool for identifying the immediate and underlying causes of accidents. All accidents or near miss must be informed, recorded and investigated as per the H&S procedures. The aim of the accident investigation must be to improve the existing practices and procedures in the organization not just blame and shame anyone. Management needs to respect the outcome of the accident investigation and should implement the recommendation mentioned in the investigation report. There is a need for a reward and penalization system in the construction companies. Awards are provided to those workers who work safely and provided with cash or gift which will give them more encouragement and motivation. Whereas, workers who do not comply with safety rules must be penalized with deduction in their salaries by these measure, workers will be more careful in the future in breaking safety rules.

7.3.3 Employees

Safety is everybody's responsibility and it can be achieved only when employees are committed to health and safety. Successful safety culture is possible through personal values, attitudes and the commitment of the employees towards safety. Workers' actions are influenced by their education, skills, behaviour, and beliefs. H&S policy mentions the responsibilities of the management and employees. The employees and management must fulfil their responsibility as they will be held accountable for it. All employees shall conduct themselves and execute their work safely and healthily. For a safe working atmosphere, the employees must cooperate with the organization in implementing the safety policies. An employee should adhere to safe working practices. Nobody should work in an unsafe place. Everybody should wear the required personal protective equipment (PPE), follow safety rules and practices, and inform the supervisors/safety officers about any unsafe conditions found at the workplace. Nobody should smoke in a non-smoking area. Trash cans should be used for littering, etc.

Most of the accidents can be prevented if employees follow the required safety procedures. Each employee must ensure their health and safety at work and needs to realize that their actions do not only affect their safety but also the safety of the workers working alongside them. Therefore, all employees must respect and comply with the required H&S rules and procedures. All site personnel is required to know and enforce the relevant requirements of the project regulations and safety requirements to ensure that they are observed. These rules and procedures are made to protect workers from accidents. Employees need to work safely even if no one is watching them because if some accident happened due to their unsafe actions, they will be the ones who will suffer. They will lose their time and money and even can hurt part of their body or suffer a fatality.

Supervisors need to set an example to the others in terms of their commitment to H&S. Supervisors need to fulfil their responsibilities and monitor work and ensure compliance with all H&S requirements and procedures and coach employees in safe practices. It is a moral responsibility that employees need to be taken care of each other when working in a team. If one worker is working unsafely then his co-worker must stop him from doing such actions. Experienced workers must correct the inexperienced workers who have limited knowledge or risky behaviour and bring awareness among them about the importance of working safely. Communication is vital at workplaces. If workers feeling uncomfortable because of the nature of the job or do not understand the procedures, they must speak about it with their line managers. All employees are responsible for reporting hazards, near-miss, and accidents/incidents. Line managers/EHS officers can help raise awareness of occupational health and safety which will improve health and safe behaviour.

7.4 Contribution to the knowledge

This study provided a methodological contribution to knowledge with the using mix methods by a combination of archival reports, interviews and questionnaire survey. This study examined and identified human factors that influence the occurrence of accidents in the Saudi Arabian construction industry. Human factors that are associated with the workers, task, and the workplace have been identified which will help in understanding the source of the accidents so that measures can be taken in the practical field to control those human factors that cause accidents. Accidents are occurring because there is no strict enforcement by the Saudi Arabian government of H&S regulations, a lack of organizational safety culture and management commitment and workers' unsafe actions. Hence, recommendations include government, construction companies, and workers. These recommendations will help the government, construction companies and construction professionals in understanding their responsibilities and implementing the control measures that need to be taken to improve the safety performance. Academically this study will provide knowledge related to human factors and fill the existing

gap in the literature by the identification of the human factors associated with workers, task and workplace that causes accidents in Saudi Arabian construction industry.

7.5 Limitations

This study was conducted in the western region of Saudi Arabia comprising of construction projects and professionals. There are mega projects ongoing in the other parts of the country and it is recommended that for future works, a research study to be conducted in the other parts of the country. In this study, accident reports of eight construction companies were studied. To achieve more extensive knowledge, it will be essential to include archival reports from more construction companies. Also, there is a need for more population of the respondents in the questionnaire survey and interviews.

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Appendixes

Appendix A

Participant Information Sheet

Research title: Influence of Human factors on the safety performance of the Saudi Arabian construction industry.

What is the purpose of the research?

This research aim is to enhance the safety performance of the Saudi Arabian construction industry by providing recommendations. This study aims to fill the gap that exists in the literature in terms of human-related accidents and human factors in the Saudi Arabian construction industry. This study will try to find the challenges that the Saudi Arabian construction industry is experiencing and will provide recommendations to overcome those challenges.

Why have I been invited to participate in this research?

To have an official answer based on the participant's experience in the field of construction and safety.

Is it compulsory to be part of this research?

No, being part of this research is solely your decision.

If I agree to take part in this research, what is the next step?

If you agree to take part in this research, kindly contact (Y.A., Tel: …….. E-mail: …….), and interview time can be arranged according to your feasibility to conduct the interview. The interview time duration will be around two hours. You have to complete the consent form.

Will I be paid to be part of this research?

No expenses will be paid for participating in this research.

As a participant, what I need to do?

Answering the questions with honesty.

Are there any potential risks of taking part in this research?

Semi-structured questions will be asked and there will be no risk for the participants.

Will my participation bring any benefits?

This research will benefit from your opinion, knowledge, and recommendations.

Will my information will be held confidential?

All information provided by you will remain confidential.

Am I free to withdraw?

You are free to withdraw from the study at any time without giving a reason.

Further information and contact details:

Thank you for your time. In case of any query, feel free to contact us.

Yours sincerely,

Y.A., PhD. Research Student.

School of the Built Environment
University of Salford
4th Floor, Maxwell Building
Room No. 413a
The Crescent
Salford, Greater Manchester
M5 4WT
Tel: ……...
E-mail: ……

Appendix B

Letter of Invitation for Participants

SUBJECT: Invitation to participate in research

Dear Sir/Madam,

My name is Y.A., I am currently studying Doctorate of Philosophy (PhD) at the School of the Built Environment, The University of Salford.

The research topic is about the Influence of human factors on safety performance in the Saudi Arabia construction industry. The research focus is to explore how human-related accidents occur in the Saudi Arabian construction industry and what are the human factors that cause human-related accidents. This research seeks to improve the safety performance of the Saudi Arabian construction industry by examining the challenges present in the industry and providing recommendations.

I am inviting you to participate in this research study either as an interviewee or by providing the accident reports. The interview time duration will approximately one hour. Ethical approval for this research has already been taken from the Ethics Committee of the University of Salford.

If you agree to participate in this research as an interviewee, kindly fill out the attached Participant Information Sheet. If there is any query about the research, I can be contacted: (Y.A., PhD Candidate, Phone …… Email: ……) or one of my supervisors (C.P. Email: …….).

It will be highly appreciated if you will be participating in this research.

Regards,

PhD Candidate

Appendix C

Research Participant Consent Form

Title of Project:

Ethics Ref No:

Name of Researcher:

No.		Yes	No
1.	Do you agree to participate in this research?		
2.	Did all the related information about the research is being explained to you?		
3.	Are you been allowed to ask questions about the research?		
4.	Do you agree that your interview can be audio-recorded?		
5.	Do you agree that your company accident reports being used in this research?		
6.	Do you understand all information that will be provided by you in this research will be treated confidentially?		
7.	Do you understand that in any report of this research, your identity will remain anonymous?		
8.	Do you understand that your participation is voluntary and you can withdraw from the research at any time without giving any reason?		

Participant Name: ……

Signature: ……

Date: …….

Researcher Name: ……

Researcher Email: ……

Appendix D

Questionnaire Survey

Questionnaire Survey

Dear participant,

You have been selected to participate in this questionnaire survey. We are interested in your opinions on role of human factors towards safety practices in the Saudi Arabian construction industry. This survey should take approximately 15 minutes to complete. Your participation is voluntary, and there are no wrong answers to the survey questions. If you agree to participate, you may skip any questions you don't want to answer, and you may stop answering the survey at any time.

Please feel free to skip any questions that you do not wish to answer. Please remember that all answers will be kept confidential

If you agree to participate in this survey, please continue with the questions below. Thank you.

1. What is your age?
Choose one option.

- ◯ 18-24 years
- ◯ 25-34 years
- ◯ 35-44 years
- ◯ 45-54 years
- ◯ 55+ years

2. What is your gender?
Choose one option.

- ◯ Male
- ◯ Female

3. What is your job role?
Choose one option.

- ◯ Senior Manager
- ◯ Midlevel Manager
- ◯ Engineer
- ◯ Supervisor
- ◯ Others

4. What is your construction professional experience?
Choose one option.

- ◯ 0-5 years
- ◯ 6-10 years
- ◯ 11-15 years
- ◯ 15-20 years
- ◯ 20+ years

5. What is the size of your organisation?
Choose one option.

- ◯ Small sized (0-50 employees)
- ◯ Medium sized (51-250 employees)
- ◯ Large sized (250 or more employees)

6. Do you have experience of managing health and safety?

Choose one option.

- ◯ Yes
- ◯ No

7. Do you think there is a relationship between human factors and the occurrence of the accidents in the Saudi Arabian construction industry?

Choose one option.

- ◯ Yes
- ◯ No

8. Have you experienced H&S (Health and Safety) issues due to human factors?

Choose one option.

- ◯ Yes
- ◯ No

9. How often have you experienced H&S issues due to human factors?

Choose one option.

- ◯ Always
- ◯ Sometimes
- ◯ Frequently
- ◯ Rarely
- ◯ Never

10. What are your satisfactory levels of the safety measures being applied in the Saudi Arabian construction industry?

Choose one option.

- ☐ Strongly not satisfied
- ☐ Not satisfied
- ☐ Neutral
- ☐ Satisfied
- ☐ Strongly satisfied

11. What is your satisfaction level with the H&S being applied in their organisation?

Choose one option.

- ☐ Strongly not satisfied
- ☐ Not satisfied
- ☐ Neutral
- ☐ Satisfied
- ☐ Strongly satisfied

12. What is your satisfaction level with the support management is providing in maintaining safety at workplace?

Choose one option.

- ☐ Strongly not satisfied
- ☐ Not satisfied
- ☐ Neutral
- ☐ Satisfied
- ☐ Strongly satisfied

13. **Do you think individual factors influence the safety performance in the construction sites?**
Choose one option.

- ◯ Yes
- ◯ No

14. **Do laziness causes the employees to neglect safety rules?**
Choose one option.

- ☐ Strongly do not agree
- ☐ Do not agree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

15. **Do negligence of the worker increase the chances of the accidents?**
Choose one option.

- ☐ Strongly do not agree
- ☐ Do not agree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

16. **Whether people take less concentration to safety due to having overconfidence?**
Choose one option.

- ☐ Strongly do not agree
- ☐ Do not agree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

17. **Do you agree that accident do not occurs in the first year of getting training as a worker is careful but as time passes than a worker gets more confidence and loses concentration so accident occurs?**
Choose one option.

- ☐ Strongly do not agree
- ☐ Do not agree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

18. **One reason worker doesn't care about safety because is because of unsafe attitude?**
Choose one option.

- ☐ Strongly do not agree
- ☐ Do not agree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

19. **Do shortcuts taken by the workers cause accidents?**
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

20. **Lack of attention occurs when workers are more focused on finishing the task than safety?**
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

21. **Whether laziness and carelessness are the reasons behind worker's lack of attention which often leads to accidents?**
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

22. **Incompetence of the workforce and lack of experience in Saudi Arabian construction industry is one of the reasons behind occurrence of accidents?**
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

23. **Workers having more education behave better than the workers having less education?**
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

24. **At your worksite, education of the workers is below high school?**
Choose one option.

- [ ] Strongly do not agree

- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

25. Is safety induction being provided to each new employee before start of the work?
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

26. One of the reasons behind accidents are untrained personnel?
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

27. Creating awareness among the workers is important in reducing the occurrence of the accidents?
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

28. Workers sometimes involve in unsafe practices when there is no supervision?
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

29. Whether proper supervision can help in reducing accidents?
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

30. Miscommunication between employees increase the risk of causation of accidents?

Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

31. One of the reasons of miscommunication that was pointed out by the interviewee participants were that in Saudi Arabian most of the workers are from different nationalities and sometimes do not speak or understand common language?

Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

32. Please select individual factors which are responsible for H&S issues that lead to accidents in the construction sites? Please select all those apply.

Check all that apply.

- [ ] Carelessness of the workers
- [ ] Workers' health issues
- [ ] Worker's non-compliance to safety rules
- [ ] Lack of attention
- [ ] Lack of working experience
- [ ] Shortcuts
- [ ] Overconfidence

33. Do you think factors with task and workplace influence the safety performance at the construction sites?

Choose one option.

- ◯ Yes
- ◯ No

34. Proper planning of work is necessary in reducing risks at the construction sites?

Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

35. Provision of lack of resources to the employee can leads to unsafe situation.

Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree

- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

36. Good safety culture enhances workers' attitude and beliefs towards safety?
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

37. Whether poor safety culture is one of the reason behind the occurrence of accidents in the Saudi Arabian construction sites?
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

38. Unsafe working condition is one of the causes of the accidents?
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

39. Suitable working/welfare conditions improve workers' attitude towards safety?
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

40. Role of the management is very important in maintaining safety?
Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

41. Lack of commitment from the management towards safety and management's priority on production over safety are the main reasons that hinders in the implementation of safety practices?

Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

42. One reason worker don't wear safety equipment is extreme hot weather conditions in Saudi Arabia?

Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

43. Provision of rest breaks and welfare facilities to the workers will help in improving worker's unsafe practices caused due to hot weather?

Choose one option.

- [ ] Strongly do not agree
- [ ] Do not agree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

44. In Saudi Arabia lack of health and safety regulations is one of the main barriers in improving safety performance in Saudi Arabia?

Choose one option.

- ◯ Yes
- ◯ No

45. At your construction sites whether government health and safety inspectors are visiting regularly to inspect safety and welfare conditions of the construction sites?

Choose one option.

- ◯ Yes
- ◯ No

46. Please select the factors associated with task and workplace which are responsible for H&S issues that lead to accidents in the construction sites? Please select all those apply.

Check all that apply.

- [ ] Lack of training
- [ ] Communication issues
- [ ] Lack of or inadequate supervision
- [ ] Unsafe working conditions
- [ ] Lack of proper planning
- [ ] Lack of resources
- [ ] Lack of awareness

- [ ] Pressure of work

47. Are you satisfied with the H&S practices applied in your company?

Choose one option.

- ◯ Yes
- ◯ No

48. Please tick the H&S practices being applied at your workplace.

Check all that apply.

- [ ] Newcomers are being provided with safety induction training
- [ ] Refresher trainings are being provided to staff on regular basis
- [ ] Required resources are available for each task
- [ ] Management and workers are committed towards maintaining safety
- [ ] Safety meetings are conducted on regular basis
- [ ] Awards and penalisation system are in place
- [ ] Working conditions are appropriate to work

49. Please rate the individual factors that you consider are most important to reduce accidents in Saudi Arabian construction industry.

Compliance to safety rules

Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Positive attitude and behavior towards safety

Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Rest

Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Good health condition

Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Following of work procedures
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Competence of workforce
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Attention towards safety while performing task
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

50. Please rate the factors associated with the task and workplace that you consider are most important to reduce accidents in Saudi Arabian construction industry.

Adequate supervision
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Regular awareness regarding safety
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Training of the workforce
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Realistic safety policy and its implementation
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Provision of required resources
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Proper planning prior to work
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Good organizational safety culture
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Management commitment towards safety
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Provision of safe working condtions
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Government commitment towards safety
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Award and penalty system
Mark only one oval.

	1	2	3	4	5	
Least important	◯	◯	◯	◯	◯	Most important

Appendix E

Interview Questions

1.	Do you think there is a relationship between human factors and the occurrence of accidents in the Saudi Arabian construction industry?
2.	Do you think individual factors influence the safety performance of the Saudi Arabian construction industry?
3.	Do you think factors associated with task and workplace influence the safety performance of the Saudi Arabian construction industry?
4.	Study of the accident report revealed that accidents are caused by various individual factors: **Shortcuts, Failure to follow work instructions, Not following safety rules, Unsafe actions, Improper use of machinery, Carelessness, Ignoring the warnings, Lack of attention, Overconfidence, Lack of working experience, and Health issues.** Please explain why workers are involved with such factors which lead to the occurrence of the accidents.
5.	Study of the accident report revealed that accidents are caused by various factors associated with the task: **Lack of communication, lack of training, lack of awareness, unsafe work methods, the improper procedure of work, lack of supervision, wrong instructions by a supervisor, the pressure of work, and the rush at work.** Please explain why these factors lead to the occurrence of accidents.
6.	The study of the accident report revealed that accidents are caused by various factors associated with workplace: **Unsafe working conditions, poor housekeeping, lack of planning, incorrect design, lack of personnel protective equipment, inappropriate materials, improper tools, and defective Machinery.** Please explain why these factors lead to the occurrence of accidents.
7.	What are the existing challenges and barriers the Saudi Arabian construction industry is facing in maintaining safe worksite?
8.	What measures can be taken to solve the challenges and barriers in the Saudi Arabian construction industry?
9.	What are your recommendations to reduce the occurrence of accidents in the Saudi Arabian construction industry?

Appendix F

Ethical Approval

Research, Innovation and Academic Engagement Ethical Approval Panel

Doctoral & Research Support
Research and Knowledge Exchange,
Room 827, Maxwell Building
University of Salford
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M5 4WT

T +44(0)161 295 5278

www.salford.ac.uk/

31 August 2018

Yasir Azmat

Dear Yasir,

RE: ETHICS APPLICATION STR1718-54: Influence of Human Factors on the Safety performance of the Saudi Arabian construction industry.

Based on the information you provided, I am pleased to inform you that your application STR1718-54 has been approved.

If there are any changes to the project and/ or its methodology, please inform the Panel as soon as possible by contacting S&T-ResearchEthics@salford.ac.uk

Yours sincerely,

APHigham.

Dr Anthony Higham
Chair of the Science & Technology Research Ethics Panel