ANALYSIS OF WORK-RELATED HEALTH AND SAFETY ACCIDENTS IN THE EMIRATE OF SHARJAH

by

Mohamed AlZarooni

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Declaration of Authorship

I declare that this thesis is my own work and, to the best of my knowledge and belief, it does not contain material published or written by a third party, except where permission has been obtained and/or appropriately cited through full and accurate referencing.

Signature: Mohamed Alzarooni

Date: 5-7-2021

Approval Signatures

We, the undersigned, approve the Master's Thesis of Mohamed Alzarooni

Title: Analysis of Work-Related Health and Safety Accidents in the Emirate of Sharjah
Date of Defense: 5-7-2021

Name, Title and Affiliation	Signature
Dr. Mahmoud Awad Associate Professor, Department of Industrial Engineering Thesis Advisor	
Dr. Ayman Alzaatreh Associate Professor, Department of Mathematics and Statistics Thesis Committee Member	
Dr. Vian Shawkat Professor, Department of Industrial Engineering Thesis Committee Member	
Dr. Moncer Hariga Head Department of Industrial Engineering	
Dr. Lotfi Romdhane Associate Dean for Graduate Affairs and Research College of Engineering	
Dr. Sameer Al-Asheh Interim Dean College of Engineering	
Dr. Mohamed El-Tarhuni Vice Provost for Research and Graduate Studies Office of Graduate Studies	

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Dedication

I dedicate this thesis to my family, friends, and loved ones wishing they would be proud of my achievements. I would also dedicate this work to my great and precious country, the UAE, and its leaders for always providing me with the opportunities and support needed to succeed in life.

Abstract

The United Arab Emirates has been growing at a rapid pace over the last few decades. This growth has led to development and prosperity across multiple sectors within the country. Along with growth, the risk of work-related safety accidents may increase in terms of occurrence and severity. In order to mitigate such a risk, the UAE government initiated and enforced laws and regulations to help reduce the number and severity of accidents. Yet, and despite the enforcement of such laws and regulations, the health and safety situation within industry sectors remains ambiguous and understudied. This has led to an increase in the number of work-related accidents occurring over the past few years with little to no explanation behind the main causes of such accidents. The aim of this thesis is to identify work-related accident causal factors and provide proposals for accident rates reduction actions. The methodology consists of two main stages: content analysis of accident reports and Confirmatory Factor Analysis (CFA). Content analysis is maintained by reviewing past accident reports provided by the UAE's Ministry of Health and Prevention. The analysis revealed that falls, injuries due to contact with sharp edges, and burns are the most frequent accident types. The CFA analysis revealed that training enhancement and total safety operating system are viable solutions to aid in controlling the frequency and effects of these accidents.

Keywords: Accidents, health and safety, frequency, severity, causes of accidents, United Arab Emirates (UAE), CFA

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Chapter 1. Introduction

1.1 Overview

This chapter presents background information about the United Arab Emirates (UAE), the construction industry within the UAE, and the occupational health and safety situation within the country. Additionally, this chapter covers the problem statement and the importance, aim, and objectives of this thesis. This will help readers prepare for the subsequent chapters and allow them to better understand and relate to the content of this research.

1.1.1 Background of the UAE. The United Arab Emirates is a federation composed of seven different emirates, which are Abu Dhabi, Dubai, Sharjah, Ajman, Ras Al-Khaimah, Fujairah, and Umm Al Quwain, that was formed in 1971. In the past few decades, the UAE underwent a huge transformation, thanks in part to the discovery of oil and the great strategies that were set by the government, which helped in elevating the country to one of the best worldwide [1]. According to the Institute for Management Development (IMD) World Competitiveness Yearbook of 2020, the UAE ranked ninth of all countries worldwide; additionally, the UAE is the only Arab country which has managed to maintain its rank in the top ten competitive countries for four years in a row [2]. As such, the nation's rapid development is also reflected positively across all sectors within the country. With the UAE's strategy to diversify its income and decrease its dependence on oil, many industries underwent a huge boom in terms of growth. One of the main industries that has witnessed a huge impact in terms of growth is the country's construction industry. The next section sheds some light on the construction industry in UAE.

1.1.2 The construction industry within the UAE. The construction industry is considered a large and robust industry in many countries around the world, especially the UAE [3]. The UAE have encountered a boom in the construction industry that started in 1996 and peaked by the year of 2007, before a sudden decline in the years of 2008 and 2009. This period of growth has led to prosperity in terms of construction projects; a variety of mega projects were introduced such as the tallest building in the world and the world's largest shopping mall [3]. Figure 1 provides a summary of work force population of UAE in 2014 by sector. The Figure suggests that construction workforce accounted for 20% of the entire work force, the highest of any other industry [4]. This large workforce reflected positively on the economy as the UAE's construction industry GDP accumulated to $33.2 billion in 2018, making it the largest of all gulf countries [5]. Yet, despite its positive contribution to the economy, the construction industry faces many challenges that are mostly related to the high volume of accidents and injuries occurring within the industry.

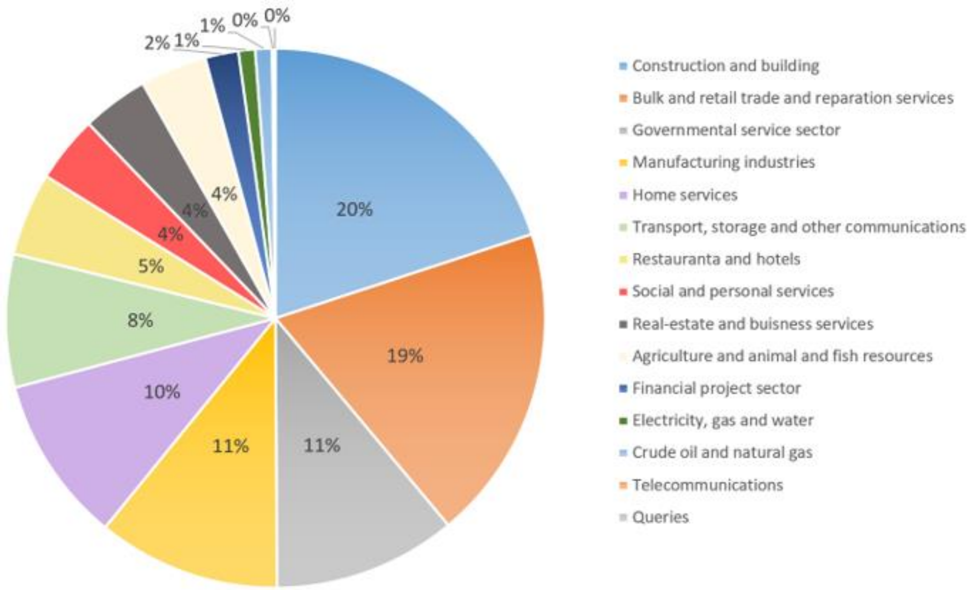

Figure 1: Relative Distribution of UAE's Employees per Economic Sectors in 2014 [1]

1.1.3 Occupational health and safety within the UAE. In order to mitigate the risks associated with the construction industry, the UAE's government issued many laws and regulations that are directed toward reducing accidents rates and enhancing the overall safety environment. For example, Chapter IV of the UAE Labour Law (FEDERAL LAW NO. (8) OF 1980) contains ten articles (Article 91 through 101) that highlight the importance of adhering to health and safety procedures within the workplace [6]. Yet despite these efforts, an alarming number of accidents occurred within the workplace. In 2019, approximately around 1,700 accidents were reported to The Ministry of Human Resources and Emiratization (MOHRE) in the emirate of Sharjah [7]. Additionally, the number of reported accidents does not reflect the actual amount of accidents occurring within the emirate, especially for entities that are not privately owned and registered under MOHRE [7]. Figure 2 depicts work-related accidents in the emirates of Sharjah in 2019 by sector. Numbers in the same figure suggest that the majority of the accidents occurred in the construction industry [7]. Additionally, according to MOHRE, the rates of injuries per 100 thousand worker have increased by around 42% between the years of 2018 and 2019 [7]. The lack of available statistics related to accident rates makes it difficult to understand the health and safety situation within the emirate. As such, it is important to investigate the situation within the emirate and analyze the proper scale of these accidents while simultaneously investigate the reasons behind these accidents.

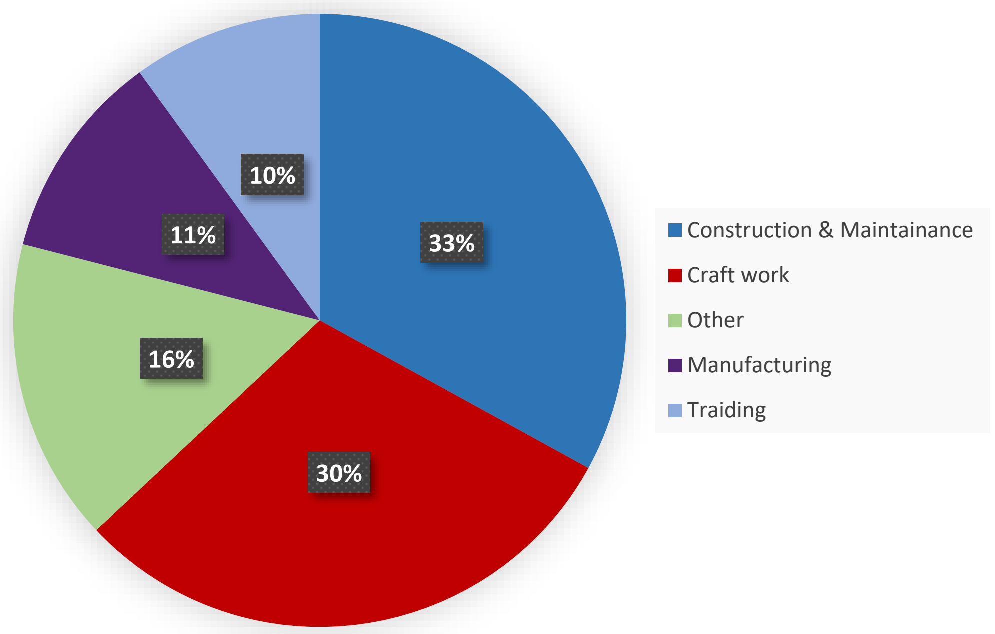

Figure 2: Composition of accidents within Sharjah in terms economic sector [7]

1.2 Problem Statement

Concerns regarding occupational health and safety have increased over the past decades, with workplace accidents being the driving force behind this increase in concerns. Work-related accidents can contribute to serious injuries and even cause fatalities in some cases. The International Labour Organization (ILO) estimated that 2.2 million individuals are killed each year as a direct result of work-related accidents; additionally, the ILO estimates that there are around 270 million non-fatal workplace accidents occurring on a yearly basis that have resulted in an injury [8], not to mention the direct and indirect financial consequences of such accidents. The UAE is one of the fastest developing countries in the world, where the construction industry in particular has witnessed a substantial boom in terms of project scale and volume. Due to this increase, the UAE has defined certain laws and regulations to properly monitor and regulate the occupational health and safety situation within the country, such as the UAE's labor law. Yet despite these efforts, there is no law in the UAE, or any of the Gulf states, that is specifically directed toward health, safety and welfare [9]. It is difficult to comprehend the entire situation within the country in terms of health and safety. Additionally, the number of work-related injuries and fatalities has increased in the last decade. According to the Health Authority of Abu Dhabi (HAAD), occupational injuries have accounted for 16% and 22% of all injuries occurring within the emirate of Abu Dhabi in 2007 and 2010 respectively. [10].

As mentioned earlier, the emirate of Sharjah in particular had an increase in accidents rates by around 42% between the years of 2018 and 2019, with the majority of those accidents (around 33%) occurring in the construction industry [6]. Based on this, the need to conduct research to analyze accident rates and their causes is of paramount value. One of the main reasons that have led to the creation of an ambiguous situation in terms of the number of occupational accidents occurring within the UAE is the lack of research being conducted to identify the root cause of accidents occurring in the workplace. Additionally, a more proactive approach is needed to prevent accidents rather than detect them. An identification of the root causes behind safety accidents is crucial in order to come up with recommendations on how to reduce the occurrence and impact of such accidents. For example, if 'lack of training' is found out as being a potential factor, then more regulations must be enforced to mandate health and safety training within the country. This research is one step towards examining root causes behind accidents in construction industry in the emirates of Sharjah.

1.3 Significance of this Research

The health and safety situation within the UAE has been steadily improving in the past years; however, occupational accidents and injuries are still considered a major contributor to morbidity, mortality, and economic loss within the UAE [11]. There is a clear lack of research in terms of the number of accidents occurring within the country and the overall health and safety situation. Additionally, the root causes of those accidents remain ambiguous, with no clear understanding of what factors are responsible for the occurrence of occupational accidents, or the impact that each factor has on those accidents.

This paper aims to identify the types of accidents occurring in the workplace and the underlying accident-related factors within the emirates of Sharjah by collecting and analyzing several accident reports followed by qualitative research based on surveying and interviewing subject matter experts. Additionally, the outcome of this research is to propose recommendations based on the identified types of accidents and their respective causes in order to reduce their occurrence. Identifying the major type of work-related accidents within the country will help in raising awareness in regard to occupational accidents, which will in turn help in delivering the full picture to stakeholders in order to apply any necessary actions. Additionally, identification of causes behind work-related accidents will further support the process of applying corrective action that would help in mitigating the risks associated with such accidents. Furthermore, by addressing the main factors contributing to the occurrence of occupational accidents, the number of accidents within the industry will decrease, which will lead to a better and safer work environment. Moreover, reduction of safety accidents will increase productivity and reduce the cost of construction organizations; this will ultimately result in boosting economy.

1.4 Objectives of this Research

The aim of this research is to identify the major types of work-related accidents and their causes within the emirate of Sharjah. Additionally, the following objectives are expected to be achieved within the scope of this research:

1- Identify the different threats and risks that occur within the workplace and the causes behind accidents in the emirate of Sharjah.
2- Collect and analyze accident-related data within the emirate of Sharjah to better understand the health and safety situation within the emirate.
3- Come up with different recommendations and potential solutions to enhance the health and safety conditions of the workplace within the emirate of Sharjah.
4- Present the results and findings of this research to the government to enhance health and safety procedures within the emirate of Sharjah.

Additionally, this research aims to answer the following two main questions:

1. What are the main types of accidents occurring within the workplace in the emirate of Sharjah?
2. What are the causes behind work-related accidents in the emirate of Sharjah?

Chapter 2. Literature Review

In this chapter, a literature review is conducted to gain better understanding of the accidents occurring in the construction industry and the possible reasons behind their occurrence. More details on surveyed literature is provided in the next sections.

2.1 Dangers within the Construction Industry

The construction industry is considered a high hazard field by many international bodies of occupational health and safety [12]. Additionally, the construction industry has a disproportionally high rate of accidents when compared to other industries [13]. The construction industry in Great Britain, for example, has averaged four times more fatality rates when compared to the all industry average over the last five years (2015 to 2020). Furthermore, the estimated cost of injuries in the year 2018/19 is around £659 million, and the industry has lost around 0.5 million working days as a result of injuries each year between 2017/18 and 2019/20 [14]. Another example can be seen in the U.S in 2004, where construction workers represented a mere 7.7% of the total U.S workforce, yet accounted for 22% of the nationally reported work related deaths [15]. In Saudi Arabia, the construction industry alone accounted for 51% of all accidents and injuries occurring in the private sector [15]. Based on reported statistics, it is evident that the construction industry is critical to the health and safety of workers, especially if no proper precautions are taken; moreover, the high rates of accident must be investigated in order to determine what different types of accidents can occur in the construction industry.

2.2 Types of Accidents in the Construction Field

The nature of work conducted in the construction industry is considered among the most dangerous on a global scale. Different accident types are associated with the construction industry [16-19]. As such, a significant body of research has been conducted to identify the different types of accidents related to the construction industry. Based on the surveyed literature, the most common types of accidents occurring in the construction industry are [20]:

- Falls from heights: according to Risser et.al. [21], falls from height can be defined as an unplanned drop of a body from one known point to another known point of impact. The greater the distance travelled, the higher the severity of the injury caused by the fall. Fall from heights are generally considered the main source of serious injuries and fatalities in the construction industry [19].
- Struck by falling/collapsing objects: this type occurs when falling/collapsing object hits another individual causing an injury to the person impacted by the falling object [20][22]. Some of the factors that affect the severity of the injury include the characteristic of the falling object, the speed of the object, and the distance traveled by the object.
- Struck by moving machinery or piece of moving machinery: this type occurs when a moving object or machinery hits a person. This may include workers being hit by a moving crane or those being run over by heavy equipment or vehicles [20][22].
- Electrocution: it occurs as a result of electrical arcs or as a result of contacting a power line by a person either directly or via a power tool [20][22].

After identifying the several types of accidents occurring within the construction industry, the causes behind these accidents must also be identified in order to fully understand the nature of these accidents. Furthermore, identifying the causes behind accidents in the construction industry will allow for better ways of control that can reduce the rates at which those accidents occur and enhance the safety conditions at the workplace.

2.3 Causes of Accidents Investigations

In order to identify the reasons behind the large number of accidents occurring in the construction industry, several studies were conducted. One study conducted by Khanzode et.al. [23] examined the history behind the development of theories related to the causing factors behind workplace related accidents. Khanzode et.al. reviewed several research papers that were conducted between the year 1919 to 2006 and categorized such literature into four different generations that highlight how people developed their look throughout the years.

The first generation introduces theories that are now seen as primitive or underdeveloped. Such theories include the ‘Accident proneness theory’, the ‘Unconscious motivated theory’, and the ‘Adjustment-stress and goal-freedom-alertness theory’. Such theories have all asserted that the main reason behind accidents actually relates to individuals conducting the work related-activity; and there are no other factors that might cause such accidents [23]. These theories have been severely criticized over the past years, yet they are still regarded as the first scientific theories approaching the reasons behind accidents [24]. It must also be mentioned that as these theories keep on evolving, the contribution of individual-related factors will still be carried out to next generations.

The second generation takes a completely different viewpoint with the introduction of the ‘Dominos theories’ which state that accidents are occurring as a result of sequenced events, and the removal of any of these events will prevent the accident from occurring [23]. The theory adds a second major factor to the causation of accidents, which is the job-related factors. The Dominos theory is still considered simple; it doesn’t completely cover the complex nature of a working environment. It also causes some generalization by focusing only on the events laid out in the sequence, while simultaneously keeping individual-related factors as the main cause of accidents [25]. As such, more theories were introduced in later generations to address the more complex nature of the workplace and tackle all issues related to the Dominos theory.

The third generation is focused on multiple factors; it introduced the ‘Injury epidemiology’ model. Derived from epidemics, injury epidemiology links injuries to disease via a compare and contrast process [23]. By doing so, the model identifies three important factors and links them to the causes of injuries that result from accidents. The three factors are the host (injured person), the agent (energy that leads to injury) and the environment (physical, biological, and organizational) [23]. For the first time since the introduction of the first generation, three external factors are taken into account evenly when identifying what causes accidents; however, it must be mentioned that all three factors are elements of the Job-related factor. Additionally, the approach itself is quite linear as it relatively links all aspects of disease with injuries, yet dose not highlight the systematic nature and complexity of the working environment beyond the Job-related factor. Thus, the same factors introduced in the previous generations remain unchanged.

The fourth and last generation highlighted by Khanzode et.al. introduces the 'System theories', which include both the 'STS theory' and the 'Macroergonomic theory'. System theories consist of complex integrated systems that include individual-related factors, job-related factors, and organizational-related factors as the main causing factors behind any accident [23]. The unique approach that system theories provide allows for the correlation and linkage of multiple factors to the causation behind different types of accidents. The Socio-Technical System (STS) Theory is a holistic framework that allows for the understanding of the entire organization by looking at its interrelated and inseparable subsystems [26]. This means that a change in any subsystem within the organization will in fact have an impact on the organization as a whole. By studying different subsystems within an organization and measuring their effect on the overall accident rates, STS can be used effectively in identifying and linking many accident causing factors that were harder to identify through past generation theories [26].

The introduction of theories through different generations shows that accident-causing factors have long been studied. Additionally, the way these factors are identified and linked is also developing as time goes by [23]. This means that throughout the years, many different factors were introduced and discussed. As such, the identification and listing process of these factors is open for interpretation, which is supported by the wide variety of factors introduced throughout the years. In order to properly identify the root causes of work-related accidents, these factors must be looked at and categorized. The three main factors introduced in the research conducted in the fourth generation will be taken into consideration when creating the accident causing factor's main categories.

2.4 Accident-related Factors

From the previous section, three main work-related factors are identified. The three main factors related to accidents are individual-related factors, job-related factors, and organizational-related factors. Individual-related factors are related to actions performed by an individual that lead to the occurrence of an accident. For example, the improper use of protective personal equipment (PPE) as a result of the worker believing that he is fearless and bold [27]. Another example that can be considered as individual-related factor is for a worker to be affected by stress due to non-work variables. These variables can include having financial problems, being exposed to domestic, or experiencing a traumatic incident out of work [27]. Individual-related factors can also be identified as worker factors; in other words, they are all issues related to the worker's actions, behavior, attitude, and motivations that can contribute to causing an accident [28].

Job-related factors can be identified as all factors that are associated with the nature of the work being conducted and that can lead to an accident. These factors can include the high risk associated with conducting a construction process, the risks associated with using a construction tool or materials, and even the place at which the work process is being carried out [29]. An example of Job-related factors can be seen when handling tools that require physical effort to utilize at construction sites. Furthermore, being subjected to prolonged periods of physical stress can lead to the development of musculoskeletal disorders; this will in turn lead to injuries and accidents in the workplace [30]. Job-related factors can also be attributed to the environment in which the work is being conducted. For example, when construction projects are performed in a high temperature area, workers can suffer from heat strokes that may result in them losing consciousness.; this may eventually result in an accident on site [31]. Although the nature of a workplace can have high temperature, several control methods can be used to reduce the risk arising from such factor, and thus the management handling the construction site can be held responsible if necessary procurements that reduces temperature are not available. This introduces the next factor which is the organizational-related factors.

Organizational-related factors are factors that contribute to accidents as a result of the organization's structure, policies, and processes. Arocena et.al. [32] further divided organizational factors into three sub-categories that are related to the quality management tools utilized by the organization, the technology and process implemented by the organization, and the level of worker's empowerment provided within the organization. In order to better understand the concept of organizational-related factors, one can identify them as actions and policies conducted by an organization that can lead to accidents. Some simple definition is presented by Salminen et.al. in which organizational factors were defined as "structural factors in the work community which either directly or indirectly influence the occurrence of accidents" [33]. However, this definition can in fact be used for all accident causation factors and is not limited to factors related to the organization; this justifies the difficulty presented when trying to define those factors. As such, the three main factors introduced in the fourth generation of research can be iterated differently from one person to another; additionally, the way the factors are grouped is subject to variation from one iteration to another.

Since there are many factors that can contribute to the causation of accidents in the workplace, researchers tried to group related factors into subgroups to make more sense of these factors. Although groupings of those factors may vary, the factors that are grouped often remain the same regardless of how they are grouped. As such, it is important to identify those factors on an individual level when trying to pinpoint the root cause of any accident. Table 1 below shows the summarized findings of accident casual factors.

Table 1: Summary of Literature review

#	Ref.	Year	Country	Industry	Analysis Methodology (CFA/ SEM/KM/ AFA)	Sample Size	Response	Main Cause
1	Khan et. al. [34]	2019	Pakistan	Construction	Modified-SIRA	22 Experts	Expert's Opinion	Lack of Resources
2	Betsis et. al. [35]	2019	Greece	Construction	Descriptive analysis	413 accident reports	Mortality rate Type of accident Type of Injury	Lack of Experience
3	Behera et.al. [37]	2019	India	Industrial (Mining)	Data analysis using software	982 fatal accident reports	Mortality rate Type of accident	Lack of training
4	Al-Khaburi et.al. [38]	2018	Oman	Construction	Descriptive	5 accident reports & 40 experts	Type of accident Expert's Opinion	Lack of training
5	Fass et.al. [39]	2017	Arabian Gulf	Construction	HFACS	519 accident reports & 22 experts	Mortality rate Type of accident Type of Injury Expert's Opinion	Lack of training
6	Williams et.al. [40]	2019	Ghana	Construction	Simple Random Sampling & Scalogram Analysis	184 surveys	Expert's Opinion	Bad Practices
7	Zhang et.al. [41]	2016	China	Industrial (Mining)	SEM	320 accident reports	Mortality rate	Lack of training
8	Duryan et.al. [42]	2020	UK	Construction	KM	43 expert	Expert's Opinion	Lack of training

2.5 Causes of Accidents in the Construction Industry

In order to identify the procedure to be used in identifying the root cause of work-related accidents within the emirate of Sharjah, similar research conducted in different countries across the globe are studied. Table 1 provides a summary of the findings presented by the different studies reviewed.

In a case study conducted by Khan et. al. in 2019 [34], the hazards that were caused in the construction industry in Pakistan were identified, weighted, and then ranked based on the score of their respected weight. The weighted criteria of each hazard was based on its probability of occurrence (O), severity (S), and probability of detecting that hazard (D). The case study ended up identifying 15 different types of hazards and also showed that the deficiency of Personal Protective Equipment (PPE) ranked the highest out of all the hazards identified. A summary of all the hazards identified and their ranking can be seen in Table 2 below [34].

Table 2: Hazards list and ranking [34]

Criteria	O	S	D	RPN	Ranking
C7: Deficiency of PPEs	0.8	0.7	0.6	0.336	1
C3: Electrocution due to electrical equipment	0.6	0.8	0.5	0.24	2
C8: Improper use of PPE	0.9	0.5	0.5	0.225	3
C1: Work at height	0.5	0.6	0.7	0.21	4
C2: Suspended objects	0.6	0.5	0.6	0.18	5
C6: Slippery floor due to liquids	0.8	0.2	0.9	0.144	6
C5: Protruding nails from the objects	0.5	0.3	0.9	0.135	7
C4: Impalement due to sharp edges	0.4	0.4	0.8	0.128	8
C15: High pressurized gas cylinders	0.4	0.8	0.3	0.096	9
C10: Absence of guards around the cutters	0.4	0.6	0.4	0.096	10
C11: Bare electrical wires	0.3	0.7	0.4	0.084	11
C14: Improper safety measures near power generators	0.2	0.7	0.3	0.042	12
C12: Improper communication	0.3	0.3	0.4	0.036	13
C9: Improper way of handling construction materials	0.3	0.2	0.4	0.024	14
C13: Improper use of scaffolding	0.2	0.2	0.3	0.012	15
TRPN				1.988	

The weighted criteria used in the ranking system, RPN, is the product of all three criteria that are related to each hazard. One of the main issues highlighted by the case study is the fact that many construction companies deliberately neglect any distributions of safety related equipment, i.e. PPEs, or do not provide proper training on how to use them in order to save on costs. This issue is truly concerning in developing countries, in which resources are scarce and the enforcement of OHS laws are much more lenient when compared to developed counterparts. Another concern raised when critiquing this case study is the fact that precise data related to accident rates and causes is hard to get. This is clearly highlighted when inspecting the way the weighted score of each hazard was placed. Rather than relying on historical data related to accidents, the weights were placed by a team of 22 experts in the construction industry of Pakistan. The case study itself addresses this issue by considering it as a limitation and recommending additional data to be collected in future studies.

Another study focused on data analysis rather than relying on experts' opinions, in which the accident reports from the construction industry in northern Greece were analysed [35]. The study examined 413 accident reports that occurred between 2003 to 2007. Additionally, several individual-related variables, such as Age, Gender, and Experience, were compared to incident-related variables, such as Type of Accident, Type of Injury, and Mortality in order to create correlations between the variable types. The methodology used incorporated the use of a software tool developed by IBM and known as SPSS, which is mainly used to perform complex statistical analysis on a set of collected data [36]. The data collected were then divided into two categories, those related to workers as an individual, and those related to accidents as an event. A descriptive analysis was then conducted on the defined sets of data, followed by a correlation analysis to link accidents to their causes and identify different correlations among different variables. The main results obtained from the analysis showed that 68% of all accidents occurred to inexperienced individuals who were new to the construction industry (experience < 12 months), which lays emphasis on the need to educate and train workers on occupational health and safety measures within Greece. The study also showed that most accidents occurred in summer, which is expected due to high temperatures, and that the most common type of incidents were falls from height. The study concluded by offering several recommendations which included: promoting education and training in health and safety on the part of companies, enforcing stricter legislations related to health and safety on the part of governments, and the need to conduct further studies to identify the causes of construction related accidents within different regions of Greece.

This approach of data analysis can also be found in different industries and different regions throughout the world. A study focused on India's mineral rich state of Odisha and covered the mining industry, examined fatal accidents occurring in the industrial sector over the period of 16 years (from 2001 to 2016) [37]. A sample size of 938 fatalities were collected from different factories throughout the state. Similar to the case study mentioned earlier, a statistical software was also used to analyze the collected data. The software packages used to conduct the analysis includes R, SQL, MS-Excel and Tableau. Yet, no detailed explanation was given on how the analysis was conducted. Another similarity to the above-mentioned article is that the most common type of accident was once again fall from height (23.94%) and that most accidents occurred during the summer season (37.6%). The study also examined two detailed incident reports that resulted in fatalities due to electrocution and explosion. The accidents resulted from lack of training in OHS and the use of poor safety management systems. The consequences of these accidents were devastating; operations were suspended for two months; two senior executives were apprehended as a result of neglecting their duties. However, some good lessons were learned from the two accident reports. For example, after the electrocution accident, the standard operating procedure (SOP) related to electrical work was revised and turned into video and audio clips that were later used throughout the state of Odisha. The case study reflected on the importance of having proper training and better enforcement for OHS practices, and the need to study past incidents and accidents to come up with future recommendations that will greatly enhance current OHS practices.

Another study, conducted in Oman, combined both data analysis and expert's opinion by inspecting the accidents history of two firms while also taking experts' opinion through a questioner to identify the root cause of accidents in the construction industry [38]. The methodology undertaken in the study was to review five accident reports from two well-known construction companies and inspected similar pattern behind the accidents caused in these reports. The results obtained from analysing the accident reports showed that there are five main causes of accidents, which are poor instruction by the supervisor, lack of worker training, poor equipment maintenance, lack of worker awareness, and finally, underestimation of dangers by workers. The study also analysed the response of 40 individuals working in many construction firms within Oman; additionally, a Likert scale tool was used to identify the main reasons behind the causes of accidents. The results of the questioners showed that the main contributors to accidents were mainly due to lack of awareness in health and safety, poor conditions of scaffolding, lack of health and safety warning signs at the construction site, and lack of safety consideration by site supervisors. Again, the pattern of not having enough education and training in OHS is reflected in the causes of accident; additionally, lack of low enforcement and regulations in OHS is also present in Oman. The study shows that most of the previous issues of OHS that are occurring in developed countries are also found in the Arabian Gulf area. However, it must be mentioned that unlike previous studies, the methodological approach used is simple; it lacks the complexity that was used in different studies.

Another study done in the Arabian Gulf region (UAE, Saudi Arabia, Bahrain, Oman, Kuwait, and Qatar) also focused on both data analysis and expert's opinions in order to determine the causes of accidents. Firstly, 519 accident reports from 15 building sites were collected and analyzed [39]. Human Factor Analysis and Classification System (HFACS) was used to analyze the data; it showed that the largest type of accidents was fall from height and struck by falling objects, which accounted for 27.8% of accidents. In addition, 41.1% of the two mentioned types of accidents resulted in severe injuries and 10.3% were fatalities, which highlights the extreme danger that is caused because of these types of accidents. The second part of the study consisted of interviews that were conducted to 22 safety engineers in the Gulf region with an average experience of 8.5 years in the industry. The aim of the interview was to identify eight main causes of fall from heights and struck by objects accidents, and to then rank these causes based on which is more likely to contribute to these accidents. The eight main factors were identified to be worker experience, task duration, worker training and skill level, knowledge of regulations, risk perception, use of safety gear, deviation from normal work standards and prior experience with accidents. Worker skills and training was ranked as the most likely factor to cause these accidents, followed by worker experience. Once again, lack of training is highlighted as a main contributor in causing accidents in the construction industry, yet it must be mentioned that, similar to the last article, the analysis conducted on the set of data lacked an applied scientific methodology and relied mostly on experts' opinion.

The lack of utilizing an applied scientific approach when analyzing data sets could result in mixed results, especially if the analysis relied more on an expert's opinion. In Ghana, a different type of study was conducted to determine the maturity of the OHS culture within the country and to look at the main reason behind the causes of accidents in the construction industry [40]. A sample size of around 184 respondents working as contractors in the Ghanaian construction industry was questioned via a survey in order to determine what they thought to be the main issue with OHS within the industry. The analysis tool used was a Scalogram, which is a one-dimensional measuring analysis technique that collects responses as either "Yes" or "No" in order to determine on different concepts. Their responses showed that the main reason (around 56% of responses) was due to pathological drivers such as people not caring about applying the system or only applying it when surveillance is present within the site, which comes under the bad practices part. Similar to the previously mentioned studies, the analysis relied mostly on experts' opinion using a questionnaire; however, as the approach differs, and as the sample being questioned is different, the conclusion is also different. The main blame this time is directed toward people with more emphasis set toward applying better OHS laws and regulations rather than promoting training and workshops.

A study conducted in china showed that the mining industry also suffered due to lack of proper training and lack of compliance with OHS procedures [41]. The study applied a systems analysis approach using structural equation modelling (SEM) to identify the main causes of fatalities in the industry; In addition, 320 coal mines accident cases, occurring between 2005 to 2010, were chosen as main test sample of the study. The result of the SEM analysis showed that the main reason of fatalities was due to lack of safety education and training, followed by inability to implement OHS rules and regulations.

Accidents in the construction industry are not limited to developing countries; in fact, developed countries, such as the UK, also suffers from high losses due to those kinds of accidents. In a study conduct in 2020, 43 different individuals working in the

OHS field were interviewed to apply Knowledge Management (KM) to identify the main causes of accidents in the construction industry within the UK [42]. The result of the interview showed that many small and large companies suffer from accidents although they are having strong OHS approaches and competent professions. The reason for this is that no proper KM is applied, something that results in lack of implementation of OHS principles in the actual workplace environment. The study also emphasized the importance of transferring OHS knowledge that is gained from training and experience, as it is often a difficult thing to implement.

The findings of the literature review showed that most of the research that is being conducted relies on reviewing past accident reports, interviewing experts in the field, surveying individuals working in the field, or a combination of two or more methods. Additionally, the literature reviewed suggests that the majority of available research relies mostly on simple analysis rather than conducting in depth analytical methods to analyze the data at hand. Furthermore, there was a clear gap in terms of research conducted within the UAE to identify accident causation factors. As such, it is important to identify the different factors that were inspected during the different studies before moving on with a more in-depth review of the analysis methods that can be used to analyze data sets.

Throughout the literature reviewed, many accident-causing factors were identified [34-42]. These factors were grouped into five different categories, three of which are introduced in the fourth generation of accident causation theories [23], and two additional categories were used to help in differentiating the different types of factors. The five different categories are:

- Organization-Related Factors: factors that are directly or indirectly related to all action, decisions, and policies of an organization. These factors can include failure to provide efficient safety regulations in the workplace, pressuring individuals to overwork, or not providing required resources to conduct work.
- Individual-Related Factors: factors that are directly or indirectly related to the actions or conditions of an individual conducting the work. These factors can include not following proper procedures or having a poor state of health.

- Job-Related Factors: factors that are related to the dangerous nature of the work being conducted. These factors can include dealing with dangerous material with high risk output or working in an unsuitable place of work such as an elevated plane or an underground trench.
- Environment-Related Factors: factors that are related to the outside environment of the workplace and are hard to control by either the organization or the individual. These factors can include high temperature, violent winds, or even natural disasters.
- Other Factors: factors that do not fall under any of the previously mentioned categories. Those factors can include government regulations or the health and safety culture of an entire community.

Table 3 shows the factors obtained as a result of the literature review. Thirty-seven different factors were identified in total, with 11 factors falling under the organization-related factors, 12 factors falling under the individual related factors, 7 factors falling under the job-related factors, and 3 factors falling under both environment-related and other factors respectively. These factors will prove critical when carrying on with the methodology, as they will be used as the initial building blocks to conduct all required data analysis.

Table 3: Accidents Casual Factors from Literature

Category	#	Factor	Literature Sources
Organizational-Related Factors	1	Lack of Training	(Khan et.al., 2019), (Betsis et.al., 2019), (Behera et.al.,2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017), (Zhang et.al., 2016), (Duryan et.al., 2020)
	2	Unavailability of Warning Signs	(Khan et.al., 2019), (Zhang et.al., 2016)
	3	Ineffective Safety Rules and Regulations	(Khan et.al., 2019), (Betsis et.al., 2019), (Behera et.al.,2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017), (Williams et.al., 2019), (Zhang et.al., 2016)
	4	Provision of Faulty Appliances	(Khan et.al., 2019), (Behera et.al., 2019), (Zhang et.al., 2016)
	5	Unavailability of Equipment or Machinery	(Khan et.al., 2019), (Behera et.al.,2019), (Fass et.al., 2017), (Zhang et.al., 2016)
	6	Unavailability of PPEs	(Khan et.al., 2019), (Fass et.al., 2017), (Zhang et.al., 2016)
	7	Lack of Proper Maintenance	(Khan et.al., 2019), (Behera et.al.,2019), (Al-Khaburi et.al., 2018)
	8	Lack of Safety Rules and Regulations	(Khan et.al., 2019), (Betsis et.al., 2019), (Behera et.al.,2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017), (Williams et.al., 2019), (Zhang et.al., 2016)
	9	Pressuring employees to overwork	(Behera et.al.,2019), (Fass et.al., 2017), (Williams et.al., 2019)
	10	Ineffective Monitoring and Enforcement on Site	(Betsis et.al., 2019), (Behera et.al.,2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017), (Williams et.al., 2019), (Zhang et.al., 2016)
	11	Not Providing Basic Requirements to Workers	(Fass et.al., 2017)
Individual-Related Factors	12	Lack of Awareness with Procedures	(Khan et.al., 2019), (Behera et.al.,2019), (Al-Khaburiet et.al., 2018), (Fass et.al., 2017), (Williams et.al., 2019), (Zhang et.al., 2016)
	13	Improper Communication	(Khan et.al., 2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017), (Zhang et.al., 2016)
	14	Improper Use of PPE	(Khan et.al., 2019), (Betsis et.al., 2019), (Behera et.al.,2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017), (Zhang et.al., 2016)
	15	Poor state of Health	(Khan et.al., 2019), (Fass et.al., 2017)
	16	Improper Handling of Materials	(Khan et.al., 2019), (Fass et.al., 2017), (Zhang et.al., 2016)
	17	Use of Damaged Equipment	(Khan et.al., 2019), (Behera et.al.,2019), (Al-Khaburi, 2018), (Zhang, 2016)

	18	Failure to follow procedures	(Khan et.al., 2019), (Betsis et.al., 2019), (Al-Khaburi, 2018), (Fass, 2017), (Williams, 2019), (Zhang, 2016)
	19	Contact with dangerous items	(Behera et.al.,2019)
	20	Intentionally Following Bad Practices	(Behera et.al.,2019), (Al-Khaburi et.al., 2018), (Williams et.al., 2019), (Zhang et.al., 2016)
	21	Failure to Identify Dangerous Situation	(Betsis et.al., 2019), (Behera et.al.,2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017), (Zhang et.al., 2016), (Duryan et.al., 2020)
	22	Overworking	(Betsis et.al., 2019), (Fass et.al., 2017)
	23	Unskilled Workers	(Al-Khaburi, 2018), (Fass et.al., 2017), (Williams et.al., 2019), (Zhang et.al., 2016)
	24	Lack of Experience	(Betsis et.al., 2019), (Al-Khaburi et.al., 2018),(Fass et.al., 2017), (Zhang et.al., 2016)
Job-Related Factors	25	Falling of Objects	(Khan et.al., 2019), (Betsis et.al., 2019), (Behera et.al.,2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017)
	26	Failure of Equipment	(Khan et.al., 2019), (Betsis et.al., 2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017), (Zhang et.al., 2016)
	27	Failure of Machinery	(Khan et.al., 2019), (Betsis et.al., 2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017), (Zhang et.al., 2016)
	28	Task Duration	(Fass et.al., 2017)
	29	High Level of Noise	(Betsis et.al., 2019)
	30	Dealing with Dangerous Material	(Behera et.al.,2019), (Zhang et.al., 2016)
	31	Unsuitable Workplace	(Betsis et.al., 2019), (Fass et.al., 2017), (Zhang et.al., 2016)
Environmental-Related Factors	32	High Temperature	(Khan et.al., 2019), (Betsis et.al., 2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017)
	33	Strong Wind	(Khan et.al., 2019), (Fass et.al., 2017)
	34	Struck by Lightning	(Khan et.al., 2019)
Other Factors	35	Lack of government enforcement	(Betsis et.al., 2019), (Behera et.al.,2019), (Al-Khaburi et.al., 2018), (Fass et.al., 2017), (Williams et.al., 2019)
	36	Unforeseen Events	(Al-Khaburi et.al., 2018)
	37	Poor Health & Safety Culture of Community	(Al-Khaburi et.al., 2018), (Fass et.al., 2017), (Williams et.al., 2019), (Zhang et.al., 2016), (Duryan et.al., 2020)

2.6 Discussion of literature review

The findings from the literature review show that there are different types of accidents occurring within the workplace. Additionally, those types of accidents can have a varying impact in terms of both the frequency at which they occur and the severity of the injury they cause. As a result, accident types can be ranked in terms of frequency and severity by labeling accidents with higher frequency and severity as more impactful when compared to other accidents with lower impact. This can be used to rank different types of accidents in order to answer the question as to what the main types of accidents occurring within the workplace in the emirate of Sharjah are. Moreover, the findings of the literature review also revealed that there is a large number of work-related accident causing factors, and that these factors diversify depending on different regions or industries. In order to answer the question of what the causes behind work-related accidents in the emirate of Sharjah are, these factors must be analyzed, and their impact in terms of causing accidents must be identified. Furthermore, the methodology behind identifying the main types of accidents and the causes behind work-related ones are discussed in the following chapter.

Chapter 3. Methodology

In this chapter, the proposed methodology adopted to identify the factors behind work related accidents in the emirate of Sharjah is presented, including data collection plan. Figure 3 depicts main steps in the proposed methodology.

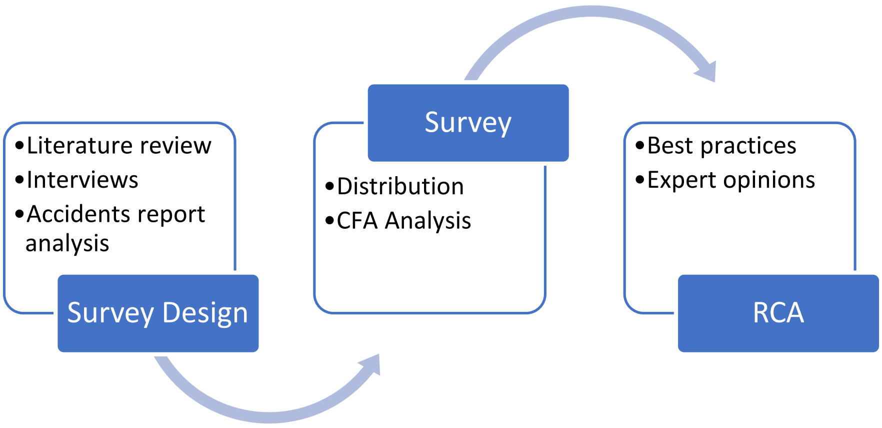

Figure 3: Proposed methodology

3.1 Proposed Methodology

The first step entitles surveying existing research to identify the main accident causing factors and the interrelation between those factors. The second step will be the data collection phase, in which work-related accident reports will be collected from governmental entities; additionally, surveys and interview will be conducted to measure the contribution of the factors introduced in the literature. The interviews will be done with several health and safety experts to seek their opinion on potential factors impacting the occurrence and severity of accidents in construction industry. The survey will be targeting construction companies' management and supervision personnel. Following the acquisition of the data, two main types of analysis will be conducted. The first type of analysis will follow a quantitative approach in which the data obtained from work-related accident reports will be reviewed and analyzed. The second type of analysis will involve a qualitative approach by reviewing the opinion of experts and workers involved in both the interviews and survey. Additionally, a factor analysis of the data will be conducted to identify the impact of the leading factors contributing to work-related accidents and to also understand the relationship better between those factors. After the completion of the analysis, a confirmation process of the analysis will be conducted via different techniques and methods. Finally, recommendations of corrective actions (RCA) and solutions will be presented to help in reducing accident occurrence and severity.

3.2 Data Collection Method

The main source of data to be collected comes in the form of work-related accident reports to be collected from the Ministry of Health and Prevention (MOHAP) in the UAE, which will be of quantitative nature. In order to acquire those reports, some documents are to be submitted to MOHAP as seen in Appendix 1; additionally, an approval must also be obtained from MOHAP research Ethics Committee. The expected data to be collected from those reports includes:

- Type of injuries
- Cause of injuries
- The time at which the injury occurred
- Background information related to the injured personnel, such as age, gender, nationality etc.
- Industry sector of company
- Size of company in terms of number of employees.

Another set of data, with a qualitative nature, will also be collected from surveys and interviews that target OHS experts or individuals working in different industries. The survey will consist of two parts, with the first part focusing mainly on the demographic aspects of the person answering the survey and the second part will focus on measuring the impact of each factor. Similar to the surveys conducted by Promsorn et.al. [43] and Zhang et.al. [44], the first part of the survey will include questions related to the person's age, experience in the field, position in the organization, knowledge of safety aspects, and the type of education received. The surveys will mainly be used to measure the relationship between the accident causing factors (found in Table 3) introduced in the literature using a Likert scale. Similar to the study conducted by Khan et.al. [34], each factor will have two different indices which are used to measure the impact of these factors. The two indices to be used are the probability of occurrence (O), and the severity of accidents (S), with each index scaled from 0 to 1. The survey will include two different five-point Likert scales in order to measure the severity and frequency of accidents which are explained below:

Probability of Occurrence (O) Scale from 1 to 5:

1. Extremely Unlikely to Occur
2. Unlikely to Occur
3. Can Occur
4. More likely to Occur
5. Extremely Likely to Occur

Severity of Accident (S) Scale from 1 to 5:

1. No Impact
2. Low Impact
3. Moderate Impact
4. High Impact
5. Very High Impact

Following the construction of the survey questions, a pilot survey will be conducted to better refine the questions and the overall survey's layout. Following that, the actual survey will be conducted following a snowball approach that will be directed towards the highest number of individuals that can participate over the period of conducting the study in order to better reflect the different working conditions presented in the workplace. Additionally, the sampling strategy will be directed towards representing the actual workforce presented within the emirate of Sharjah. As such, the sample characteristic is expected to include workers from different industries, representing different organizations, assuming different jobs, having different work experience, and having undergone different levels of training. Following the collection of data, the collected data will be digitally inputted to conduct the analysis phase.

3.3 Data Analysis

After obtaining the accident reports, an in-depth data analysis will be conducted using the Exploratory Factor Analysis (EFA) method. A literature review will be conducted to better understand the EFA method and the manner it will be utilized to conduct the analysis on the collected set of data. In order to better understand the collected data, three measuring indices will be utilized as follow [45]:

- Occurrence Index (OI): This index measures the probability of occurrence of each factor. This means that if a factor with an O score of "1" is extremely unlikely to occur whole a factor with an O score of "5" is extremely likely to occur. The equation used to measure this index is:

$$OI = \frac{(n_1+2n_2+3n_3+4n_4+5n_5)}{5N} \quad (1)$$

N: The total number of respondents for the factor being measured.
n_1: The total number of respondents who scored the factor as 1 (Extremely Unlikely to Occur)
n_2: The total number of respondents who scored the factor as 2 (Unlikely to Occur)
n_3: The total number of respondents who scored the factor as 3 (Can Occur)
n_4: The total number of respondents who scored the factor as 4 (Likely to Occur)
n_5: The total number of respondents who scored the factor as 5 (Extremely Likely to Occur)

- Severity Index (SI): This index measures the severity that each factor has in terms of causing accidents. This means that a factor with an S score of "1" is producing no impact in terms of severity while a factor with an S score of "5" will produce a very high impact in terms of severity. The equation used to measure this index is:

$$SI = \frac{(n_1+2n_2+3n_3+4n_4+5n_5)}{5N} \quad (2)$$

N: The total number of respondents for the factor being measured.
n_1: The total number of respondents who scored the factor as 1 (No Impact)

n_2: The total number of respondents who scored the factor as 2 (Low Impact)
n_3: The total number of respondents who scored the factor as 3 (Moderate Impact)
n_4: The total number of respondents who scored the factor as 4 (High Impact)
n_5: The total number of respondents who scored the factor as 5 (Very High Impact)

The two indices are used to measure the characteristic of each factors in terms of how likely it can occur and the impact it is exerting on the accident scale. The characteristic of each factor will then be used to identify which factors are more important with respect to each other. This is done by calculating the Relative Importance Index (RII) shown in the equation below:

$$RII = OI * SI \tag{3}$$

The RII will help in identifying the most critical factors by comparing the factors with respect to each other and ranking them in an ascending order with the factors scoring the highest RII to be in the top. It must be noted that the weighing scales of all indices place the most weight on the value score of ‘5’. The measuring scale is derived from the literature review and is tailored to fit the nature of the study conducted in this paper [34] [45].

3.4 Factor Analysis

The factors identified within Table 3 can be described as a set of interrelated variables that contribute to the causation of accidents within the workplace. However, without conducting proper analysis, the relationship between those factors and the impact they have on accidents cannot be properly identified. As such, it is important to identify the method at which those factors are going to be analyzed and the information to be obtained from conducting the analysis. An efficient method that is compatible with analyzing such variables is the factor analysis method, which is an analytical method that can be utilized for examining underlying patterns and the relationship between different variables; additionally, factor analysis can also be used to summarize the factor lists into a more compact and refined set of factors [46].

Factor analysis is categorized into two different types, either an Exploratory Factor Analysis (EFA) or a Confirmatory Factor Analysis (CFA). In any factor analysis, factors are approached as a set of variables that are highly interrelated; as such, each type of factor analysis investigates the relationship between those variables in a different way. EFA is an analysis method that is mainly used to summarize a set of variables into specific categories that have similar characteristics between them. CFA, on the other hand, is another form of factor analysis that is used to test how well a theoretical model represents the actual data set by grouping variables into categories, based on similar characteristics known as constructs [43]. In the case of identifying accident causing factors, the variables are already grouped together into pre-determined constructs as seen in Table 3. As such, the methodology utilized in CFA aligns with the objective of the research since it will confirm of the contribution each factor has on the occurrence of accidents in the construction industry.

3.5 Validity and Reliability Testing

In order to make sure that the set of data collected is adequate for conducting the CFA, the validity and reliability of the collected data set must be tested. As such, the Average Variance Extracted (AVE) measurement is to be identified for each construct. For AVE, a value of 0.5 or greater is generally accepted [43]. This measure will validate that the data collected satisfy the requirement in order to conduct the factor analysis.

Another test to be conducted is the reliability coefficient which is used to measure the consistency of the measuring scale via the Cronbach's α. The Cronbach's alpha measure is done by calculating the coefficient α, which ranges from 0 to 1. The value of α that corresponds to a value greater than 0.6 is considered the minimum acceptable value whereas a value between 0.6 and 0.69 is considered moderate and a value between 0.7 and 0.79 is considered good. Finally, an α value of 0.8 or above is considered excellent, and it corresponds to the measuring scale being highly reliable [47]. Finally, the possibility of using the ordinal logistic regression (OLR) tool will be inspected after receiving the accidents reports. The OLR can be used to measure the effects that different attributes (such as age or sex) have on the responses of individuals undertaking the surveys and to also identify any relationship between attributes and accidents occurrence rate [48]. The utilization of OLR will also aid in presenting suitable RCA and measuring the impact that RCA have on reducing the rates of accidents or the severity of the accidents occurring as a result of the accident-causing factors.

3.6 Comparison and Recommendations Based on Results

Following the completion of the factor analysis, a comparative analysis will be conducted in which the highest ranking accident causing factors within the UAE will be compared to the highest ranking factors in other countries. The comparison will be done by reviewing literature with similar approaches that focus on root cause analysis of accident causing factors in different regions. Following the comparative analysis, some recommendations will be provided in order to reduce the impact of those factors in terms of their contribution to accidents; moreover, a set of proposed solutions presented in different countries will also be suggested in order to better control and reduce the risks caused by those factors.

Chapter 4. Results

This chapter presents results from MOHAP accident reports analysis and interviews with subject matter experts (SME). The results of interviews and data analysis along with the literature review are used to verify the completeness of survey used for data collection.

4.1 MOHAP Data Analysis

Following the acquisition of MOHAP work-related injury reports, a quick review was done to identify the different parameters presented in those reports. As mentioned earlier, the main information that were expected to be in the report were the type of injuries, cause of injuries, the time at which the injury occurred, background information related to the injured personnel, (such as age, gender, nationality etc.), industry sector of company, and size of company in terms of number of employees. Although the reports did contain some information that would help in meeting the objective of this research, the information available in the reports were not as expected and required re-organization of some fields in order to conduct the analysis. Additionally, it was requested by MOHAP representatives that the actual numbers of incidents reported are not to be shared with the public; as such, a brief explanation is to be presented in order to understand the layout and content of the report, and only percentages will be presented.

4.1.1 Explanation of MOHAP reports factor. MOHAP shared two reports, one for the year of 2019 and the other was for the year 2020. Both reports contained similar fields; however, the 2019 report contained some entries in the Arabic language and, in order to properly conduct the analysis, all entries of the Arabic language were translated to English in order to unify entries and effectively conduct the analysis. The reports were shared via email in two separate Microsoft Excel files and highlighted all reported work related injuries occurring in the emirate of Sharjah for each year respectfully. For each entry within the two reports, the following information were shared:

- Nationality of Injured Person
- Age of Injured Person

- Birth Date of Injured Person
- Diagnosis of Injury
- Admission Day & Time of Injured Person
- Discharge Date & Time of Injured Person
- Acuity of Injury
- Start Date of Sick Leave
- End Date of Sick Leave
- Hospital Name

The main drawback to the information within the report is the fact that the information related to the diagnosis of injuries was not standardized; in addition, the cause of injury was mentioned in some cases, while in other cases it was empty. Moreover, for some cases, the diagnosis contained specific information related to the cause of injury, type of injury, and the type of accident, while in other cases, such information was missing or has no details related to the injury cause, type, or accident type. As such, the information in the reports were re-organized, and some entries were further broken down to analyze the causes behind these injuries with respect to the different parameters mentioned in the report.

4.1.2 Types of accidents in MOHAP reports. After reviewing the diagnosis of each entry within the two reports, it was found that only 13.11% of all cases did in fact outline the type of accident for each accident. Thus, the focus of this part of the analysis will be directed towards these known types and their relationship with respect to the severity of the injuries they cause. There were ten main factors identified as the main types of accidents; additionally, these factors were identified as follow:

- Asphyxiation due to harmful gasses or fumes
- Burn
- Electrocution
- Fall
- Heat exhaustion (HE)
- Injury due to contact with sharp edges (ISE)
- Muscle strain
- Physical Assault

- Struck by Falling Object (SFO)
- Struck by Moving object (SMO)

The severity of the injury caused by each factors was identified directly from MOHAP five-point Likert scale in the Acuity entry which was as follow:

1 - Immediate (Red): representing life-threatening injuries that require immediate attention

2 - Emergent (Orange): representing sever injuries that are still considered serious

3 - Urgent (Yellow): representing injuries that require urgent attention

4 - Semi-Urgent (Green): representing minor injuries that require lower attention

5 - Non-Urgent (Blue): representing injuries that require low or minimum attention

Figure 4 summarizes the accident frequency breakdown analysis. In general, less than 1% of the injuries reported were of Immediate level, while most of the injuries reported (around 76%) were of Urgent level. Additionally, both Emergent and Semi-Urgent injuries were at around 11% respectively. Finally, the lowest type of injuries reported were of Non-Urgent level (below 1%), which is expected, as people will refer to report injuries that they view as minor or do not require medical care.

To better understand the impact of these factors in terms of accident severity, the occurrence of accidents that resulted in an injury of Urgent or greater consequence will be inspected. Three Pareto charts were developed to identify which factors contributed mostly to causing Immediate, Emergent, or Urgent injuries; in addition, the values of the number of accident occurring were not revealed due to confidentiality agreement with MOHAP. Figures 5, 6, and 7 below show the contribution of each factor in terms of causing immediate cases, emergent accidents, and urgent cases respectively.

From Figure 5, it is shown that ‘Fall’ contributed to around 66.7% of all immediate cases that were reported, while both ‘Burn’ and ‘Struck by Moving Object’ contributed 16.7% each. The figure also shows that the remaining seven factors did not cause any immediate accidents between the years of 2019 and 2020.

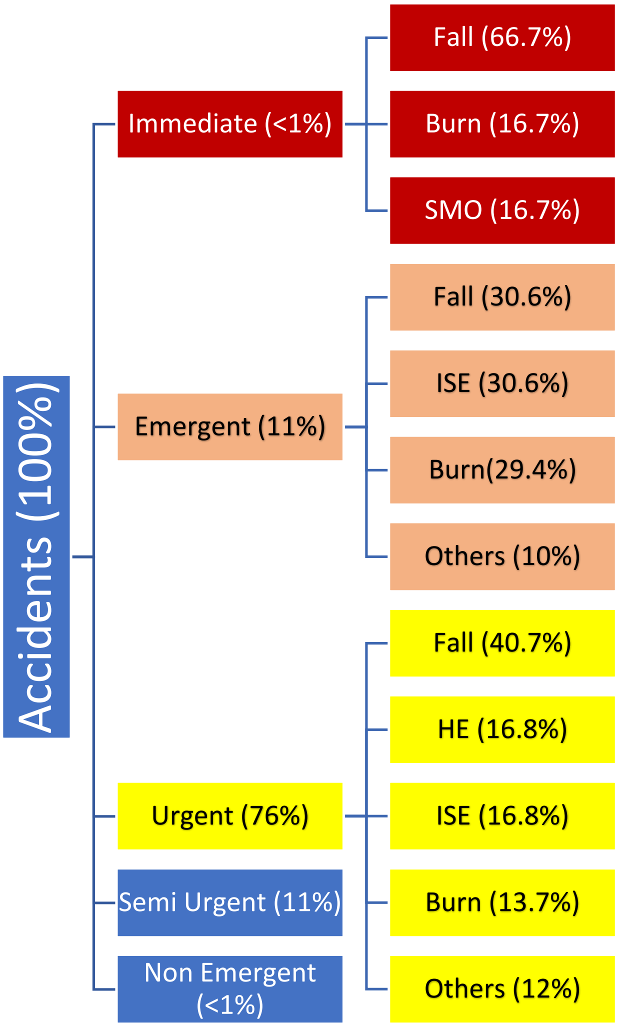

Figure 4: Accident's frequency breakdown analysis

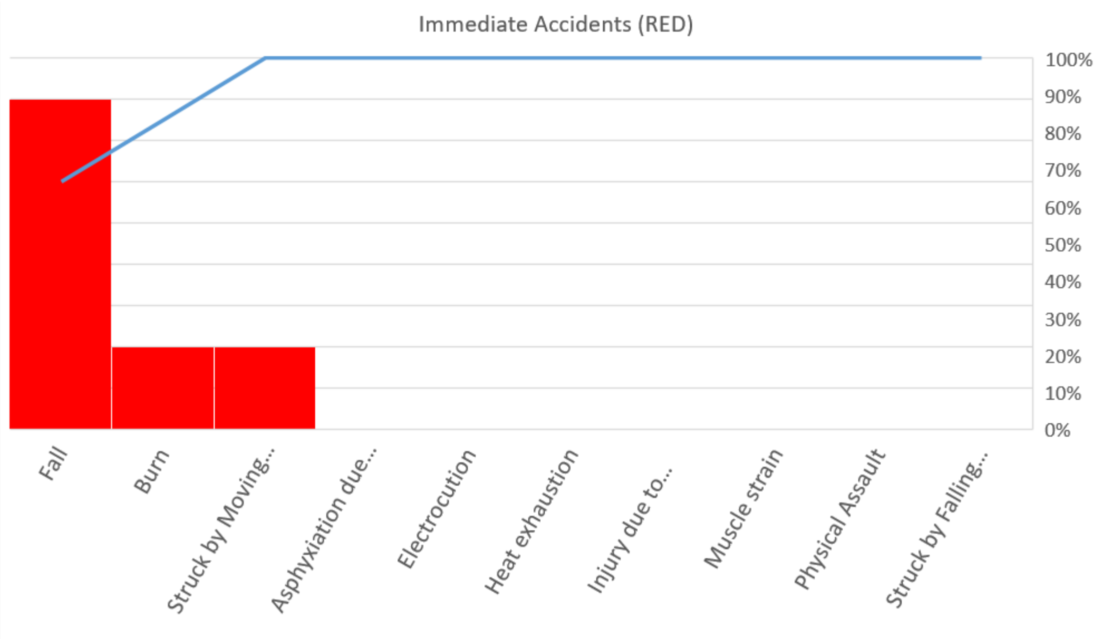

Figure 5: Immediate Cases by Accident Type

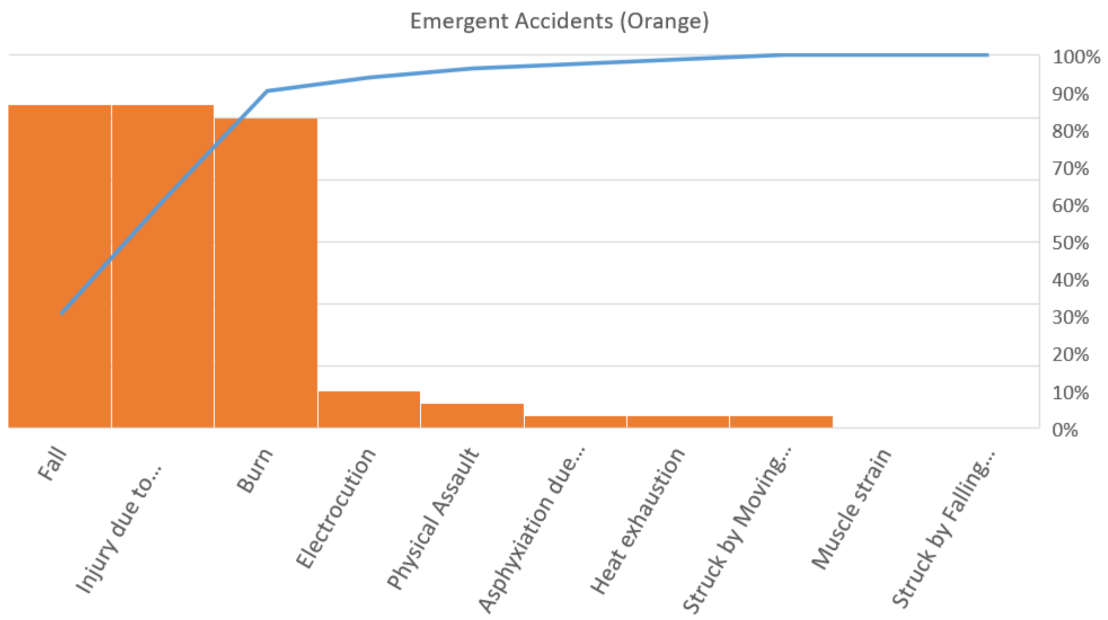

Figure 6: Emergent Cases by Accident Type

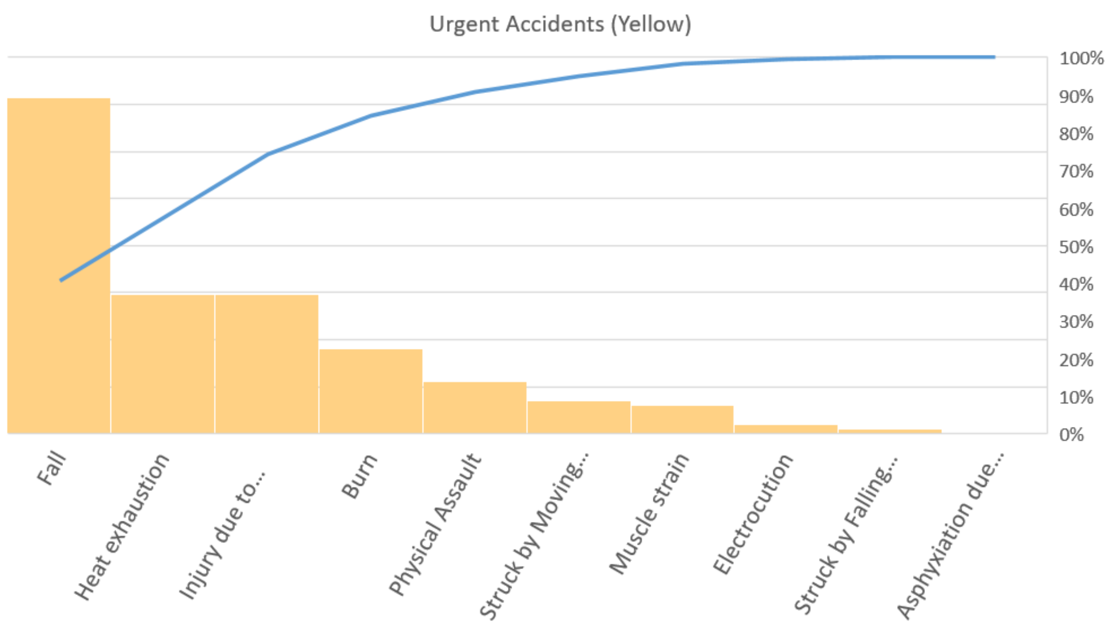

Figure 7: Urgent Cases by Accident Type

For emergent cases, shown in Figure 6, it is clear that around 90% of cases are occurring as a result of three accident types, which are ‘Fall’, ‘Injury due to contact with sharp edges’ and ‘Burn’. Once again, the results reveal that ‘Fall’ came on top, but this time it is tied with ‘Injury due to contact with sharp edges’ with each accident type representing around 30.6% respectfully. ‘Burn’ came in third representing around 29.4% of total emergent cases. All remaining accident types also resulted in some emergent cases making up the remaining 10%, with the two exceptions being ‘Muscle Strain’ and ‘Struck by Falling Object’ which did not cause any emergent cases.

Similar to the immediate and emergent cases, Figure 7 shows that ‘Fall’ was also a leading accident type in causing urgent cases, with a total contribution of around 40.7% of all cases. ‘Heat exhaustion’ and ‘Injury due to contact with sharp edges’ shared in the second spot, with each accident type contribution to around 16.8% of all cases respectfully. These three accident types combined make up around 74.3% of all urgent cases, with remaining types contributing toward the remaining 25.7% (except for ‘Asphyxiation due to harmful gases’ which did not contribute to any urgent cases). Following the three top accident types, ‘Burn’ came in fourth contributing to around 10.3% followed by ‘Physical assault’ cases which contributed to around 6.4%, with the remaining types combined accumulating the remaining 9% of all urgent cases.

From reviewing the previously mentioned Pareto charts, one can see that the highest contributor to all different levels of severity was in fact due to fall related accidents. This is expected as falls are considered the leading cause of patients being admitted to trauma centres (or hospitals) [49]; additionally, falls can result in severe injuries even at short heights [50]. In a study conducted by Young et. al., patients being admitted to trauma centre for falling from the same level and those who were admitted due to falling from heights sustained severe injuries and had almost identical severity when compared to each other [51]. The analysis also showed that burn-related accidents also contributed to all three levels of injuries. Moreover, accidents related to contact with sharp edges made up a large portion of emergent and urgent cases, while accident related to heat exhaustion were also strongly present in urgent cases. The results obtained from reviewing those charts showed that different accident types had disproportionate impacts on the different levels of cases; in other words, some accident types had more impact on the severity of injuries sustained when compared to other accident types.

4.1.3 Age impact on accident’s frequency. The second factor that was analyzed after the type of accidents was the age of the personnel involved. In order to see the impact that age had on the frequency of accidents, the injured personnel were grouped based on their age into the following categories:

- Individuals that are younger than 25 years of age
- Individuals aging from 25 to 34 years of age
- Individuals aging from 35 to 44 years of age
- Individuals aging from 45 to 54 years of age
- Individuals that are 55 years old or older

Each category was then graphed with respect to the number of injuries occurring for each group. In order to truly reflect the impact that age had on the frequency of accidents occurring, the data obtained had to be normalized. The normalization of the data was conducted by dividing the number of accidents for each subgroup by the number of people presented in the workforce for each sub group respectfully. The main assumption that was made was that the population of the UAE for the year of 2020 [52] was used as a representation of each subgroup presented in the workforce, with children being left out of the count as they are not included in the workforce. The resulting graph obtained can be seen in Figure 8 below.

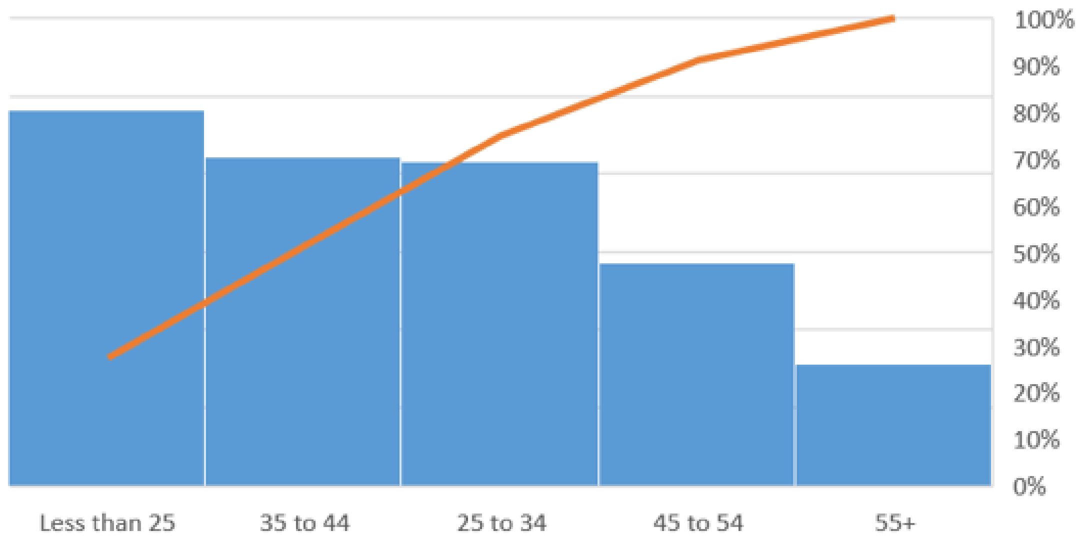

Figure 8: Injuries per Age Group

From figure 8, it is clear that individuals younger than 25 years are more prone to accidents when compared to their older peers. This is expected as such individuals are less experienced in areas related to conducting their tasks when compared to older individuals, thus they are more likely to get into accidents.

4.1.4 Timing impact on accident's frequency. The third factor that was analyzed was the timing of the accident and its impact on the frequency of accidents.

In order to properly inspect the impact of timing, hours of the day were grouped together into four different categories in order to mimic work shifts occurring in the actual workplace, with each category consisting of 6 hours respectfully. The four different categories were as follow:

- Morning, representing working hours from 7:00 am to 12:59pm
- Afternoon, representing working hours from 1:00pm to 6:59pm
- Evening, representing working hours from 7:00pm to 12:59am
- Night, representing working hours from 1:00am to 6:59am

A Pareto chart was constructed to show at which time of the day the highest number of accidents did occur. The Pareto chart is shown in Figure 9 below:

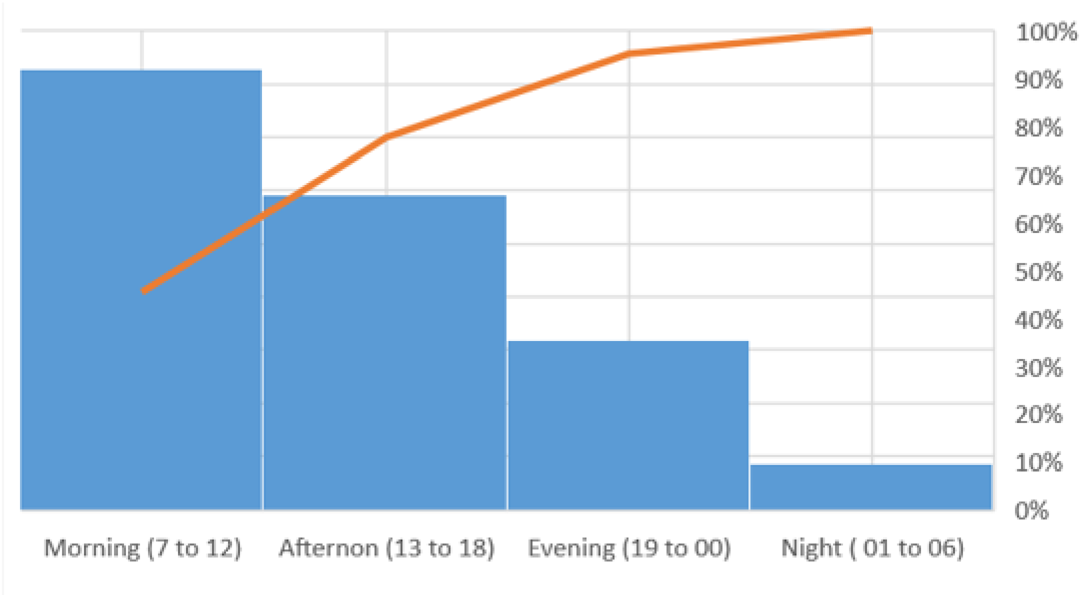

Figure 9: Timing Impact on Frequency

Figure 9 shows that most accidents occur during morning time, representing around 45% of all reported accidents. This is expected as most organizations have work shifts available in the morning time. Accidents during the afternoon period were also relatively high, accounting for around 32% of all accidents, which is also expected as many employees spend their afternoon period at their workplace. What was not expected is that around 23% of accident occurred in shift C and D (18% occurring at evening and 5% at night). Although it was expected that some accidents were going to occur at later hours due to some workers working night shifts, these accidents may occur as a result of the absence of direct supervision due to the nature of most workplaces. This was confirmed by some of the SMEs.

4.1.5 Seasonality impact on accident's frequency. Following the analysis done on the impact of timing, a similar approach was done to analyze the impact of the season at which the accident occurred with respect to the frequency of accidents occurring. Months were grouped together as seasons as follow:

- Winter, consisting of the months of December, January, and February
- Spring, consisting of the months of March, April, and May
- Summer, consisting of the months of June, July, and August
- Spring, consisting of the months of September, October, and November

A Pareto chart was constructed to compare the contribution of each season with respect to the number of accidents occurring in every season. The Pareto chart is shown in Figure 10 below:

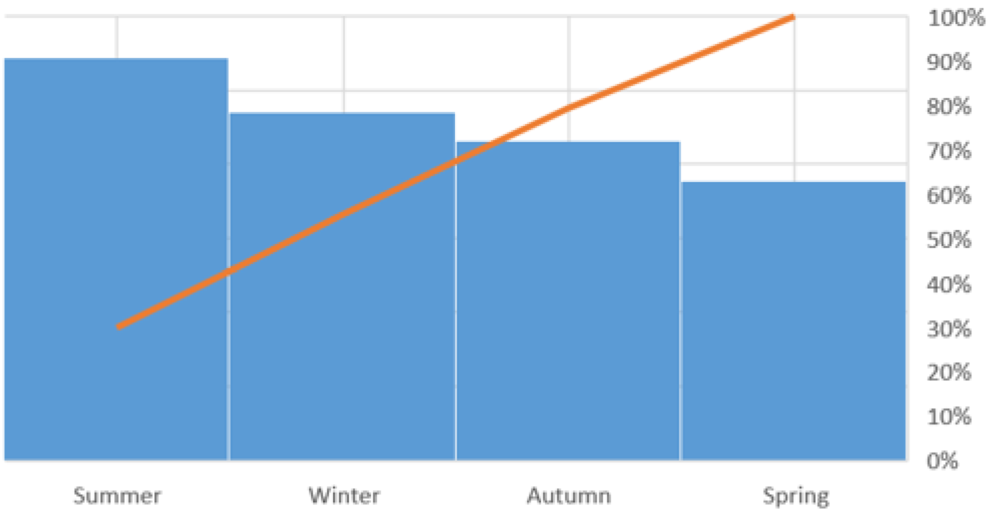

Figure 10: Total Accidents by Season

Figure 10 clearly highlights that the Summer season accounted for the most number of accidents (around 30%), followed by Winter (around 26%), Autumn (around 23%) and Spring (around 21%). The increased numbers of accidents in Summer may be linked to an overall increase in temperature, and in order to verify this assumption, the number of heat exhaustion cases occurring during each season was inspected. Figure 10 below shows the number of heat exhaustion cases occurring in each season.

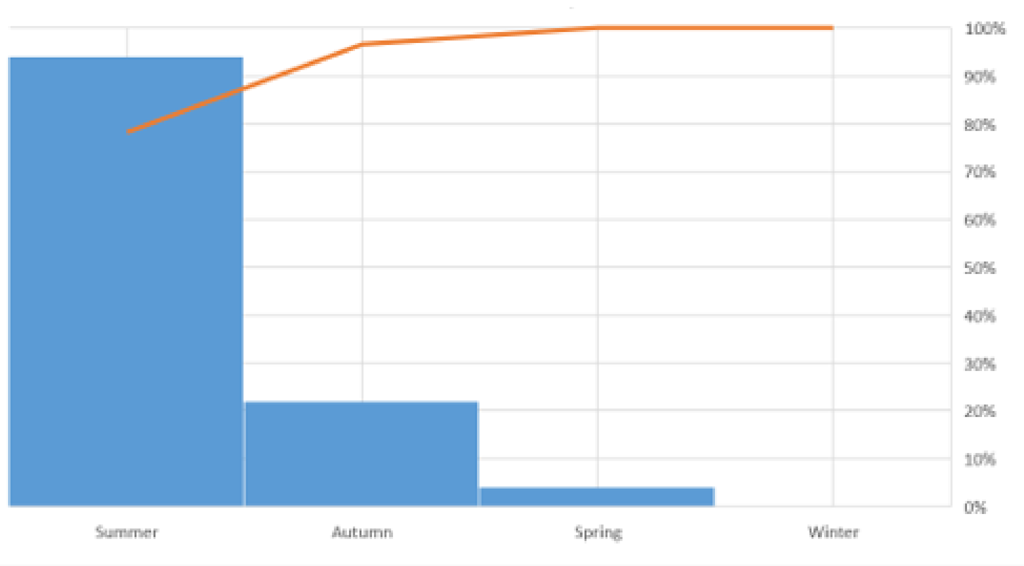

Figure 11: Heat Exhaustion Cases by Season

From Figure 11, it is clear that around 80% of all accidents related to heat exhaustion occurs during summer, with around 15% occurring in autumn and only 5% occurring in spring. Additionally, there were no reported heat exhaustion cases occurring during winter. This shows that the temperature increase in summer can be considered a significant factor in raising the number of work-related accidents.

4.1.6 Day impact on accident's frequency. Similar to the analysis done for each season and their effects on the accident rates, an analysis was also conducted to relate the number of frequency of accidents occurring to the days of the week. A pie chart was constructed to show the percentage of total accidents occurring within each day of the week. Figure 12 below shows the result obtained from the pie chart:

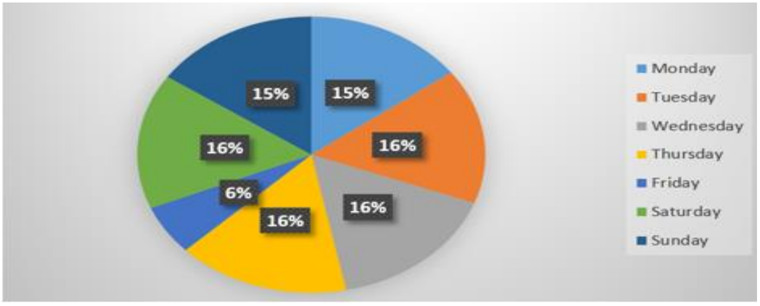

Figure 12: Day Impact on Frequency

Inspecting the percentages obtained within Figure 12 reveals that on all days, except for Friday, the percentage were almost uniform (around 15 to 16%). This suggests that accident rates are not affected by the days of the week. Additionally, the decrease of accident rates on Friday is expected as it is the official weekend day within the UAE.

4.1.7 Nationalities impact on accident's frequency. The last factor that was analyzed was the nationality of the person injured. In order to identify whether or not the nationality of the individual would affect the frequency of accidents occurring, a similar approach was taken to that of the analysis conducted on the impact of age. The number of accidents occurring was plotted for each nationality in a Pareto chart; however, the data must first be normalized in order to accurately reflect whether or not a connection is formed between the two entries. The normalization process was done by dividing the number of injuries individuals in each nationality had with the population of that nationality presented within the UAE [53]. The resulting Pareto chart can be seen in Figure 13 below:

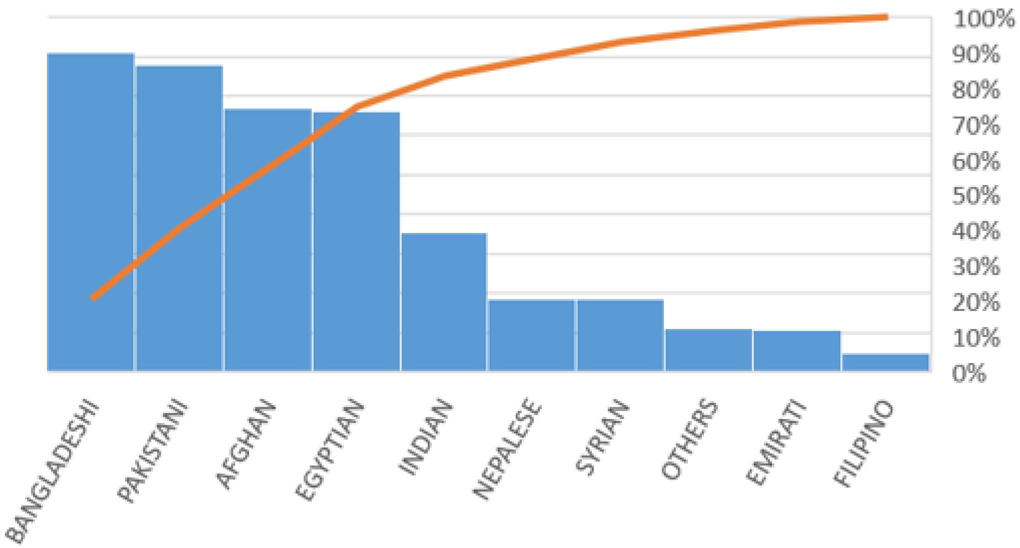

Figure 13: Injuries per Nationality

The data presented in Figure 13 shows that Bangladeshis came on top contributing to around 21% of all cases, followed by Pakistanis (around 20%), Afghanis and Egyptians (each contributing to around 17% respectfully). These four nationalities alone contributed to around 75% of all cases, which is really worrying since they only make up around 26% of the UAE population combined. This may indicate that the nationality of an individual or their cultural background can impact the rate at which injuries occur.

4.1.8 Immediate cases analysis. Finally, an in-depth analysis was conducted to view whether there were any findings that can be identified from immediate cases. As mentioned earlier, the diagnosis of each entry was not uniform across all entries, thus each immediate case was examined in an individual manner and the type of injuries for around 86% of all cases was identified, whereas the remaining 14% was left as unidentified accidents. The resulting injury types were identified as either cardiac arrests, falls, head injuries, fractures, haemorrhages, burns, struck by moving objects, or traumatic shocks. A Pareto chart was constructed in order to identify which type of injury was occurring the most, which can be viewed in Figure 14 below.

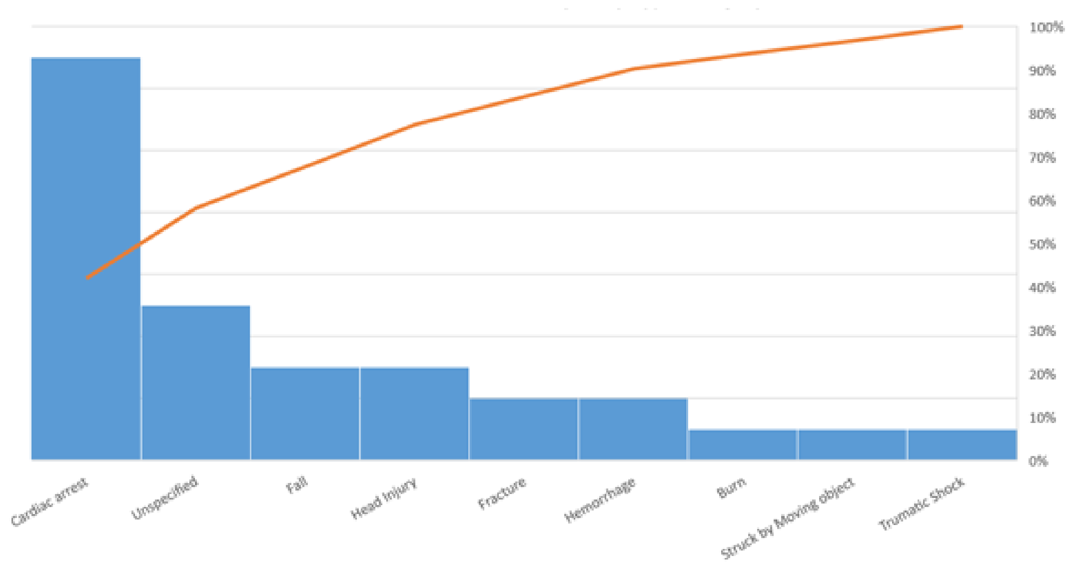

Figure 14: Immediate Accidents Analysis by Type of Injury

From Figure 14, one can see that most immediate cases occurred as a result of cardiac arrests (around 40% of all cases). Additionally, after eliminating unspecified injuries, falls and head injuries came in second (each accounting for 8.33% of all cases). In order to come up with a valid conclusion regarding cardiac arrest cases, it was important to see whether those cases did in fact occur during a workday or during weekends. The number of cardiac arrest cases per day were plotted in a Pareto chart viewed in Figure 15 below.

Figure 15 shows that all cases of cardiac arrests occurred during working days, and that no cases were reported during weekends. It is also clear that the number of cases were the highest during Mondays and Tuesdays which are considered mid-week days in which workers have already worked for more than one shift. This may indicate that these cases are the result of work-related stress.

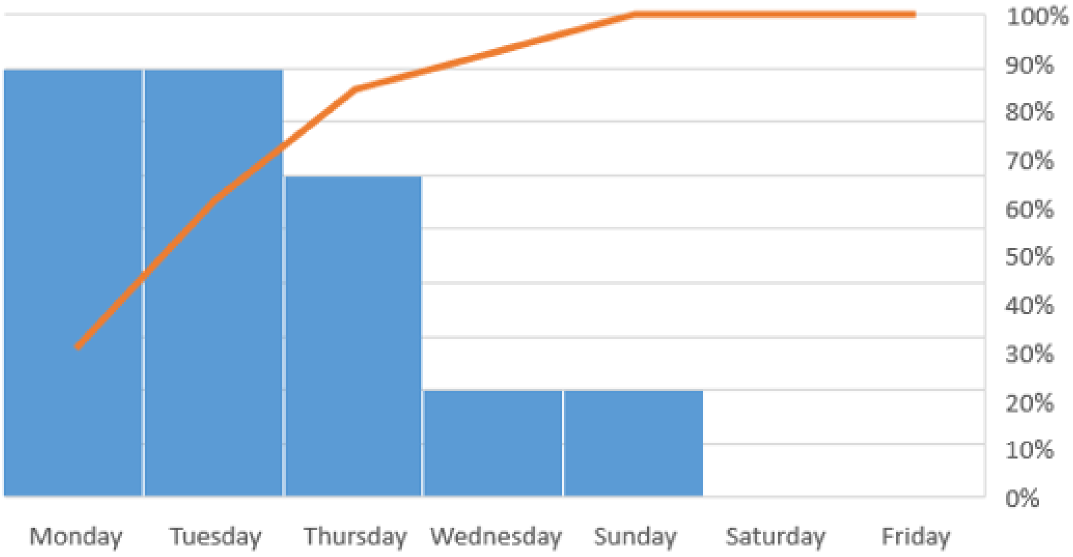

Figure 15: Cardiac Arrests Cases per Day

4.1.9 Summary of findings from MOHAP data. Following the analysis of MOHAP data, a list containing all identified accident types was constructed in order to carry on to the next phase of analysis, which is SME interviews. The preliminary list of accident type contains ten accidents which are:

1. Asphyxiation due to harmful gasses or fumes
2. Burn
3. Electrocution
4. Fall
5. Heat exhaustion
6. Injury due to contact with sharp edges
7. Muscle strain
8. Physical Assault
9. Struck by Falling Object
10. Struck by Moving object

MOHAP data also revealed that the need to improve reporting to trace down accident causing factors and eliminate any ambiguity in terms of accident types description. Moreover, the data set revealed that the contribution of accident types was disproportionate in terms of frequency and severity as accident types such as falls, burns, and contact with sharp edges had more impact in terms of severity and frequency of accidents when compared to other factors. Furthermore, the data set also revealed that some factors, such as experience, nationality, and temperature can also directly impact the occurrence of accidents, which supports the initial findings obtained in the literature review. The result of the analysis also transformed the way analysis is going to be conducted within this study as suggestion on how to better conduct the analysis is expected to be obtained during interviews conducted in the next section.

4.2 Interviews with Health and Safety Experts

Based on the findings obtained from both the literature review and MOHAP's data analysis part, a set of interviews was conducted with six health and safety experts in order to construct the survey questions. The health and safety experts were based in the UAE and working for either the private or public sectors.

The first set of interviews were conducted in a face-to-face manner or via an online meeting platform if the interviewee preferred not to meet. The interviews were of a semi-structured nature, in which an initial draft of the survey made was given to each interviewee, and their feedback was collected, based on their judgement and experience. After editing the draft based on each interviewee's comments, the Delphi method was used to properly identify any non-essential changes done to the survey. This was done by conducting another set of interviews in which the updated draft was shared with each interviewee with the comments highlighted for each change. During the second phase of interviews, some changes were omitted as some interviews decided these changes were not necessary and would further complicate the nature of the survey. Finally, a last set of interviews was conducted to verify and approve the content and structure of the survey.

The results of the interviews revealed the final form of the survey in terms of both content and structure. The results also introduced two main lists, one for the accident types and another for accident-causing factors. The list of the types of accidents included 15 different types which are as follow:

1. Fall from height
2. Struck by falling objects (SFO)

3. Slippage
4. Fire
5. Electric shock
6. Lifting heavy load (LHL)
7. Struck by moving objects (SMO)
8. Injury due to contact with sharp edge (ISE)
9. Asphyxiation due to air quality
10. Asphyxiation due to harmful gasses or fumes
11. Loud noises
12. Physical assault
13. Muscle strains
14. Repetitive stress injury
15. Heat exhaustion (HE)

The labelling of some types of accidents was also changed, such as ‘Burn’ changing to ‘Fire’, as it made it easier for participants to better understand the types of accidents. Furthermore, the grouping of accident-causing factors was also changed to include seven different constructs instead of the five previously mentioned in the literature. Additionally, some factors were added into the final list bringing the total number of factors up to 46 instead of the 37 mentioned in the literature. The list of the accident-causing factors and their respective grouping can be seen in Table 4 below.

Table 4: Breakdown of Accident-Causing Constructs and Factors

Construct	Factor Label	Accident-Causing Factors
Unawareness of H&S	A1	Lack of initial training/certification
	A2	Lack of training refreshers/recertification
	A3	Lack of motivation/reward system
	A4	Lack of H&S personal (organization)
	A5	Hiring of unskilled Workers
	A6	Lack of H&S policy, procedure & regulation documentation
	A7	Lack of regular auditing/inspection

Bad H&S Practices	B1	Unavailability of Warning Signs
	B2	Ineffective supervision (monitoring and enforcement) on site
	B3	Not providing basic and clear directions requirements to workers
	B4	Unavailability of personal protecting equipment (PPE)
	B5	Improper Use of PPE
	B6	Improper Communication/language barriers
	B7	Improper Handling of Materials
	B8	Contact with dangerous items/material
	B9	Slippery surfaces/spills
Lack of H&S systems	C1	Lack of Safety Rules and Regulations
	C2	Ineffective Safety Rules and Regulations
	C3	Lack of Awareness with Procedures
	C4	Lack of planning (HAZARD analysis)
	C5	Failure to Identify Dangerous Situation
Failure to provide required resources	D1	Provision of Faulty Appliances
	D2	Unavailability of Equipment or Machinery used to help in task (crane, lift, shield…)
	D3	Lack of Proper Maintenance
	D4	Use of Damaged/failed Equipment
	D5	Equipment/machines failed during work
	D6	Equipment/work site is not ergonomically designed
Worker’s Factors	E1	Work intensity/pressure
	E2	Worker poor state of health (workers sick, injured...) while doing work
	E3	Worker failure to follow procedures
	E4	Workers intentionally following poor practices
	E5	Overworking
	E6	Lack of Experience

	E7	Task Duration/lack of breaks
Environmental Factors	S1	Falling of Objects
	S2	Task timing
	S3	High Level of Noise
	S4	Unsuitable Workplace
	S5	High Temperature
	S6	Strong Wind
	S7	Dust/air contamination
	S8	Struck by lightening
	S9	Unforeseen Events
Governmental Factors	G1	Lack of government laws and regulations
	G2	Lack of government enforcement/inspection
	G3	Poor Health & Safety Culture of Community

The final structure of the survey was laid out into three different sections. Section one contained some general information questions about the participants and their organization, such as their educational level, job title, years of experience, and organization size in terms of numbers of employees. Section two is the enquiry to rate each accident type in terms of severity and frequency. The biggest change occurring in this section, when compared to the methodology discussed earlier, was the elimination of the probability of detection as it was viewed difficult for participants to identify. Finally, section three asked participants to rate each accident-causing factors in terms of how likely they contribute to causing accidents. The results obtained from the survey will be discussed in the following section.

4.3 Survey Results and Analysis

After finalizing the findings obtained from the interviews, the surveys design was finalized and later shared with participants to collect the required data and conduct the required analysis. The analysis part consisted of general overview of responses, data validity measure, confirmatory factor analysis (CFA), and ordinal linear regression (OLR).

4.3.1 Survey design. As mentioned earlier, the survey consisted of three main sections with a brief explanation of the content of each section presented in the form of a brief paragraph. The first section consisted of information related to the participants and their organization, containing around 11 questions in total. The second section, which addressed accident types, asked participants to rate each of the 15 identified accident types in terms of frequency and severity based on their experience within their respective organizations; additionally, the rating was done based on a five-point Likert scale, as seen in Table 5 below.

Table 5: Frequency and Severity Scales

Frequency Scale		Severity Scale	
Weight	Description	Weight	Description
1	Refers to 0 accidents occurring per year	1	Refers to very low severity
2	Refers to 1 accident occurring per year	2	Refers to low severity
3	Refers to 3-5 accidents occurring per year	3	Refers to moderate severity
4	Refers to 5-10 accidents occurring per year	4	Refers to high severity
5	Refers to 10 or more accidents occurring per year	5	Refers to very high severity

Participants were also given the option to entirely skip this section if they were not familiar with different types of accidents occurring in the workplace. This was done to avoid any unnecessary filling of wrongful information. Moreover, participants were also given the option to skip rating any type of accident they believed to be insignificant in term of both frequency and severity. Finally, the third and last section addressed the accident-causing factors, in which participants rated each of the 46 different factors in a five-point Likert scale format, based on each factor’s contribution in terms of causing work related accidents. The survey ends with two optional open ended questions in which participants were asked to share their feedback on how to reduce the frequency and severity of accidents occurring in the workplace.

4.3.2 Data collection. The survey was published on the 7th of June 2021 via emails that were sent to different public and private organizations following the snowball approach, in which participants were encouraged to share the survey with as much people as possible in order to ensure that the sample size is as diverse as possible and that it reflects an actual representation of the targeted workforce. The link to the survey continued to be open for around 18 days or till the 24th of June 2021, in which 290 individuals participated in the survey. Before conducting the survey, participants were asked whether or not they agreed to participate in the survey, and in order to conduct the survey the participant must willingly agree to participate via answering with yes, otherwise they would not be able to participate.

Table 6 summarizes the respondents' demographical data. It is clear that most participants, around 87.3%, are having a bachelor's degree or higher. As for the participant's job titles, there is a good overall distribution across the required fields. Most participants work in operations, around 27.9%, and the least number of participants are from HSE, around 11%. In terms of participant's work experience, around 57.5% of participants are considered experienced having work experience of 5 or more years, and around 31.4% of participants have work experience of 1 to 5 years, and only 11% have work experience of less than 1 year. For HSE experience, the data suggests that only 20.3% of participants are experienced in HSE, having worked for 5 or more years in HSE, whereas 38.6% have no experience in HSE, 17.2% have less than 1 year of experience in HSE, and around 23.8% are somewhat experienced having worked for 1 to 5 years in HSE. Finally, in terms of HSE training, around 25.2% of participants had no training, 41.4% received basic work training in HSE, while the remaining 33.4% are considered trained in HSE.

Table 6: Participant's details

Characteristic	**Frequency**	**%**		**Characteristic**	**Frequency**	**%**
Education Level				***HSE Experience***		
High school diploma	37	12.8%		No experience in Health and Safety	112	38.6%
Bachelor degree	173	59.7%		Less than 1 year of work	50	17.2%

Master degree	64	22.1%	1 to 5 years of work experience	69	23.8%
PhD or Doctorate degree	16	5.5%	5 to 10 years of work experience	30	10.3%
			10 to 20 years of work experience	24	8.3%
			More than 20 years of work experience	5	1.7%
Job title			***HSE Training***		
Project Manager	51	17.6%	No training in health and safety	73	25.2%
Process Engineer	58	20.0%	Basic training from work	120	41.4%
HSE	32	11.0%	Took classes or workshops in health and safety	50	17.2%
Operation	81	27.9%	Attended a certified training course in health and safety	42	14.5%
Other	68	23.4%	Acquired a diploma in health and safety	3	1.0%
			Acquired a university degree in health and safety	2	0.7%
Work Experience					
Less than 1 year	32	11.0%			
1 to 5 years	91	31.4%			
5 to 10 years	83	28.6%			
10 to 20 years	59	20.3%			
More than 20 years	25	8.6%			

Information obtained in terms of each participant's organization is summarized in Table 7. The industry types are laid out in a well distributed way, in which there is no single industry type overshadowing other industry types (all except for education are between 13.4% and 18.3%), which suggests that there is a somewhat equal representation across all industries. As for organization size, the majority of respondents (33.1%) work for small scale organizations with 0-500 employees, which was expected; however, what was not expected was that the second highest responses (around 22.4%) were for extremely large organization, having more than 10,000 employees. This is actually considered really good as it gives better credibility to the results, in which people from vastly different organizational sizes give their viewpoints. As for job sites, 44.1% of participants worked in offices, 10.7% worked in indoor production or operation facilities, 10% worked at outdoor sites, and around 35.2% worked in mixed facilities which contained indoor and outdoor job sites. In terms of working times, the majority of participants (around 73.4%) worked during one 8 hours shift, which is expected as it is the official working hours in most workplaces. The participants were also asked to rate both the accident and incident reporting systems within their organization. It was found that the majority of participants rated both their accident and incident reporting system as being either good or extremely good, with 66.5% for accident reporting systems, and 59.6% for incident reporting systems. The results obtained in terms of both the information of participants and organizations suggest that the sample size represented is diverse and that the respondents are qualified to give their viewpoints in terms of rating accident types, and accident-causing factors.

4.3.3 Data analysis. The data analysis is broken down into several sub sections which analyze the responses based on the accident types and the accident-causing factors. In order to analyze the accident types, the responses collected in section two of the survey related to ranking each accident type in terms of frequency and severity will be evaluated using the Relative Importance Index (RII) discussed in the literature.

4.3.3.1 Accident types analysis**.** The responses of participants in terms of frequency for each accident is summarized in Table 8 below. The table summarizes the ranking of each accident types based on their Frequency Index (FI), the most frequent type of accident turned out to be loud noises with a FI score of 0.521, followed by slippage (scoring 0.52), then heat exhaustion (scoring 0.511), then ISE (scoring 0.492), and finally repetitive stress injury (scoring 0.479) which completes the top five most frequent types of accident.

Table 7: Organization's Information

Characteristic	Freq.	%	Characteristic	Freq.	%
Industry type			***Accident Reporting System***		
Construction	52	17.9%	Extremely good	76	26.2%
Industrial	53	18.3%	Good	117	40.3%
Oil and Gas	39	13.4%	Neutral	53	18.3%
Health Care	41	14.1%	Need improvement	30	10.3%
Public Sector	39	13.4%	Poor	3	1.0%
Education	23	7.9%	There is no system	11	3.8%
Other	43	14.8%			
Organization Size			***Incident Reporting System***		
0-500	96	33.1%	Extremely good	54	18.6%
500-1000	36	12.4%	Good	119	41.0%
1000-5000	38	13.1%	Neutral	65	22.4%
5000-10000	55	19.0%	Need improvement.	33	11.4%
Above 10,000	65	22.4%	Poor	3	1.0%
			There is no system	16	5.5%
Job Site			***Work Time***		
Indoor offices	128	44.1%	One 8 hours shift	213	73.4%
Indoor-operation/production	31	10.7%	Two 8 hours shift	29	10.0%
Outdoor	29	10.0%	Three 8 hours shifts	15	5.2%
Mixed	102	35.2%	Two 12 hours shifts	10	3.4%
			Other	23	7.9%

An interesting finding arises when comparing the frequency ranking to the actual accident reports submitted by MOHAP. From the MOHAP accident reports, the accident types of fall from heights, fire, heat exhaustion, and ISE were identified as the most contributors when it came to occurrence. Although heat exhaustion cases and ISE are present in the top five in terms of frequency, both fire and fall from height accident types scored a much lower rank with 10th and 12th overall respectively. This can indicate that most workers do not identify fire and fall from height accidents as common types of accidents; additionally, since MOHAP reports are based on workers visits to hospitals, many accident types, such as loud noises and slippage, may be considered as minor and are eliminated from the reports.

Table 8: Frequency Analysis for Accident Types

Rank	Accident type	Scale					Total Participants	Total Freq. Score	Frequency Index
		1	2	3	4	5			
1	Loud noises	41	22	41	23	13	140	365	0.521
2	Slippage	29	35	50	20	8	142	369	0.520
3	Heat exhaustion	42	27	38	17	16	140	358	0.511
4	ISE	35	41	39	12	12	139	342	0.492
5	Repetitive stress injury	36	45	36	14	9	140	335	0.479
6	Muscle strains	47	31	34	23	5	140	328	0.469
7	LHL	49	35	28	25	5	142	328	0.462
8	SMO	52	31	36	16	5	140	311	0.444
9	Physical assault	57	24	37	18	4	140	308	0.440
10	Fire	56	28	41	11	7	143	314	0.439
11	SFO	58	28	29	22	4	141	309	0.438
12	Fall from height	63	27	31	13	7	141	297	0.421
13	Electric shock	62	34	24	15	5	140	287	0.410
14	Asphyxiation due to air quality	69	19	32	12	4	136	271	0.399
15	Asphyxiation due to harmful gasses or fumes	74	22	26	10	7	139	271	0.390

Following the analysis of frequency responses, the severity of the accident types is inspected, as seen in Table 9 below. The results obtained from the responses complements the findings of MOHAP reports in terms of accident contributions to severe cases. The ranking based on the SI score reveals that fall from heights accidents were the most severe achieving a score of 0.567, followed by heat exhaustion cases (scoring 0.527), then SFO (scoring 0.525), then fire (scoring 0.524), and finally SMO (scoring 0.523) which completes the top five most severe accident types. What also backs the credibility of the responses is that in comparison to the data analysis conducted on MOHAP reports, the top accident types causing the most severe consequences (highest acuity in MOHAP reports) are almost identical to the top causing accident obtained from the survey responses, with the only exception being SMO which was not identified as a top cause when analyzing the accident reports. Additionally, fall from height accident was identified as the most severe type of accident with a far greater score when compared to other accident types which was also the case when analyzing the accident reports. This highlights the importance of addressing fall from height accidents and shows that workers are aware of the consequences of such accident type.

Table 9: Severity Analysis for Accident Types

Rank	Accident type	Scale					Total Participants	Total Severity Score	Severity Index
		1	2	3	4	5			
1	Fall from height	32	20	33	21	21	127	360	0.567
2	Heat exhaustion	29	33	33	24	10	129	340	0.527
3	SFO	33	34	20	30	11	128	336	0.525
4	Fire	38	23	29	21	15	126	330	0.524
5	SMO	33	27	29	27	9	125	327	0.523
6	ISE	28	32	39	21	7	127	328	0.517
7	Electric shock	42	17	28	27	9	123	313	0.509
8	Asphyxiation due to harmful gasses or fumes	51	14	26	20	15	126	312	0.495
9	LHL	42	25	30	23	6	126	304	0.483
10	Physical assault	43	20	38	19	4	124	293	0.473
11	Slippage	32	43	31	19	3	128	302	0.472
12	Loud noises	40	35	27	22	5	129	304	0.471
13	Asphyxiation due to air quality	46	20	34	19	6	125	294	0.470
14	Repetitive stress injury	42	37	27	16	4	126	281	0.446
15	Muscle strains	47	32	31	11	5	126	273	0.433

Following the analysis of frequency and severity, the RII score was calculated to identify which accidents types are considered the most important with respect to each of the listed accident types. The results obtained are presented in Table 10 below. The final raking of the accidents revealed that heat exhaustion was ranked first, scoring a value of 0.270 for the RII score. The top eight ranking accident types were similar to the ranking obtained in the severity score, with the exception being the addition of both loud noises and slippage as ranking third and fourth respectively. Although these two accident types have scored low severity scores, they were identified as the most common type of accidents in the frequency ranking and are therefore presented in a high rank on this list. In fact, many studies have identified noise-related accidents as one of the most common work-related accidents worldwide; additionally, those studies also reported that exposure to loud noises can increase the chance of occurrence of accidents in the workplace [54][55][56]. Moreover, accidents related to slips and falls are also considered another common type of work-related accidents occurring worldwide [57]. The final ranking shows that extra attention must be presented toward accidents involving heat exhaustion, injury due to contact with sharp edges, loud noises, slippage, falls, struck by objects and fire as they present more threat when compared to other types of accidents taking place in the UAE.

Table 10: Relative Importance Index of Accident Types

Rank	Accident type	FI	SI	RII
1	Heat exhaustion	0.511	0.527	0.270
2	Injury due to contact with sharp edges	0.492	0.517	0.254
3	Loud noises	0.521	0.471	0.246
4	Slippage	0.520	0.472	0.245
5	Fall from height	0.421	0.567	0.239
6	Struck by moving objects	0.444	0.523	0.232
7	Struck by falling objects	0.438	0.525	0.230
8	Fire	0.439	0.524	0.230
9	Lifting heavy load	0.462	0.483	0.223
10	Repetitive stress injury	0.479	0.446	0.213
11	Electric shock	0.410	0.509	0.209
12	Physical assault	0.440	0.473	0.208
13	Muscle strains	0.469	0.433	0.203
14	Asphyxiation due to harmful gasses or fumes	0.390	0.495	0.193
15	Asphyxiation due to air quality	0.399	0.470	0.187

4.3.3.2 Accident-causing factors analysis. The second part of the survey data analysis part involves the analysis of accident-causing factors based on the responses given for each factor. As mentioned earlier, the responses are analyzed by implementing a data validity measure, CFA, and OLR. The aim of the analysis is set to prove the following hypothesis:

H1 Each construct influences employees' safety

H2 There is a strong correlation between constructs

H3 Questions within each construct measure the same thing

4.3.3.2.1 Validity measure of accident-causing factors. The validity measure was conducted via three main indicators which are the Cronbach's α, the composite reliability (CR), and the average variance extracted (AVE). Chronbach's α provides an indication of reliability based on the inter-correlation of variables within each construct; however, CR is considered more reliable. Additionally, a value above 0.8 or 0.9 is considered satisfactory for both indicators which indicates a good reliability for the data set. Moreover, an AVE value of more than 0.5 is considered in terms of achieving sufficient covariance validity [58] [59]. The results obtained for the validity measure of each data set is summarized in Table 11 below. The results obtained supported the reliability and validity of the data set as all constructed. The values of Chronbach's α and CR for all constructs were high and were well above 0.8, which indicates that all variables within each construct measure the same thing and prove that *H3* is true. Additionally, it was also observed that the value of Cronbach's α decreased when replacing any variable within each construct, which adds to the reliability of each variable set. Furthermore, the value of AVE was also above the required value of 0.5 for all constructs, which suggests that sufficient covariance validity was reached.

Table 11: Validity Measure result

CONSTRUCT	CRONBACH'S α	CR	AVE
UWHS: UNAWARENESS OF H&S	0.882	0.884	0.524
BHSP: BAD H&S PRACTICES	0.916	0.917	0.552
LHSS: LACK OF H&S SYSTEMS	0.919	0.918	0.693
FPR: FAILURE TO PROVIDE REQUIRED RESOURCES	0.934	0.934	0.704
WF: WORKER'S FACTORS	0.902	0.901	0.565
EF: ENVIRONMENTAL FACTORS	0.925	0.925	0.580
GF: GOVERNMENTAL FACTORS	0.855	0.856	0.665

4.3.3.2.2 CFA of accident-causing factors. The CFA resulted in an acceptable level of fit, as the Standardized Root Mean Residual (SRMR) value was calculated at

0.056 which is acceptable as it is lower than 0.08 and close to the ideal value of 0.05. Additionally, the root mean square error of approximation (RMSEA) value was calculated to be 0.0797, which is also acceptable as it is below 0.8. [60]. The results obtained for the CFA conducted is displayed in Table 12. The results show that the correlation of all variables with respect to their assigned construct greatly supports the grouping of variables and proves that all variables within constructs are highly correlated. Additionally, the values obtained for the CFA loading estimate are also found to support the model, as all variable loading is above the good standings of 0.6 except for variable A3 which is still within the acceptable range as it is above 0.38. Furthermore, 37 out of the 46 defined variables, or around 80% of variables, had a high loading value (0.7 or above), which further adds to the credibility of the model and further supports the evidence of failing to reject *H3* hypothesis. Moreover, the findings prove that *H1* is true, since variables within all constructs are shown to contribute to causing accidents which in turn influences employees' safety [58][61]. Finally, the correlation between each construct is calculated in Table 13 and the path diagram of the CFA is displayed in Figure 15.

Table 12: CFA results

Construct	Variable	Correlation with total	CFA Estimate	*P*-Value
Unawareness of H&S	A1: Lack of initial training/certification	0.776	0.796	< .001
	A2: Lack of training refreshers/recertification	0.728	0.678	< .001
	A3: Lack of motivation/reward system	0.518	0.541	< .001
	A4: Lack of H&S personal (organization)	0.692	0.7	< .001
	A5: Hiring of unskilled Workers	0.648	0.674	< .001
	A6: Lack of H&S policy, procedure & regulation documentation	0.682	0.751	< .001

	A7: Lack of regular auditing/inspection	0.642	0.749	< .001
Bad H&S Practices	B1: Unavailability of Warning Signs	0.726	0.809	< .001
	B2: Ineffective supervision (monitoring and enforcement) on site	0.685	0.726	< .001
	B3: Not providing basic and clear directions requirements to workers	0.750	0.766	< .001
	B4: Unavailability of personal protecting equipment (PPE)	0.710	0.752	< .001
	B5: Improper Use of PPE	0.727	0.756	< .001
	B6: Improper Communication/language barriers	0.702	0.722	< .001
	B7: Improper Handling of Materials	0.757	0.788	< .001
	B8: Contact with dangerous items/material	0.631	0.64	< .001
	B9: Slippery surfaces/spills	0.666	0.684	< .001
Lack of H&S systems	C1: Lack of Safety Rules and Regulations	0.817	0.858	< .001
	C2: Ineffective Safety Rules and Regulations	0.805	0.849	< .001
	C3: Lack of Awareness with Procedures	0.798	0.807	< .001
	C4: Lack of planning (HAZARD analysis)	0.792	0.769	< .001
	C5: Failure to Identify Dangerous Situation	0.741	0.766	< .001
Failure to provide required resources	D1: Provision of Faulty Appliances	0.790	0.831	< .001
	D2: Unavailability of Equipment or Machinery	0.783	0.821	< .001

	used to help in task (crane, lift, shield…)			
	D3: Lack of Proper Maintenance	0.820	0.859	< .001
	D4: Use of Damaged/failed Equipment	0.846	0.859	< .001
	D5: Equipment/machines failed during work	0.800	0.807	< .001
	D6: Equipment/work site is not ergonomically designed	0.792	0.832	< .001
Worker's Factors	E1: Work intensity/pressure	0.686	0.72	< .001
	E2: Worker poor state of health (workers sick, injured...) while doing work	0.739	0.803	< .001
	E3: Worker failure to follow procedures	0.720	0.682	< .001
	E4: Workers intentionally following poor practices	0.652	0.672	< .001
	E5: Overworking	0.733	0.75	< .001
	E6: Lack of Experience	0.695	0.74	< .001
	E7: Task Duration/lack of breaks	0.741	0.832	< .001
Environmental Factors	S1: Falling of Objects	0.751	0.81	< .001
	S2: Task timing	0.721	0.805	< .001
	S3: High Level of Noise	0.764	0.797	< .001
	S4: Unsuitable Workplace	0.761	0.813	< .001
	S5: High Temperature	0.653	0.683	< .001
	S6: Strong Wind	0.759	0.741	< .001
	S7: Dust/air contamination	0.693	0.668	< .001
	S8: Struck by lightening	0.705	0.725	< .001
	S9: Unforeseen Events	0.758	0.783	< .001
Governmental Factors	G1: Lack of government laws and regulations	0.748	0.827	< .001

	G2: Lack of government enforcement/inspection	0.736	0.812	< .001
	G3: Poor Health & Safety Culture of Community	0.701	0.793	< .001

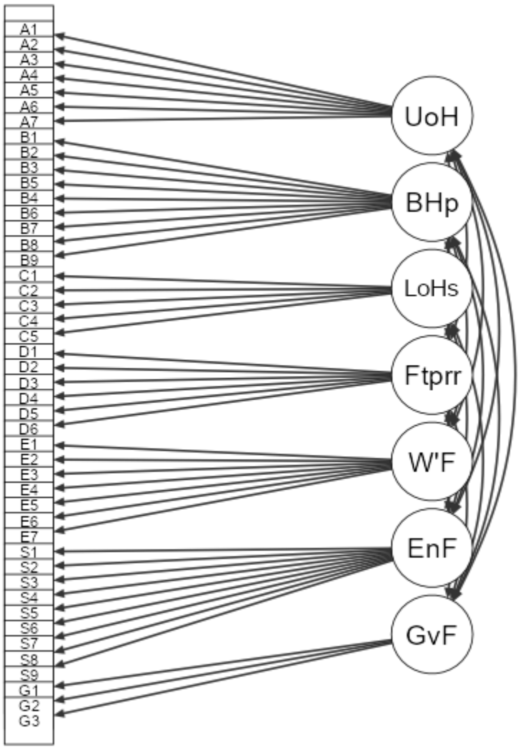

Figure 16: CFA path diagram

Table 13: Correlation between constructs

	BHSP	LHSS	FPR	WF	EF	GF
UWHS	0.861 (<0.001)	0.92 (<0.001)	0.821 (<0.001)	0.729 (<0.001)	0.674 (<0.001)	0.743 (<0.001)
BHSP		0.943 (<0.001)	0.87 (<0.001)	0.789 (<0.001)	0.696 (<0.001)	0.756 (<0.001)
LHSS			0.905 (<0.001)	0.811 (<0.001)	0.704 (<0.001)	0.811 (<0.001)
FPR				0.828 (<0.001)	0.804 (<0.001)	0.809 (<0.001)
WF					0.913 (<0.001)	0.842 (<0.001)
EF						0.872 (<0.001)

The results obtained show that there is a strong correlation between all constructs with respect to each other, which verifies the hypothesis presented in *H2*. The correlation is also sensible as a higher correlation is noticed when comparing the constructs of UWHS, BHSP, and LHSS which are similar to each other as they are all related to health and safety practices. A high correlation is also noticeable when comparing LHSS to FPR, as the later can be considered as part of being unable to provide health and safety requirements if done intentionally. After proving the correlation among constructs, the impact that these constructs have on major accident types is measured via OLR in the following section.

4.3.3.2.3 OLR of accident-causing factors. OLR was used based on the median of the variables to measure the impact each of the seven constructs had on the frequency and severity of major types of accidents identified earlier, which includes heat exhaustion, fall from heights, fire, and injury due to contact with sharp edges. The regressions is done in a stepwise approach by maintaining the hierarchy of constructs and using a reference value of 5 (strongly agree), and only factors with *p*-value less than 0.1 where considered [58]. The equation obtained for fall from height frequency and severity are seen in equations (4) and (5) below.

Fall from height frequency.

$$ln\frac{\Pr\left(FallF_j \leq j \mid X\right)}{\Pr\left(FallF_j > j \mid X\right)} = a_j - 3.43BHSP_j + 1.65LHSS_j - 1.02FPR_j - 2.53WF_j - 0.45EF_j + 3.40GF_j + 1.12\left(BHSP_j * WF_j\right) - 0.37\left(LHSS_j * GF_j\right) - 0.48\left(WF_j * GF_j\right) \quad (4)$$

where as $a_4 = 8.25, a_3 = 6.95, a_2 = 5.53, a_1 = 4.59$

Fall from height severity

$$ln\frac{\Pr\left(FallF_j \leq j \mid X\right)}{\Pr\left(FallF_j > j \mid X\right)} = a_j + 7.73UWHS_j - 2.5BHSP_j + 2.79LHSS_j - 8.02FPR_j - 5.66WF_j + 2.13EF_j + 3.45GF_j - 0.87\left(UWHS_j * WF_j\right) - 1.21\left(UWHS_j * GF_j\right) - 0.58\left(BHSP_j * LHSS_j\right) + 2.33\left(BHSP_j * WF_j\right) - 1.38\left(BHSP_j * GF_j\right) + 0.93\left(LHSS_j * FPR_j\right) - 1.24\left(LHSS_j * GF_j\right) + 1.38\left(FPR_j * GF_j\right) + 0.57\left(EF_j * GF_j\right) \quad (5)$$

where as $a_4 = 4.40, a_3 = 3.07, a_2 = 1.43, a_1 = 0.38$

For each equation, the relationship between the constructs as well as the interactions between each construct were taken into consideration. In equation (4), one can see that all constructs, except for UWHS, do in fact have an influence on the frequency of falls. Additionally, the interaction between different constructs, which includes an interaction between BHSP and WF, LHSS and GF, and WF and GF respectively, is highlighted as well. This is expected as there is a strong correlation between different constructs as highlighted earlier in Table 13. In order to better understand the level of impact that these constructs have, the probability of fall frequency was compared by moving from a median value of 5 to a median value of 4 utilizing both equations. The results from equation (4) showed that the probability of falls occurring decreased from 99.42% to 95.47% when moving from a median of 5 to 4, which indicates that a decrease in the value of the median of constructs would decrease the probability of falls occurring. Similarly, the results from equation (5) showed that the probability of the severity of falls decreased from 89.56% to around 80.08% when moving from a median value of 5 to 4, which also indicates that a decrease in the value of the median of constructs decreased the probability of severity of falls. This further backs the hypothesis $H1$, showing that there is an influence each construct has on the frequency and severity of different accident types. The coefficients of each of the remaining OLR equations with respect to the frequency and severity of each accident type are shown in Table 14 below.

Table 14: OLR coefficients

Construct	Fire Freq.	Fire Sev.	Heat Ex. Freq.	Heat Ex. Sev.	ISE Freq.	ISE Sev.
a_1	1.97	1.71	-1.07	-6.32	-1.86	-3.20
a_2	2.91	2.80	0.10	-4.69	-0.15	-1.71
a_3	4.77	4.10	1.75	-3.12	1.67	0.14
a_4	5.91	5.39	2.90	-1.32	2.67	1.98
$UWHS_j$	0.06	2.41	1.46	5.24	0.31	-1.16
$BHSP_j$	-1.04	-4.34	-1.92		-2.51	1.60
$LHSS_j$	0.12	1.68	3.65	7.43	2.28	8.36
FPR_j	0.97	-2.26	-4.00	-7.60	-2.65	-10.71

WF_j	-0.53	0.60	2.38	-2.88	1.86	-0.87
EF_j	-1.05	1.55	1.88	1.24	2.20	2.16
GF_j	0.18	-1.08	-3.08	-0.16	-0.94	2.14
$UWHS_j * BHSP_j$		1.37	0.37			-0.52
$UWHS_j * LHSS_j$				-0.45	0.80	
$UWHS_j * FPR_j$					-0.72	
$UWHS_j * WF_j$		-1.18			-0.92	
$UWHS_j * EF_j$	-0.64	-0.86	-1.39	-1.17		0.74
$UWHS_j * GF_j$	0.57		0.39		0.63	
$BHSP_j * LHSS_j$		-1.06				
$BHSP_j * FPR_j$	0.39	0.88				
$BHSP_j * WF_j$		0.91				
$BHSP_j * EF_j$		-1.07			0.67	
$BHSP_j * GF_j$						
$LHSS_j * FPR_j$		0.60				0.50
$LHSS_j * WF_j$			-1.02	-1.23	-0.82	-1.43
$LHSS_j * EF_j$						-1.50
$LHSS_j * GF_j$				-0.41	-0.49	
$FPR_j * WF_j$			1.54	2.12	2.05	2.39
$FPR_j * EF_j$	-0.73				-1.71	
$FPR_j * GF_j$		-0.89			1.23	
$WF_j * EF_j$	1.13		-0.77			
$WF_j * GF_j$	-0.98		-0.71		-0.85	-0.50
$EF_j * GF_j$	0.41	1.42	1.47	0.59		

The results obtained in Table 14 show that each construct did in fact affect the frequency and severity of each different accident type, with the exception of BHSP construct as it did not affect the severity of heat exhaustion accidents. The results obtained also reveal that the interaction between each construct influenced the severity and frequency of some accident types to an extent. For example, the interaction between the constructs UWHS and EF affected the severity and frequency of almost all accident types, with the exception of affecting the frequency of ISE. This further backs *H1*, in which each construct influences the employee's overall safety with respect to different accident types. Additionally, form the OLR equations, it is clear that all construct exerts a degree of influence on different accident types, as such, it is important to further study the influence that each construct has on different accident types.

4.4 Discussion of results

The results obtained from the analysis supports the fact that employees' safety is influenced by many different variables. In the MOHAP data analysis part, multiple variables that can have a potential impact on the frequency and severity of the accidents were identified. For example, the finding that age affects the frequency at of accidents is confirmed in another study conducted in Italy from the years of 1995 to 2015 [62]. Similarly, from MOHAP data analysis, fall from height was identified as the leading type of accident occurring in the workplace which also supports the findings of a study conducted in Indonesia in which fall from height accident was also the leading type of accident from the year of 2009 to 2015 [63]. The reporting mechanism in MOHAP reports was also found to be in need for improvement as it would help in identifying the causes of accidents if more data is available. Additionally, the issue with limited data in occupational accident reports was addressed in a study conduct in the Spanish province of Catalonia; moreover, the study suggested that more data need to be collected in these accident reports, and there is need to train the individuals inputting data in order to identify occupational health and safety variables [64].

The results obtained from the survey analysis showed that heat exhaustion, injury due to contact with sharp edges, loud noises, slippage, and fall from height accidents were the highest ranking accident types requiring more attention to address these accident types. These five accident types are reported by many studies and were listed as major types of occupational accidents for different accident fields including a study in South Korea [65], the UAE [66], and Greece [67], in which fall-related cases were always identified as a leading type of accident. The results of the CFA on accident causing factors also supported the likelihood that all variable introduced in this study have a degree of influence on causing accidents. From the OLR analysis, it was clear that all constructs did in fact exert a degree of influence with respect to the severity and frequency of different accident types. As such health and safety experts' opinion was taken via interviews, and responses from surveys were collected in order to give possible recommendations to address the findings of this study as seen in the next chapter.

Chapter 5. Conclusions and Recommendations

The study answered a question related to the main types of accidents occurring in the emirate of Sharjah by identifying major accident types in the emirate based on the frequency and severity of those accidents. Additionally, the study also provided an answer to the causes behind those accidents in the form of a model that includes 46 accident-causing factors grouped into seven main constructs, which are unawareness of health and safety, bad health and safety practices, lack of health and safety systems, failure to provide required resources, worker factors, environmental factors, and governmental factors. The influence of each factor was proven via a CFA and an OLR analysis in which the results showed that each construct did in fact contribute to causing accidents in the workforce within the UAE. Additionally, there were several limitations presented in this study such as the shortage of time, the qualitative nature of the analysis conducted, and the scarcity of accident reports presented in the emirate of Sharjah. Finally, the study concluded by providing recommendations based on the surveyed responses and experts' opinion as follow:

- Addressing all accident-causing factors mentioned in this study is important in order to address work-related accidents occurring in the UAE.
- Some factors associated with the worker's characteristics such as age and nationality can influence accident occurring rates, and as such further studies are encouraged to analyze the nature of this influence.
- Temperature plays a significant role in influencing the frequency of accidents, as the number of accidents increased during hotter seasons. As such, it is important to address the issue of rising temperature degrees when working within the UAE.
- The process behind the accident reporting system must include additional information in order to better understand and study accidents occurring within the workplace. The inclusion of extra variables in those reports will allow for better studies to be conducted in order to identify new relationships between those variables and help in reducing the number of accidents in the future.

- Additional studies need to be conducted on occupational accident reports in order to better understand the reasons behind these accidents and come up with new hypotheses on why these accidents occur in the first place.
- It is important to provide sufficient awareness and training programs for workers in health and safety topics in order to reduce accident rates within the UAE. Additionally, organizations must be aware of how to implement a proper health and safety systems within their workplace in order to protect their workers from harm.
- Intentionally following bad health and safety practices must be punishable by law, and a standardized health and safety system must be enforced within the UAE in order to guide organization on how to implement proper health and safety practices.
- Training employees should involve risk assessment and mitigation, proper use of personnel protective equipment, emergency response, and general health and safety training in order to reduce the frequency and severity of accidents.
- ‘Fall from heights’ is a major type of accidents, and proper codes of practices must be followed when conducting any type of work at height.
- Proper accident and incident investigation must be conducted in order to identify the root causes behind work-related accidents; additionally, organizations must report any accidents or incidents occurring in their workplace to the responsible authorities.
- Failure to provide the required resources to conduct any type of work-related activities must be reported by employees, and actions must be taken towards organizations failing to require the necessary resources that are required to safely conduct work.
- Employees’ feedback must be collected in a periodic manner in order to identify any issues affecting their safety that can arise while conducting assigned tasks. Additionally, employees must be tested on how to perform the required safety procedures when conducting their work.
- Sufficient and continuous supervision must be presented at worksites in order to guarantee that proper health and safety practices are being followed when conducting the required work.

- The effects of accident-causing factors must be studied since they have the potential to increase the rate at which accidents occur and the severity of those accidents.

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Appendix

Appendix 1: MOHAP Requirements Form

UNITED ARAB EMIRATES
MINISTRY OF HEALTH & PREVENTION

الإمارات العربية المتحدة
وزارة الصحة ووقاية المجتمع

MOHAP RESEARCH ETHICS COMMITTEE INSTRUCTIONS & REQUIREMENTS SUBMITING RESEARCH FILES FOR ETHICAL APPROVAL

- Please send the research study files as **soft copies first and the application form in word format** by email to the **MOHAP- REC**
- The Coordinators will first scan, review and give feedback before sending to the **MOHAP REC**
- Then you will submit **ONE USB** & **five (5 five) Hard copies of the study files-** and As per the number of MOHAP REC members to meet the **quorum**
- **PLEASE FOLLOW & SUBMIT THE BELOW DOCUMENTS** :

1.	Cover Letter -signed and dated by the Principal Investigator/Co-coordinating Investigator) addressed to MOHAP REC **(mandatory)**
2.	Complete the Application form as is **(mandatory)**
3.	Research Summary **(mandatory)**
4.	Approvals/Opinions from other Research Ethics Committees in UAE **(if applicable)**
5.	Consent forms and Participant information sheet in all languages applicable **(mandatory)**
6.	Data collection forms/Questionnaires/other instruments **(mandatory)**
7.	Study protocol **(mandatory)**
8.	Investigator Brochure **(if applicable)**
9.	CVs and GCP certificates of (good clinical practice valid for 2 years) of the Principal, Co-investigators and Investigative team **(mandatory)**
10.	Financial agreements- English and Arabic and should be a tripartite signatories **(if applicable)**
11.	All Students will need a copy of the approval cover letter with a logo from the University, to the MOHAP research Ethics Committee, signed from the University and dated by their Principal Investigator/Co-Investigator onsite/supervisor/ mentor/advisor **(mandatory)**
12.	All Post Graduates students /including master's degrees, doctorates (PhD's) **(for applicants from Universities)** All students will need ,Principal Investigators/Co-Investigator onsite/supervisor/ mentor/advisor responsible and eligible from the University to be designated for the conduct **(mandatory)**
13.	**Students cannot be the Principal Investigators**

******Please send the given check list with the research study files***

Page **1** of **1**

Vita

Mohamed Alzarooni was born in Sharjah in 1995. He graduated from high school in 2013 from Al Wehda Private School (WPS) achieving the highest overall score during that graduation year. Mr. Alzarooni pursued his bachelor degree in Mechanical Engineering at the American University of Sharjah (AUS) and earned multiple awards and certificates for being an active member of the AUS community and for participating in many on campus events. Mr. Alzarooni completed the program requirements and graduated with very good standings in the year of 2017.

Mr. Alzarooni later worked for Istithmar group for a period of time before joining Sharjah Prevention and Safety Authority (SPSA) in 2019 as a facilities prevention engineer where he is present to date. He has also attended many professional training courses and is certified in the fields of quality, safety, and management during his time at SPSA. In 2019, Mr. Alzarooni began a Master's program in Engineering Systems Management at AUS. In 2021, Mr. Alzarooni was appointed head of the projects section at the standards at conformity department at SPSA.

Mr. Alzarooni is also a board member and the CEO of Istithmar group, a private firm specializing in food and beverages, real state, and facility management.