Development of an Integrated HSE Management Plan for Contracting Companies in the Oil and Gas Industry

Negin Chegenizadeh

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Declaration

To the best of my knowledge and belief, this thesis contains no material previously published by any other person except where due acknowledgement has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Human Ethics The research presented and reported in this thesis was conducted in accordance with the national health and Medical Council National Statement on Ethical Conduct in Human Research (2007)—updated March 2014—and meets ethics guidelines. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number# 71244

Full Name: ……Negin…Chegenizadeh………………………………….

Date: ………20/10/2020………………...

Abstract

Both domestically and internationally, the oil and gas industry has been inherently identified as a high-risk work environment. For many decades the employees, and in particular contracting companies of this industry, suffered from a high frequency of accidents and incidents caused by numerous occupational safety– and health–related inadequacies and shortcomings. Only over the past few decades has the importance of safe workplace environments been realised. A number of high-profile catastrophic incidents have shaken the industry, resulting in an evolutionary leap in safety standards. As a result, organisations have been searching for techniques to develop higher performing safety cultures and systems to protect their most important investments: their people and assets.

However, in this process contractors and subcontractors have been overlooked and treated as an external resource, rather than one of the direct employees. The aim of this study was to develop an integrated best practice health and safety management plan model for contracting and subcontracting oil and gas companies aimed at reducing accidents and incidents that have been caused directly or indirectly by contractor or subcontractor companies.

In the comprehensive review of published information, it was identified that many major catastrophic incidents such as the Deepwater Horizon (Gulf of Mexico) incident were linked to a poor relationship between the service provider contracting companies and the main client, through such gaps as poor communication and a lack of safety standardisation.

To collect research information, workplace and work processes observation, participants' observation, secondary data analysis / archival study and surveys have been used. This study took a theoretical and systematic approach towards analysing accidents and incidents through the use of pattern matching safety data to identify main themes, and to accurately determine the most effective risk control measures and best practice measures to eliminate hazard risks in the offshore industry. The study design was a mixed methods research approach with both quantitative and qualitative data collected.

Through the analysis of various safety management plans, this research identified the high-performing elements required to enable success in occupational safety and health performance and management processes of the Western Australian oil and gas industry. This was achieved through

amalgamating these key factors into a model health and safety management system and plan that can be utilised by all oil and gas industry contracting companies.

To trial the effectiveness of the plan described above, the model health and safety management plan was implemented by one contracting company for maintenance operations in the Western Australian offshore oil and gas industry. The justification for analysing only one contracting company's data was that the research study took a detailed, holistic, comprehensive approach, targeting critical areas of one contracting company in the oil and gas industry. The selected contracting company is one of the key players in this industry and provides a vast majority of services to a number of client companies in oil and gas industry. It is justified to claim this company plays a role model for other contracting company with similar capabilities. In saying that the research only conducted a case study, with a pointer that other service companies can emulate this example.

This model safety management plan was implemented throughout the organisation. A detailed comprehensive case study was undertaken. Following implementation of the integrated safety plan, the accident and injury incident rate significantly decreased demonstrating its effectiveness. This plan can be used across all contracting and subcontracting companies working offshore since the research findings identified that it was important to have standardisation of health and safety management across the oil and gas industry.

This study concluded that one critical requirement in every workplace is to have a comprehensive safety management plan that details all the necessary steps and tools that every key stakeholder in the organisation needs to be aware of and follow to operate safely and within the jurisdiction of the law. Recommendations are made to roll out the integrated health and safety management plan to other contracting companies working in the oil and gas industries. It is anticipated that contracting companies working in the oil and gas industry who use the safety management plan developed though this research will achieve a harmonised workplace, which can enable the oil and gas industry to move towards achieving a world-class health and safety performance.

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Firstly, I would like to thank my supervisor, Dr Ali Saeedi, for his ongoing support and guidance throughout this research. I would also like to extend my appreciation to my co-supervisor, Dr Janis Jansz, for her kind and sincere support throughout this study. Finally, I am also grateful to my husband, and to my family and friends for their support during this time.

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List of Abbreviations

ALARP	as low as reasonably practicable
AMSA	Australian Maritime Safety Authority
AOD	alcohol and other drugs
ASCO	Australian Standard Classification Occupations
BOSIET	Basic Offshore Safety Induction & Emergency Training
BP	British Petroleum
CEO	chief executive officer
DWG	designated work group
EAP	employee assistance program
EIA	environmental impact aspect
EMS	environmental management system
ERP	emergency response and rescue plan
FFW	fitness for work
FAI	first aid injury
FOET	further offshore emergency training
FPSO	floating, production, storage and offloading
GSR	Golden Safety Rules
HAZID	hazard identification
HIRARC	hazard identification, risk assessment and risk control
HOF	human and organisational factor
HR	human resources
HRA	health risk assessment
HSE	health, safety and environment
HSR	health and safety representative

ILO	International Labour Office
ISD	inherently safer design
ISSOW	Integrated safe system of work
KPI	key performance indicator
LNG	liquefied natural gas
LTI	lost time injury
MOI	mechanism of injury
MSIC	Maritime Security Identification Card
MTI	medically treated injury
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NSC	National Safety Council
NT	Northern Territory
OCP	Operational Control Procedure
OECD	Organisation for Economic Co-operation and Development
OHS	occupational health and safety
OIM	offshore installation manager
OPGGS(S)	Offshore Petroleum and Greenhouse Gas Storage (Safety)
OPITO	Offshore Petroleum Industry Training Organisation
OSHA	Occupational Safety and Health Administration
PDCA	Plan Do Check Act
PPE	personal protective equipment
PSA	Petroleum Safety Authority
PSM	process safety management
PSV	pressure safety valve
PTW	permit to work
QSM	quality management system

RIF	risk influencing factor
RWI	restricted work injury
SMART	specific, measurable, achievable, realistic and timely
SSCP	Safe Supervisor Competence Program
SDS	safety data sheet
SEMS	safety and environmental management system
SMS	safety management system
TBOSIET	tropical basic offshore safety induction & emergency training
TFOET	tropical further offshore emergency training
TRI	total recordable injury
UK	United Kingdom
US	United States
WA	Western Australia
WLL	working load limit

Glossary of Terms

Accident

An accident is defined as a situation that was not intended or planned, but which, through a number of specific factors, resulted in either property damage or human loss/injury. Typically, accidents appear to occur without apparent or intentional cause.(Safe Work Australia, 2011a)

Contracting company

Refers to a corporation, partnership, sole proprietor, joint venture, government or government subdivision or agency, or other organisation that carries out works on a contract basis agreed upon on by both entities.(Safe Work Australia, 2011a)

Employee

The term employee refers to whoever works for a public or private employer and obtains remuneration in wages, salary or a retainer fee from his or her employer while working on a commission, tips, piece-rates or payment-in-kind basis. It also refers to a self-employed person, whether he or she employs others or not, and to those who work without pay for a family business or farm. This population does not include volunteers; it excludes persons whose only work is voluntary.(Safe Work Australia, 2011a)

Fatality

This refers to death in a workplace during the work or on the way to and from the workplace that has been caused by a direct or indirect work-related accident. (Safe Work Australia, 2011a)

Fatality rate

The total number killed as a result of work-related injury expressed as a per-capita rate against the population at risk of work-related injury (Safe Work Australia, 2011).

First aid injury (FAI)

A first aid injury is classified as a low-level case such as a minor injury (e.g. minor scratches, burns or cuts) for which items in a first aid kit are sufficient to treat the injured person by an internal, qualified first aid officer. Owing to the low-level severity of the injury, the employee is physically able to return to normal work duties without any restrictions.(Safe Work Australia, 2011a)

Industry

A grouping of businesses that carry out similar economic activities, which could be related either to providing services or producing goods.(Safe Work Australia, 2011a)

Lost time injury (LTI)

Refers to the time, which could be shift or a day, that is lost at work as result of death or injury.(Safe Work Australia, 2011a)

Injury

The general term refers to damage to the body. Workplace injury refers to harm that has been indirectly or directly caused by work carried out at a workplace, or on the way from or to the workplace.

Job

A set of tasks designed to be performed by one person for an employer (including self-employment) in return for payment or profit. (Safe Work Australia, 2011a)

Incident

An incident is defined as an unplanned event occurring in the workplace. An incident does not necessarily have to result in an injury to an individual; an incident can also be classified as a near miss, unsafe act/condition or even a situation involving property damage.(Safe Work Australia, 2011a)

Location of incident

The place at which the injury/fatality occurred. This can be coded to the appropriate category of ANZIC 2006 where applicable.(Safe Work Australia, 2011a)

Medically treated injury (MTI)

A medically treated injury is classified as a medium-level case (e.g. stiches, sutures, infection, removal of foreign objects, use of x-rays) to the extent that a doctor's treatment is required to adequately treat the specific work injury. Typically, every medically treated case result in a few doctor's visits until the employee receives a full fitness-for-work clearance and the injury is fully treated. Owing to the medium severity of the injury, the injured person is usually placed on restricted duties for an extended period of time or alternative work is provided at the workplace. Each medically treated case is assessed by a doctor.(Safe Work Australia, 2011a)

Near miss

A near miss is classified as an unplanned incident that did not result in injury but had the potential to cause serious bodily harm. Near misses are an early warning call to organisations that they must revise their work processes to determine the specific gap that caused the unsafe act/condition in the first instance.(Safe Work Australia, 2011a)

Restricted Work Injury (RWI)

Refers to the type of work-related injury whereby a person is unable to fully operate normal occupation duties whether he or she is at work or not. The injured person must be assigned to light duties during the recovery period.(Safe Work Australia, 2011a)

Service Provider Company

A commercial enterprise, which could be a business or an organisation, who offers or performs work in their areas of expertise. In this study, the terms contracting company and service provider have been used interchangeably.(Safe Work Australia, 2011a)

Total injuries

Total injuries include all injuries that have occurred in a workplace. They include every single reported injury, including a first aid injury, restricted work case, medically treated injury, lost time injury and/or fatality.(Safe Work Australia, 2011a)

Total recordable injuries (TRI) (TRI = LTI + RWI + MTI)

Total recordable injuries are defined as the medium- to high-level severity incidents that occur in the workplace. They include lost time injuries, restricted work injuries and medically treated injuries.(Safe Work Australia, 2011a)

TRI rate (per 200,000 work hours)

The total recordable injury rate is a specific measure used in the workplace as a lag indicator of all medium-level to high-level severity incidents such as fatalities, lost time injuries and restricted work injuries. First aid injuries are not included in this rate. This specific rate is calculated per 200,000 work hours.(Safe Work Australia, 2011a)

Chapter 1: **INTRODUCTION**

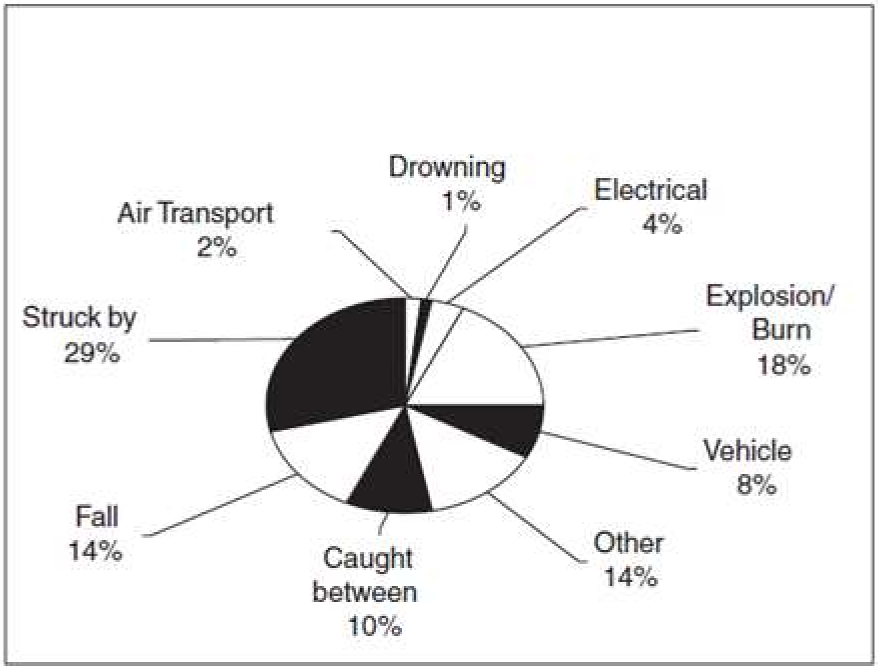
1.1 Background

The oil and gas industry has been acknowledged as one of the highest-risk working environments, particularly because of the hazardous and dangerous nature of the work involving the use of complex equipment and heavy machinery, risky operations, potentially unsafe site conditions, handling of volatile hazardous substances, confined spaces and working at heights (Aven & Vinnem, 2007). Furthermore, typically offshore installations are in the harshest of environments with continuously changing worksites, multiple operations and crews (including contractors and subcontractors) typically from different industries with sometimes different safety ethics, objectives and methodologies, all working in close proximity to each other (Omorogbe, 1997).

A high percentage of workplace accidents worldwide occur each year in the oil and gas industry, and workers in this industry are more likely to die as a result of their work than are any other workers in a similar industry (Aven & Vinnem, 2007). The oil and gas sector throughout history has had several major catastrophic accidents (some of these highly televised). These accidents usually have resulted from explosions and fire through poor risk control mitigation of flammable chemicals, falls from heights, being struck by falling objects, fatigue, electrocution, chemical exposures and rig collapse (Omorogbe, 1997).

Through a general analysis of industry accident data in the offshore industry, incidents were examined from least severe (e.g. minor first aid) to severe (e.g. partial/permanent incapacity, fatality). It was determined that slips, trips and falls from height had a high frequency of occurrence in the oil and gas industry. From 1998–2002, a total of 53% of reported accidents were classed as either falls from height, caught between or struck by an object(Attwood, Khan, & Veitch, 2006b).

Figure 1.1 Significant Incidents by Category, 1998–2002 Oil and Gas Industry



Note. From "Occupational Accident Models: Where Have We Been and Where Are We Going?" (p. 665), by D. Attwood, F. Khan & B. Veitch., 2006a, *Journal of loss prevention in the process industries, 6*(19), p. 665 (https://doi.org/10.1016/j.jlp.2006.02.001). Copyright 2006 by Elsevier.

The work-related offshore fatality rate in the North Sea is considerably higher than that of the Gulf of Mexico region. This conclusion is irrespective of the fact that large sums of money and resource expenditure are directly allocated to the North Sea region in an effort to improve health and safety processes, outcomes and systems. Furthermore, both offshore regions are classified as high risk in nature. Logically, one would think the rate would be lower under these circumstances, so the subsequent question to ask must be, why? The statistics below in Table 1.1 indicate otherwise (Smallman, 1994).

Table 1.1 Comparison of Fatality Statistics for the Gulf of Mexico and the North Sea (1970–1989)

	Gulf of Mexico	North SEA
Total Oil Production (million barrels 1970-89)	15	13.6
Fatalities (1970-89)	240	404
Fatalities per million barrels of oil	13.2	30.7
Fatalities per 1,000-man year	1.4	2.8
Fatalities per 1000 platform years-Fixed Type Platform	1	98
Fatalities per 1000 platform years-Mobile Type Platform	40	165

Note. From *Offshore Safety Management Systems* (p. 34), by C. Smallman, 1994, Current Practice and a Prescription for Change Journal of Disaster Prevention and Management*, 3*(3) (https://doi.org/10.1108/09653569410065001). Copyright 1994 by Emerald Insight.

A whole range of factors may have resulted in the variations between the two locations. One reason could be related to numerous inconsistencies in statistics through under-reporting of incidents by offshore personnel in the North Sea. However, the statistics shown in Table 1.1 specifically target fatalities, and offshore incidents of such a high magnitude and severity must be reported as per regulatory requirements. Another potential factor to consider is the harsh weather conditions because the North Sea, particularly in the winter months, experiences frequent gales and storms; nevertheless, this alone would be unlikely to change the rate considerably.

Since there is a high probability that these reasons are not the cause, an assumption must be made that the comparison of fatality rates should be taken as credible evidence of the safety performance of both these sectors. The Gulf of Mexico had higher number of accidents with less fatalities. In contrast with the North Sea, three-quarters of the fatalities are attributable to just three major accidents, as shown below in Table 1.2 (Smallman, 1994).

Table 1.2 Major Accidents in the North Sea

Accident event	Date	Lives lost
Alexander L. Kielland	1980	123
Chinook helicopter	1986	45
Piper Alpha	1988	167

Note. From "Offshore Safety Management Systems: Current Practice and a Prescription for Change" by C. Smallman, *Journal of* Disaster Prevention and Management*, 3*(3), p.34 (https://doi.org/10.1108/09653569410065001). Copyright 2006 by Emerald Insight.

In addition to this, hazardous work conditions, inadequate or negligent risk assessments and workplace inspections indirectly could lead to increasing the likelihood of a serious injury, lost time injury (LTI) or fatal accident occurrence. Furthermore, both the reputational and financial consequences of accidents should be highlighted as another important concern to this multibillion-dollar industry. All relevant stakeholders in this industry agree that information exchange on past incidents and accidents is one vital technique for preventing the recurrence of similar accidents in the future (Wilen, 2011).

In recent years there have been some efforts to develop and evolve health and safety; however, unfortunately most of these leaps have focused mainly on the major oil and gas companies' management systems, including such areas as policies and procedures to maintain safety accreditation, and the neglect of employees, who are directly exposed to risk on a daily basis on site and who are the best individuals to control this risk (Wilen, 2011).

Furthermore, less attention has been given to the smaller contracting companies who provide both long- and short-term services to these larger companies. These smaller contacting companies are a critical component of the work system, and the larger oil and gas industries rely on their services to continue to operate efficiently (Smith, 2014).

Throughout the history of the offshore oil and gas industry there has been a noticeable disjoint between employees, contractors and subcontractors in relation to health, safety and environment (HSE). An academic group was tasked at exploring the level of safety culture of this industry. About 75 operators, 17 drilling contractors and over 1,000 contractors/subcontractors who vary in size, complexity and financial capacity, support offshore drilling, production and construction activities in the Gulf of Mexico. The academic committee came to the conclusion that because of differing safety perspectives and economic interests, offshore oil and gas companies do not all belong to a single industry association that speaks with one voice regarding safety (Korsen, 2016)

Contractor management failure has led to many offshore catastrophic disasters of the twenty-first century. During the Montara oil leak and wellhead platform fire which occurred in 2009 in the Timor Sea off the Northern Coast of Western Australia, a subsequent inquiry concluded that the operator of this facility did not observe sensible oilfield practices and that there were major shortcomings in systems, processes, communications, risk management and contractor management. These problems were widespread and systemic, and they directly led to the blowout (Lemont, 2012). This incident further highlights the importance of treating contractors the same as employees when it comes to health and safety.

Black Elk Energy, an operator contracting company who worked on an offshore platform in the Gulf of Mexico, was involved in a significant incident in which three of its employees were tragically killed in November 2012. This incident was a clear example of contractor's negligence as well disregarding the contractor by the operator company according to the (United States) US Bureau of Safety and Environmental Enforcement who oversaw the investigation. The final report found numerous gaps in safety precautions related to offshore welding, as well as inadequate communication exchange among contractors. These inefficiencies noted in the investigation resulted in a blast on the offshore platform facility which was managed by Black Elk Energy as the main operator in charge(Technology, 2013).

The statistics discussed in later chapters of this thesis indicated that the number of direct and indirect accidents and injuries across these contracting companies was in fact higher than those of the principal contractor, which could be because they were not familiar with the particular site, had tight deadlines and were given unrealistic key performance indicators to meet.

Failure to meet these deadlines can have an adverse effect on the contracting companies' bottom line financially. Furthermore, there is a risk of damage to their reputation, which could then result in a complete loss of the project as well as a lower probability of being successful in future tenders. This additional stress and pressure can render these smaller organisations more prone to taking certain shortcuts or indirectly making mistakes (Smith, 2014).

The purpose of this study was to focus on the health and safety status of contracting companies and their employees. One particular contracting company's HSE performance was analysed to detect if there were any gaps in their HSE management plan and to conduct an analysis of their HSE incident/injury data. This study is one of the first to have focused on the health and safety status of the contracting company and its employees.

1.2 Research Aim, Objectives, and Scope of the Study

The aim of this study was to create an integrated best practice safety management plan to reduce the occurrence of both low- and high-level incident and work-related injuries.

The fundamental objectives of this study are summarised below:

1. To conduct a feasibility study and develop the scope and structure of the research. To identify the gaps and limitations concerning standardisation and implementation of HSE management plans in the oil and gas industry. The achievement of this research objective is demonstrated in Chapter 1.
2. To analyse key catastrophic HSE incidents in the oil and gas industry through use of root cause analysis. The achievement of this research objective is demonstrated in Chapter 2.
3. To study the importance of HSE management plans from a legalisation point of view and the status of current industry movements with a view to achieving a standardised HSE management plan. The achievement of this research objective is demonstrated in Chapter 2.
4. To identify the best research methods to analyse the historical incident data obtained from the offshore contracting company that has the highest validity and reliability rating. The achievement of this research objective is demonstrated in Chapter 3.
5. To identify the key factors ("high-performing" aspects) of each management plan that have been proven successful. The achievement of this research objective is demonstrated in Chapter 4.
6. To conduct a pilot study by implementing the HSE management plan across an offshore contracting company organisation and observe the outcomes. This plan can be utilised by any contracting companies in the oil and gas industry. The achievement of this research objective is demonstrated in Chapter 5.
7. To emphasise key strategies on how to implement this best practice HSE management plan for contracting companies, including the promotion of a positive safety culture. The achievement of this research objective is demonstrated in Chapter 5, which describes the successful implementation strategy

8. To analyse both contracting company and Australian oil and gas HSE incident statistics. The achievement of this research objective is demonstrated in Chapter 6. In this chapter, it is demonstrated that following the implementation of the HSE management plan by the offshore contracting company, the incident and accident rate significantly reduced.
9. To create safety standardisation throughout the oil and gas industry. The achievement of this research objective is demonstrated in Appendix 6 with the creation of an HSE management plan checklist.

To assist with achieving the research aim, the following three questions were asked:

1. What health and safety management plans do other industries such as construction, health services and asset management to enable them to work effectively towards a zero-harm goal?
2. Which strategies are used in the workplace by oil and gas contractors and subcontractors to maintain the highest level of workplace safety and health according to lead and lag indicators?
3. Could a standardised health and safety management plan be developed for contractors working in the oil and gas industry to harmonise health and safety expectations across the industry to achieve high standards of health and safety in contractors' workplace and strive towards a zero-harm goal?

Particular attention is given to analysis of mainly offshore operations for the following reasons:

1. The offshore environment is a highly complicated, high-risk work environment.
2. A large number of catastrophic incidents have occurred offshore with significant loss of life.
3. Owing to the remote location of many offshore sites, it is extremely difficult to evacuate a large number of personnel safely, particularly during a blowout disaster.
4. A specific contracting company was engaged in this research, whose main operations were based on offshore installations.

1.3 What Was Known About the topic?

Prior to conducting this research, a great deal of research had been conducted on health and safety in the oil and gas industry. Key topics known were safety culture, risk management, safety investigation through accident models and safety legislation. However, very little of this research had been directed towards contractors through safety standardisation, the development of safety management plans and implementation of strategies to ensure contractors are provided with enough information and guidance to be compliant.

1.4 Contributions of the Study

This is the first study to investigate and explore the gaps in contractor safety management systems in the oil and gas industry and to evaluate techniques to improve safety performance. The model safety management plan acts as a best practice standard for other oil-and-gas-related organisations to use as a benchmark. This has enabled the industry to provide a safer work environment for oil and gas employees and to reduce risk (so far as reasonably practicable) or as a best-case scenario eliminate incidents and accidents that could lead to further human, financial and reputational loss.

The integrated HSE plan would be followed by contracting companies to meet HSE requirements when required to work for a larger client company in oil and gas. This approach will promote safety standardisation and ensure all contracting companies know clearly what the requirements are and how HSE standards and operations should be run to be truly successful and strive towards zero harm and a lower rate of accidents and incidents.

This study benefits contracting companies by providing clear HSE rules and regulations that enable standardisation in the industry and result in a reduction in the occurrence of both low- and high-level incident and injuries. This will have far-reaching positive impacts for the industry as a whole and further move the industry towards a "proactive-generative" safety culture. Furthermore, in the Appendices section, some useful tools are provided, which were developed through this research work, and which are outlined below:

Appendix 12: HSE Key Performance Indicators

During the research study, a number of useful tools were created that enabled the contracting company to drive best practice in health and safety. One of these tools consisted of HSE leading indicator key performance indicators (KPIs). The specific KPIs outlined in Appendix 12 were structured to ensure management and employee engagement in hazard and risk control, through reporting and communication of hazards, direct involvement of HSRs in safety and targeting high-risk specific KPIs such as fatigue management, process safety, HSE inspection and consistent reporting of HSE improvements. Also, each KPI had a measurable target that drove accountability of all key staff in the workplace; this ensured that everyone was committed to health and safety.

Appendix 13: Training Matrix

One root cause identified in the research study was a lack of adequate training and skills of employees, resulting in injury. So subsequently, the second tool developed during the research study was the site-specific training matrix shown in Appendix 13. The matrix was designed to ensure that employees were deemed competent in their specific roles prior to being mobilised on site. This comprehensive guide clearly demonstrated what specific offshore safety training was required, depending on the individual's job position (trade background). This matrix was critical in ensuring that no employee could be mobilised on site without the necessary skills and qualifications, as defined in the matrix.

Appendix 14: HSE Management Plan Checklist

Having an integrated best practice HSE management plan requires that a number of critical internal documents must be in place to be successful. The third tool developed in the research study was the HSE management plan checklist, shown in Appendix 14. For auditing purposes this checklist can be used to ensure that the contracting company has all relevant policies and procedural documentation in place.

Appendix 15: HSE Policy Template

One of the most important documents an organisation can have is their HSE policy. An organisation's safety policy is a recognised, written statement of its commitment to protect the health and safety of its employees. It must be clearly displayed in the workplace and communicated to all employees, and management must sign this policy to demonstrate their commitment. The HSE policy is an endorsed commitment by management to its employees regarding their health and safety. The fourth tool developed in the research study is the HSE policy template, provided in Appendix 15.

1.5 Significance

This research project is unique in that it enables the integrated HSE management plan to be adopted not only by contractors in the oil and gas industry, but by other similarly high-risk industries, such as construction and mining, thus providing clear safety benchmarks and improving work processes, management systems and organisational safety culture across any workplace environment.

1.6 Limitations

The main limitations faced in this study are outlined as follows:

1. Owing to the collaborative nature of the oil and gas industry, many different stakeholders are often involved in the extraction and refinement processes. When accidents do occur, in certain circumstances it's often difficult to pinpoint who is directly responsible. This is also dependent on the extent and timeliness of the incident investigation process.
2. Furthermore, because of political complications or historically poor safety culture practices, some accidents could go unreported or alternatively could be misclassified. Therefore, obtaining reliable HSE statistics can be challenging.

1.7 Structure of the Thesis

Chapter 1 provides some background on the research by demonstrating the general status of the offshore oil and gas industry via statistical analysis as well as an overview of past catastrophic incidents, and then comparing these against other industries. This chapter also lists the aims and objectives of the research. It then describes the previous information and data that were known about the offshore oil and gas industry prior to the research. Next, it explains what the research topic is set to contribute to the industry, as well as the significance of the study to the industry as a whole and which key stakeholders will benefit from this research in the long term. Finally, specific limitations of the research will be clearly defined.

Chapter 2 exclusively covers the literature review. This chapter provides a detailed introduction and outlines a historical review of health and safety in the oil and gas industry. A brief analysis of significant catastrophic oil-and-gas-related disasters of the twenty-first century is presented and benchmarked to determine common trends. Furthermore, the importance and purpose of an occupational safety and health management plan in this industry is presented.

Chapter 3 provides a comprehensive review of the general scope of the HSE management plan. Another section discusses the importance of contracting companies in this industry. Most projects are so immense in size that they require partial, or even in some instances complete, outsourcing to smaller businesses with specific skills sets and expertise. Hence, one single project might involve hundreds of smaller businesses' collaborations, which can subsequently prove challenging from an HSE perspective.

These contracting companies are historically more at risk of being involved in accidents because they might not be completely familiar with the site, sometimes being requested for an unplanned job at the last minute. Furthermore, contractors are given added pressure to achieve targets with strict and challenging deadlines, which if not met can mean a huge financial punishment and could also affect future project opportunities.

Chapter 4 provides an overview of the accident incident data of the service provider company. This chapter also analyses the extracted data and discusses suitable accident prevention models to assist in identifying root causes.

The purpose of Chapter 5 was to create an integrated best practice management plan for use by any contracting service company who works in the oil and gas industry. This is achieved through the analysis of the key strategies of other successfully implemented HSE management plans. This chapter also demonstrates the importance of a well-developed safety and health management plan and discusses the key safety and health management principles in enabling organisations to become a world-class leader in safety and health. It also outlines the importance of people management, risk management, health and safety planning, performance, management information, management review, audit improvement and performance risk/reward KPI's.

Finally, Chapter 6 discusses and summarises the significance of the results, concludes this study and makes recommendations for future work.

1.8 Chapter Summary

This thesis presents the first study to explore standardised health and safety management plans for the oil and gas industry in relation to contracting companies, and to evaluate the possibilities of creating a standardised health and safety management plan in promoting a high standard of workplace safety at work relating to injury prevention. The next chapter reviews the published literature about health and safety management plans in various industries and the reasons why it is essential to have a comprehensive HSE management plan in a workplace where contractors are actively engaged. As part of the literature review, Chapter 2 also explores some of the catastrophic disasters that have occurred in this industry, and root cause analysis is applied to understand better how these incidents could have been prevented. Note that the terms Contracting Company and Service Company are used interchangeably throughout the present and following chapters.

Chapter 2: **LITERATURE REVIEW**

2.1 Historical Analysis of the Oil and Gas Industry

2.1.1 A Review of Occupational Health and Safety in Oil and Gas industry

This chapter provides a snapshot and general review of occupational safety and health in the oil and gas industry, which includes all the major types of offshore installations, such as conventional fixed platforms; floating, production, storage and offloading facilities (FPSOs); and semi-submersibles. The purpose of this study was to determine the evolution of health and safety throughout the past few decades and to pinpoint the key strategies (e.g. policies, procedures, initiatives) that acted as catalysts to enable best practice and the development of a successful world-class safety management system to reduce future safety offshore incidents (including catastrophic outcomes). This chapter records the historical developments related to safety management and safety barrier models that have been fundamental for justifying the main research work presented in later chapters.

According to (Machinery Industry, 2019), the intense monetary significance of oil and its products has led to it being known as black gold. The industry is normally separated into three major elements: upstream, midstream and downstream. Numerous industries require petroleum for their operation, and it is considered vital for site operation and maintenance. This component is even necessary for civilisation and is a critical concern for many nations (Machinery Industry, 2019).

Further emphasis on reliance on world oil production was placed by (Environment News Service, 2011). "The need to sustain local sources of oil is huge, but so is the need to protect the lives of those who work in the high-risk environment of offshore drilling industry, as well as the people who live in the region". This quote was given by Committee Chairman Donald Winter, who was responsible for producing the final report in relation to the catastrophic Deepwater Horizon blowout disaster.

2.1.2 Literature Review and Methodology

The literature review was conducted using an initial search of the databases Science Direct, ELSEVIER, ProQuest, Emerald, SAGE, INSPEC, One Petro and Web of science. Other searches were conducted through Google Scholar, a Curtin University library catalogue and the Resources

Safety and Safe Work Australia websites. The literature search was limited to the English language and included published literature from 1971 up to and including 2019. A total of 950 relevant references were identified using the relevant keywords. Relevant key words used in the literature search were "HSE management plan", "contractor HSE performance", "catastrophic incidents", "health and safety of oil and gas", "safety and health legislation", "safety and health management", "safety accident modelling", "safety and health surveying", "safety lag and lead key performance indicators", "risk management" and "hierarchy of controls". The method used for the literature search and screen process is summarised below in Figure 2.1.

Figure 2.1 Method for Literature Review Process

Search for References with Relevant Keywords

- Science Direct (n = 250)
- ELSEVIER (n = 100)
- ProQuest (n = 100)
- Emerald (n = 100)

Total = 550

- SAGE (n = 100)
- INSPEC (n = 100)
- OnePetro (n = 100)
- Web of Science (n = 100)

Total = 400

Total: 550 + 400 = 950

The total number of deleted duplicate studies from databases from 1971 to 2019 (n = 250)

Total: 950 − 250 = 700

Excluded irrelevant studies after reviewing abstracts (n = 340).

Total: 700 − 340 = 360

After reviewing the full texts, 30 studies were excluded because:

- Not completely relevant to the main topic
- Lack of information
- Inadequate data collection
- Language limitation
- Conclusions not clear

Total:360 – 50 = 310

Excluded very low quality and irrelevant studies (n = 170)

Total: 310 − 182 = 128

Total articles included = 128

Total publications included in report = 185

Books 40
Journal Article 128
Magazine Article 10
Electronic Article 30
Research Reports 7
Laws 5

2.1.3 Offshore Industry Snapshot

Inherently, the production of oil and gas offshore can be a high-risk activity. This could be due to constant existence of threat from fires and explosions. Drilling rigs and platforms are commonly congested with personnel, equipment and machinery, and in the event of an emergency there are limited areas to which to safely and efficiently escape. Therefore, it is critical for this industry to focus on the safety of its workers and the prevention of catastrophic events. Overall, these efforts have been successful to a degree, particularly with regard to occupational health and safety.

In the past, the offshore environment has experienced major accidents, which can occur quite frequently and have both direct and indirect costs in terms of loss of human life, environmental damage, economic, financial and reputational loss (Sutton, 2012).

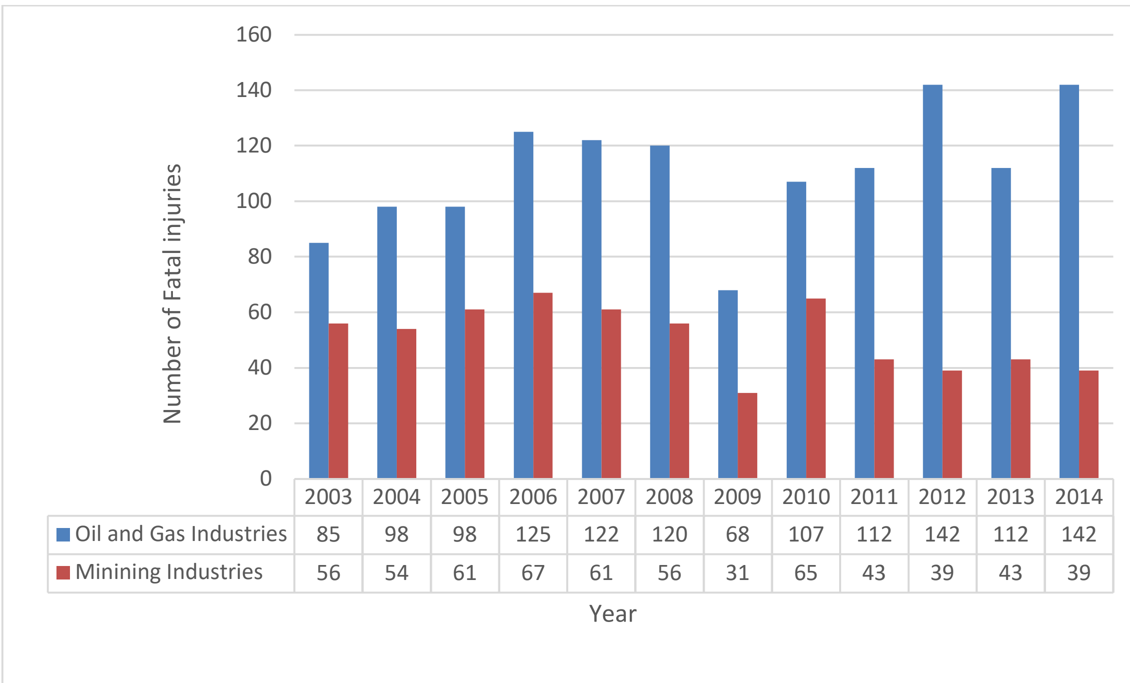
The highest rate of critical accidents has been linked to the oil and gas drilling processes compared with other divisions of this industry, and hence it is essential to ensure optimal safety while carrying out drilling operations. The transitory, overlapping, continuous and complicated characters of drilling operations frequently dictate the variety of risk. Furthermore, the risk is extremely difficult to fully control. Among all that could go wrong, blowouts are the most undesired and dreaded occurrences during drilling operations. Another key challenge in drilling operations is the occurrence of a kick, which, if not controlled appropriately, could result in a blowout. Moreover, an offshore blowout can lead to devastating consequences (Bhandari, Abbassi, Garaniya, & Khan, 2015).

According to (Attwood et al., 2006b) the statistics collected from oil and gas accidents and incidents show that the likelihood for employees of serious injury or fatality from occupational accidents has been just as high as from fire, explosions and other catastrophic incidents. Each year there will be a total of 50 offshore employees who will be injured to a significant level, and approximately 10 employees will be killed in a workplace accident (Mannan, 2014).

One distinguishing characteristic of the offshore industrial environment is that in comparison with onshore industries, major accidents and incidents occur more frequently. Accidents on the production platform Piper Alpha in the British sector (167 fatalities) and the semi-submersible Alexander L. Kielland in the Norwegian sector (123 fatalities) were two of the largest accidents in the North Sea, contributing to approximately half of the total number of fatalities since offshore work commenced in this region (Tveit, 1994).

As shown in Figure 2.2 below, the US oil and gas industry's fatality rate had generally stayed consistently high, peaking in 2012 and 2014. As demonstrated, the oil and gas industry fatality rate is comparably higher than the mining and quarrying industry statistics, and more needs to be done to reduce this rate. As is discussed in detail in later chapters, more comprehensive investigative techniques were utilised to determine root causes more efficiently so that the correct risk controls could be implemented.

Figure 2.2 Fatal Occupational Injuries in the Private Sector Mining Quarry and Oil and Gas Extraction Industries in the US, 2003–2014



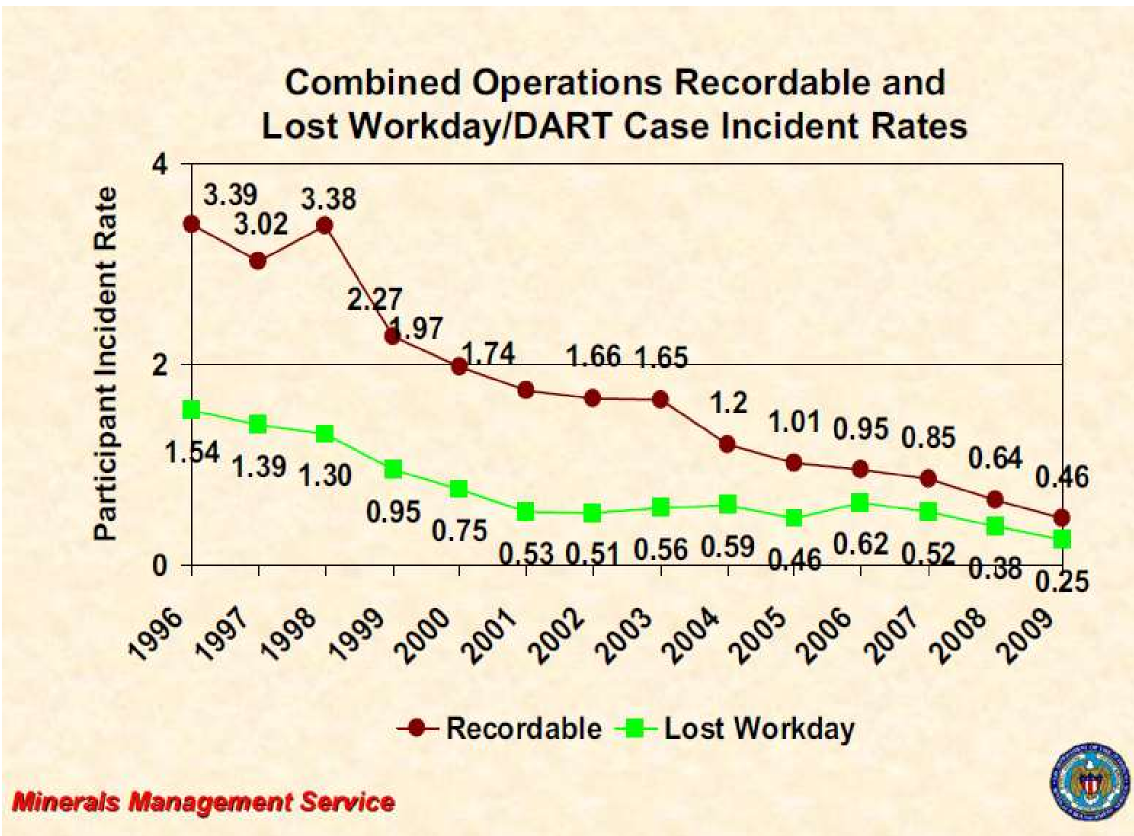
Reported by National Safety Council [NSC] fatal work injuries in the mining quarrying, and oil and gas extraction industry increased 17% in 2014, and the fatal injury rate also increased to 14.1 per 100,000 FTE workers in 2014 from 12.4 per 100,000 FTE workers in 2013; 78% of the total work injuries in this sector were in oil and gas extraction industries in 2014.

Note. From *Oil and gas industry to 'step up' safety in OSHA-backed campaign* (p. 1) by NSC, Safety Plus Health, 1(1), (https://www.safetyandhealthmagazine.com/articles/13714-oil-and-gas-industry-to-step-up-safety-in-osha-backed-campaign). Copyright 2015 National Safety Council.

In the past, the offshore industry has evidently gone through considerable change. Competitiveness and liberalisation have created advantages in the quality and value of goods and services. In contrast, the complexity and seriousness of the processes and systems have increased (e.g. energy ratings have increased, temperatures, pressures and flows have increased, storage has reduced, dependency on technology has increased). The situation discussed above demonstrates the risk of significant accidents with a high degree of damage in relation to people and economic loss (Zio & Aven, 2013).

This highlights the ever-increasing need to ensure that HSE is ingrained in every work process and task on offshore installations so that these catastrophic incidents do not repeat themselves. Figure 2.3 highlights the incident rate over a 13-year period in the US Outer Continental shelf.

Figure 2.3 Safety Trends—US Outer Continental Shelf



Note. From *Offshore Safety Management* (p. 4), by Sutton, I., 2012, Elsevier (https://www.elsevier.com/books/offshore-safety-management/sutton/978-1-4377-3524-6). Copyright 2012 Elsevier.

The chart above provides a snapshot of how the offshore sectors performed from 1996 through to 2009 on the US outer continental shelf. Specific injury indicators measured were recordable injuries, which are defined as any work-related injury or illness requiring medical treatment. All recordable injuries must be reported to the main regulator. The second injury outcome was the lost workday indicator rate, which relates to an employee being involved in an incident that results in being off work for a full shift. Both these injury indicators are an effective way of determining the performance of the industry because they capture higher severity–related injuries. Upon analysis both indicators can be shown to have dramatically fallen over the 12-year period; the steep decline in the recordable injury rate from 3.39 to 0.64 indicates a drop of approximately 80%. In addition, the number of lost workdays also fell by a similar percentage. It was also interesting to note that this rate was not affected by the ever more challenging processes and conditions demanded in this industry during those years, particularly as the industry moved into deep water operations (Sutton, 2012).

However, irrespective of the statistics shown above, unfortunately, the offshore industry has experienced its fair share of notable HSE-related catastrophic incidents, which has highlighted the need for a better safety management system and planning. Offshore-related catastrophic incidents that do occur because of the inherent high-risk climate of the industry usually result in a high number of fatalities as well as millions of dollars' worth of damage. These safety incidents not only affect the related organisation from a safety and health standpoint but also from an environmental and reputational perspective.

As discussed by (Dhillon, 2010), some notable incidents in the international offshore industrial sector that are commonly discussed and analysed are as follows:

- 2012: Stena Clyde accident in Bass Strait
- 2010: British Petroleum's (BP) Deepwater Horizon disaster
- 2009: Montara explosion in the Timor Sea, Western Australia (WA)
- 2007: Perforadora Central Usumacinta jack-up accident, Mexico
- 2005: Mumbai High North Platform accident, India
- 1988: Enchova Central Platform accident, Brazil
- 1988: Piper Alpha Platform accident in the North Sea
- 1982: Ocean Ranger oil rig disaster, Canada
- 1979: Bohi No.2 oil rig jack-up accident, Gulf of Bohi, China

Some of the challenges in the oil and gas industry are with highly technically sophisticated conditions (particularly the need to drill in deep water), which have indirectly introduced new issues that may not have been adequately evaluated. Incidents of this nature include the following:

- In the Gulf of Mexico, 28 major well control spills incidents were reported in 2010. This number has risen 4% from 2008, 56% from 2007 and over 60% from 2006.
- The number of serious incidents in the United Kingdom (UK) has risen 31% from 2009 to 2010.
- The number of releases and well incidents in Norway has risen 48% from 2009. One of these incidents, the Statoil-operated Gullfaks C gas incident in the North Sea, had the potential to be extremely serious. Control of pressure in the C-6A well was suddenly lost, the mud column vanished and the alarm was called (Sutton, 2012).

According to (Dhillon, 2010, p. 124)

> The seven main contributors to individual risk have been identified and are as follows:
>
> - Process leaks that can ultimately develop into fires or explosions that may escalate
> - Occupation-related accidents
> - Ignited blowouts with possible escalation
> - Helicopter-related accidents on the platform itself
> - Extreme environment-related loads
> - Ramming by ships or other floating items
> - Structural failures. (p. 124)

Furthermore, according to (Mannan, 2014, p. 520), “The most typical causes of these accidents include equipment failure, human error, and extreme natural impacts (i.e., seismic activity, ice fields and hurricanes). In drilling activities, accidents usually happen with unexpected blowouts of liquid and gaseous hydrocarbons from the well due to high pressure” (p. 520). To detail more evidence that human error does, in fact, play a major role in accident occurrence, a comprehensive survey was conducted offshore with 200 installation managers. The survey indicated that the managers believed a lack of maintenance, situational awareness and attention to be one of the main root causes of accidents on production platforms and drilling rigs (O'Dea & Flin, 2001). This suggests that the worker’s situational perception of their work environment is not necessarily always sufficiently high to enable a safe productive operation.

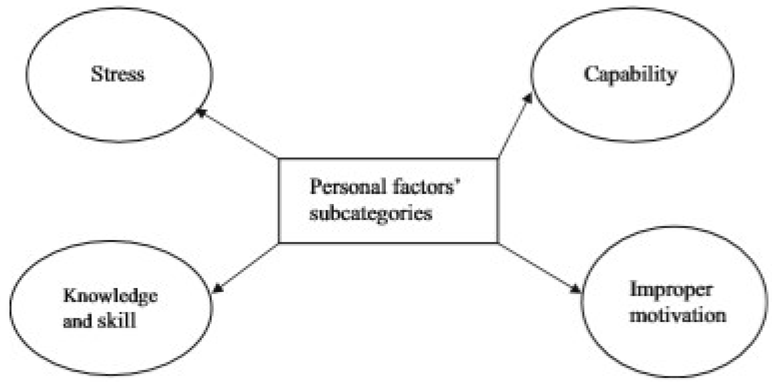
Two issues have plagued the oil and gas industry over the past few decades, these include a higher proportion of "green hat" employees who have entered the industry with very low levels of experience, as well as employees who have had a relatively low level of official education and training. According to Hopkins (2008), the majority of experienced workers in the oil and gas industry are getting closer to retirement age, which means the industry might have to deal with a skills crisis in the next decade, which would lead to a shortage of knowledgeable employees. On average, it requires a total of three years to adequately train a new generation in order to replace retirees. This excludes the decade for the person to become familiar with the industry and learn the professional discipline that was currently held by the experienced workers (Abulhassn, 2015).

In this industry, around 40% of operational leaders have obtained only a high-school level of education (O'Dea & Flin, 2001). (Gordon, 1998) suggested that lack of workers' training, qualification, experience and abilities is the root cause of the majority of incidents in the industry. The situation could even become worse combined with poor management and leadership. The combination of inadequate management and leadership with a low level of education among crew members can result in a high degree of conflict and misunderstanding over instructions. For example, the Piper Alpha disaster that occurred in July 1988 is still deemed one of the worst offshore oil disasters in the history of the UK. The accident resulted in 165 fatalities out of 220 members. In this accident, as with many other accidents in the industry, human error played a significant role.

(Gordon, 1998) also mentioned that the main reason for the Piper Alpha incident occurrence was a direct lack of communication during the handover between the day and night shift crew. Also, some critical information related to the replacement of a pressure safety valve (PSV) with a blind flange, which was not provided; subsequently, this became a major contributing factor in the Piper Alpha disaster. Historical analysis of this incident and other similar catastrophic disasters revealed that both a general lack of experience and education played a major role in these incidents (Abulhassn, 2015).

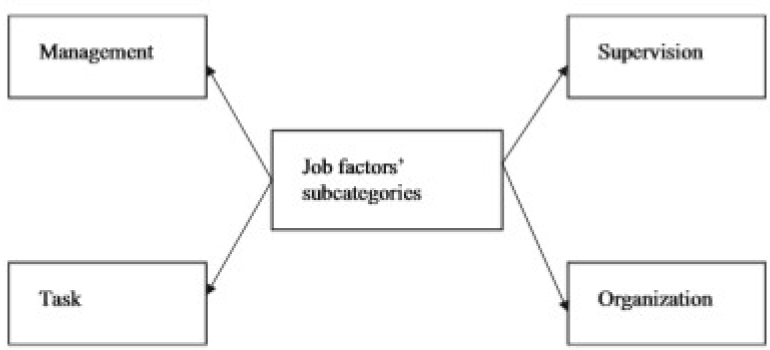
A study was conducted in the UK in which 25 offshore companies were questioned to determine the main personal factors in offshore accident reporting. A majority of the causes identified concerned operating without authority, use of faulty or damaged equipment, employees unfit for work because of drug and alcohol use, incorrect use of work equipment, safety devices not being maintained thus being more prone to failure, lack of attention on the job at hand, and work tasks being performed on live equipment without following basic safety isolation processes (Dhillon, 2010). Evidently, this further highlights the importance of human factors in the offshore environment and how employers should take seriously any personal factors that exist in the workplace, which have the potential to contribute to a serious incident.

Figure 2.4 Subcategories of Personal Factors in Offshore Accident Reporting



Note. From *Safety in the offshore industry* (p. 128) by Dhillon, B., 2010, Book of Mine Safety A Modern Approach, Springer (https://doi.org/10.1007/978-1-84996-115-8_10). Copyright 2010 Springer.

Figure 2.5 Subcategories of Job Factors in Offshore Accident Reporting

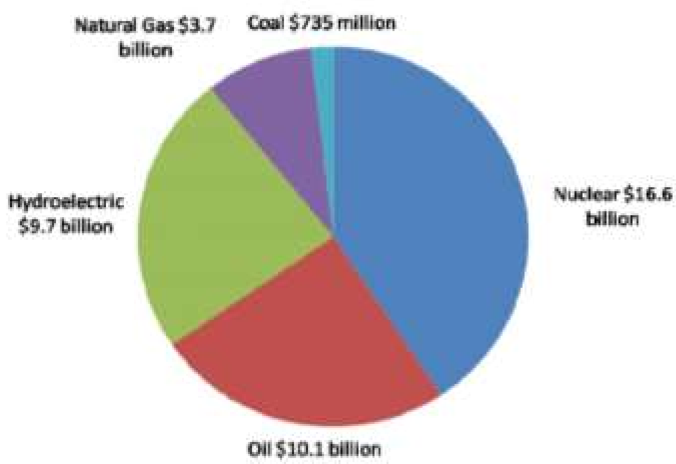


Note. From *Safety in the offshore industry* (p. 128), by Dhillon, B., 2010, Book of Mine Safety A Modern Approach, (https://doi.org/10.1007/978-1-84996-115-8_10). Copyright 2010 Springer.

Typically, when assessing the risk score of a task, often the consequence is measured by the potential human loss; however, the costs of property damage when there is a significant incident should also be considered. In particular, it is important to compare the offshore oil and gas industry with other sectors.

> A study found that only a small amount of accidents caused property damages greater than $1 billion, with most accidents below the $100 million mark. The second largest source of fatalities, nuclear reactors, is also the second most capital intense, supporting the notion that the larger a facility the greater consequences of its failure. The inverse seems true for oil, natural gas, and coal systems: they fail far more frequently, but have comparatively fewer deaths and damage per each instance of failure. While hydroelectric plants were responsible for the most fatalities, nuclear plants rank first in terms of their economic cost, accounting for 41% of all property damage. Oil and hydroelectric come next at around 25% each, followed by natural gas at 9% and coal at 2% (see Fig. 9). Excluding Chernobyl and the Shimantan Dam, the three other most expensive accidents involved two oil spills and one nuclear accident but killed no people. **(Sovacool, 2008, p. 1806)**

Figure 2.6 Energy Accident Property Damage, 1907–2007



Note. From *The costs of failure: A preliminary assessment of major energy accidents, 1907–2007* (p. 1806), by Sovacool, B, 2008, Journal of Energy Policy, 36(5) (https://www.researchgate.net/publication/4948261_The_costs_of_failure_A_preliminary_assessment_of_major_energy_accidents_1907-2007). Copyright 2008 Elsevier.

The pie chart in Figure 2.6 highlights the cost of energy related property accidents in the different industrial energy sectors from the period of 1907 to 2007.

Following this, an analysis of the frequency of energy failures were outlined in the quote below. "By energy source, the most frequent energy system to fail is natural gas, followed by oil, nuclear, coal and then hydroelectric. The distribution of accidents over time also reveals their shifting and dynamic nature" (Sovacool, 2008, p. 1808). The high failure rate and subsequent accidents of oil and gas in comparison with other industrial sectors certainly raise alarm bells regarding whether the oil and gas industry has sufficient safety controls in place to eliminate accidents in the future. Table 2.1 shows the energy related accidents by source over a period of a decade.

Table 2.1: Energy Accidents by Source, 1907–2007

Technology	Accidents	% of total
Natural gas	91	33
Oil	71	25
Nuclear	63	23
Coal	51	18
Hydroelectric	3	1
Other renewables	0	0

Note. From *The costs of failure: A preliminary assessment of major energy accidents, 1907–2007* (p. 1808), by Sovacool, B, 2008, Journal of Energy Policy, 36(5) (https://www.researchgate.net/publication/4948261_The_costs_of_failure_A_preliminary_assessment_of_major_energy_accidents_1907-2007). Copyright 2008 ELSEVIER.

The frequency of accidents demonstrated in Table 2.1 sheds light on increased social awareness and ethical concerns, encouraging government bodies as well as policymakers that a more proactive stance and authoritarian position must be taken in relation to managing safety. Historically, in the UK the first government move was apparent in the Robens Report of 1972 (Robens, 1972). This report highlighted that the key principles of safety management must lie with both employers and employees if any tangible improvements were to be seen in preventing future accidents and incidents. The report (Robens, 1972) recommended "voluntary efforts" principles, which provided a foundation for the statutory *Health and Safety at Work Act 1974*, which was the act of the Parliament of the United Kingdom and eventually would lead to the establishment of the Health and Safety Executive. This recommendation, although voluntary at the time, changed the way safety management was viewed in the whole of Europe.

In contrast, in the US in 1971, the *Occupational Safety and Health Act* (OSHA) became operational. These safety regulations put the main responsibility on the employer of the organisation. The regulations also emphasised the significance of health and safety management as opposed to being considered alongside industrial safety (Umar, 2010). Table 2.2 below has summarised a number of publications related to the global oil and gas industry.

Table 2.2: Overview of Oil and Gas Industry

Author(s) publication year Data collection country	Research aim	Study population	Research methodology and data analysis	Research limitations/ strengths	Key findings
Mannan. S (2014) United Kingdom	To provide an analysis of the different hazards encountered offshore as well as the common offshore incidents	-	Qualitative research, archival research	*Limitations* Only a specific number of safety incidents were pointed out. A more comprehensive analysis of the industry would have provided more validity to the study *Strengths* Emphasised the many different hazard and risk outcomes that have occurred offshore	Highlighted that the most common type of offshore safety events included fires, collision, explosions and loss of well control (blowout)
Gordon, P.E (1996) United Kingdom	To highlight the impact of human factors in major industrial accidents in the offshore oil and gas industry	A total sample of 25 UK offshore oil companies' accident reporting forms where analysed, and the contributing and root causes of accidents were compiled into a list. 'Immediate Causes' were either technical or human	Qualitative research. Analysis was undertaken of accident reporting forms through observational analysis and screening of documentation	*Limitations* There was a high degree of variation between the 25 UK offshore accident reporting forms with regard to the number of items in each category, and their clarity and structure *Strengths* Provided a wealth of information in relation to statistics on common human factor–related causes of accidents.	**Significance of human factors in offshore industrial accidents** The findings from this research confirmed that human factors play a key role in major oil and gas–related incidents. This conclusion and supporting results can be provided to management, supervisors and the workforce with the view of making personnel aware of the significance of human factors related to accidents. Furthermore, resources can be allocated to the development of various training programs related to human factors.

Odea.A & Flin.R (2001) United Kingdom	To determine the role and experiences of site managers in relation to safety in the oil and gas industry	An extensive survey questionnaire was performed with 200 offshore installations managers (OIMs) from 157 oil and gas facilities operated by 36 organisations on the UK continental shelf	Qualitative research. Through the use of a questionnaire	*Limitations* More research is required to determine exactly the amount of influence each site manager has on safety climate *Strengths* Following this study, a cross industry forum was formed whereby OIMs could meet periodically to discuss various safety issues, in the interest of best practice and developing a higher level of safety leadership offshore	**Role and experience of site managers in safety** This research suggested that managers were very aware of their roles as leaders in safety, and they knew the most effective way of forming good quality participative and open relationships with subordinates. However, managers with less experience appeared to overestimate their abilities to adequately influence and stimulate the workforce. The main gaps that are still present include standardisation, simplification and ensuring safety policies and procedures are clear, as well as improved workforce competency and increased workforce involvement in safety
Sovacool, B (2008) Singapore	To provide a preliminary assessment, which includes the social and economic costs of major energy accidents between the period of 1907 to 2007 and to highlight the cost of failure	A study of 279 incidents took place. The incidents were responsible for $41 billion in property damage and 182,156 deaths in the energy sector	Qualitative research. analysis of archival documentation, which consisted of studying historical archives, and newspaper and magazine articles. Certain words were highlighted such as “energy”, “spill”, “leak”, “accident”	*Limitations* The research does not highlight how these costs related to other hidden or cumulative events. Another point to consider is whether better governance can really improve energy systems *Strengths* The preliminary study calculated the absolute cost of energy accidents in terms of death and property damage	**The cost of energy-related accidents** Energy-related events have a major toll on human health and welfare, the work environment and society. The fact that these accidents are systemic in nature means that they can be predicted with a fair degree of certainty. Therefore, in the future there is a greater possibility that similar events can be predicted and acted upon accordingly

Dhillon, B.S (2010) Global	A study was undertaken to determine how well personnel in the offshore drilling industry understood situational awareness	A total of 12 offshore staff engaged in the interviews	Qualitative study, research conducted via interviews	*Limitations* Only a fraction of employees eventually engaged in the interviews. *Strengths* The paper provided an in-depth analysis of employees' situational awareness in the offshore drilling industry	**Situational awareness in the offshore industry** A study of the world errors in offshore drilling incidents indicated that 66.7% of the incidents were perception-related, 20% comprehension-related, and 13.3% projection-related
Gupta, J.P & Edwards D.W (2002) United Kingdom	To research inherently safer design (ISD) in the process-related industry	A survey was carried out among industrialists, academics and regulators. A total of 63 surveys were conducted from 11 countries representing a very broad spectrum, which added validity to the survey	Qualitative research. Use of surveys distributed to relevant parties	*Limitations* The survey was sent to 400 people worldwide who were thought to be active in ISD; however, this could not be completely confirmed *Strengths* Several participants indicated that they would henceforth include ISD in their course on process safety and design. The research study spread the teachings of ISD	**Inherently safer design in the process industry** The sad truth was that ISD is applied when an ISD enthusiast is in the team, and not otherwise
Keyserling, M (1983) United Kingdom	To determine the relationship between occupational injury rates and work experience	The study was conducted on a population of 344 volunteer industrial workers through monitoring their frequency of visits to the medical clinic, over a period of 14 months	Qualitative research. Use of survey. Each participant was asked to answer questions regarding work and health history	*Limitations* There were no studies conducted to determine if young inexperienced workers were subjected to various hazards as opposed to their older, more experienced colleagues. Typically, in many workplaces it is fashionable to assign the most undesirable tasks to the newest employees *Strengths* This paper determined that this risk can be substantially reduced via use of administrative controls such as training, close supervision and regulator feedback.	**Occupational injury rates and work experience** The research found that employees with a seniority level between 3 months to 1 year were exposed to an increased rate of medical incidents as opposed to other employees

2.1.4 Literature Summary: A Review of Occupational Health and Safety in the Oil and Gas Industry

The seven papers reviewed above all contribute in providing an overview of the oil and gas industry over the past century from a health and safety perspective. They provide an insight into the key defining areas that shaped health and safety to the present day. The first paper provided an analysis of the different hazards encountered offshore as well as the common offshore incidents. The second paper reviewed emphasised the importance of human factors in the oil and gas industry, providing extensive evidence that human factors had indeed historically played a significant role in both minor and major oil and gas incidents, having proven a direct link to such catastrophic incidents as the Deepwater Horizon and Piper Alpha disasters. The third paper critically analysed the roles and experience of site managers in the industry to determine if there were adequate levels of safety leadership in management roles. The fourth paper in table 2.2 summed up an analytical snapshot of general energy-related accidents from 1907 to 2007. It specifically highlighted the HSE elements, as well as the cost of failure in oil-and-gas-related incidents. The fifth paper researched inherent safer design in the process industry, while the sixth discussed an interview-based study to determine how offshore drilling personnel understood the concept of situational awareness. The final paper presented a study related to the relationship between employment duration and occupational injury frequency, highlighting a re-occurring issue in the industry related to inexperience as a compounding contributing factor.

This section conducted a general review of occupational safety and health in the oil and gas industry. Upon historical analysis, it was identified that a great number of fatalities in this industry were attributed to catastrophic incidents resulting in a high degree of human, financial and reputational loss. Therefore, the next section will critically examine how catastrophic incidents can be critically analysed to determine root causes of incidents through various accident modelling.

2.2 Accident Investigation and Root Cause Analysis

2.2.1 Analysis of Catastrophic Incidents

Analysis of historical catastrophic incidents can be beneficial in providing a unique opportunity for organisations to learn from past experiences and to openly share key learnings, to eliminate the possibility of similar events occurring again. As Jack Welch, the former chief executive officer

(CEO) of General Electric and expert on management, was never tired of saying, never waste a crisis (Meyer, 2019). These incidents are typically analysed to determine both root causes and contributing factors through established techniques such as root cause analysis and accident causation modelling. Large established companies have had their fair share of catastrophic incidents. "or for Exxon was the accident of Exxon Valdez, which released crude oil into the fresh waters off Alaska. For Shell it was the decommissioning of its Brent Spar rig that infuriated environmentalists. These incidents also highlight the potentially extensive lifecycle costs of offshore assets, not to mention that generally incidents are bad for business. For example, the share price of BP fell by 51% in the 40 days following the Deepwater Horizon incident. The blowout of BP's Macondo well highlighted the significance of operational excellence to the world. The catastrophic incident released approximately 3.19 million barrels of crude oil into the Gulf of Mexico (Meyer, 2019).

An effective tool used by various organisations to critically analyse catastrophic incidents is the use of various accident causation models. These models are used to identify root causes and contributing factors. Various accident causation models typically used in the oil and gas industry, such as the domino theory and the Swiss cheese model, will be discussed further in the following section. Accident Models and At-Risk Behaviours: Key Learnings

According to (Suchman, 1960), a significant event is defined as an accident if it is unexpected, unplanned, unintentional and inescapable in nature; it is also classed as an accident if there is limited warning, it occurs rapidly or if there has been a degree of negligence. There are several attributes that can be used to categorise an event as an accident. It was proposed that the following three characteristics be used to classify an event as an accident: (1) degree of expectedness (2) level of avoid ability and (3) level of intention. Secondary characteristics are: (1) level of warning, (2) length of occurrence, (3) level of negligence and (4) level of misjudgement (Suchman, 1960).

2.2.1.1.1 At-Risk Behaviour

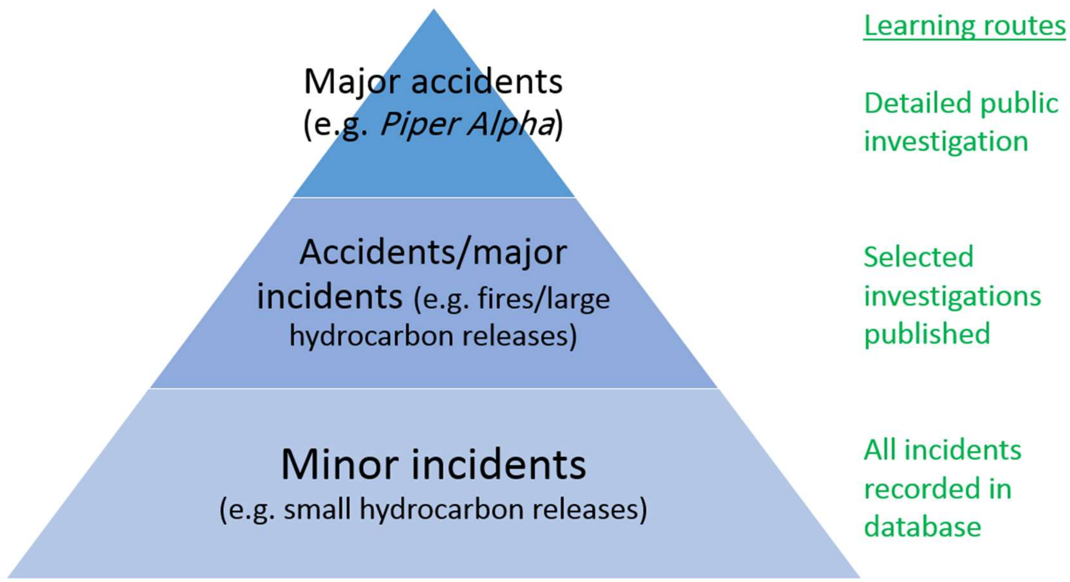
Studies conducted in the 1990s demonstrated that the employees who became most susceptible to injury were those who suffered a high level of physical strain, an also who perceived their work as high risk. (R Flin, Mearns, Fleming, & Gordon, 1996) advanced this research to the British region of the North Sea. The study found three specific areas that typically would lead to an accident. These included (1) personalised characteristics (including attitudes towards safety, work experience, knowledge), (2) work characteristics (job tasks, job stress, environment) and (3) platform characteristics (safety management, safety culture). This study (R Flin et al., 1996) also highlighted that the balance between safety versus production demands and a strong emphasis by management on safety had a significant impact on the perception of workers regarding risk.

2.2.1.1.2 Accident Models

During the 1960s several loss of control preventions–related theories began to appear; these particular loss prevention theories were mainly developed in the UK by the Institute of Chemical Engineers. However, greater research was conducted in light of such catastrophic accidents as the Flixborough disaster where it became apparent that more research was required to determine the root causes of accidents. The Flixborough disaster in 1974 was an explosion at a chemical plant, which killed 28 people and seriously injured 36 people. During this period, it became apparent that loss prevention was an integral part of the management system. Although the principles of the accident model theory were developed specifically for the process industry, they are applicable in other industrial sectors (Lees, 1980).

The pyramid in Figure 2.7 below shows how organisations can conduct various accident investigation exercises with their staff to ensure that key learnings are identified, from previous accidents.

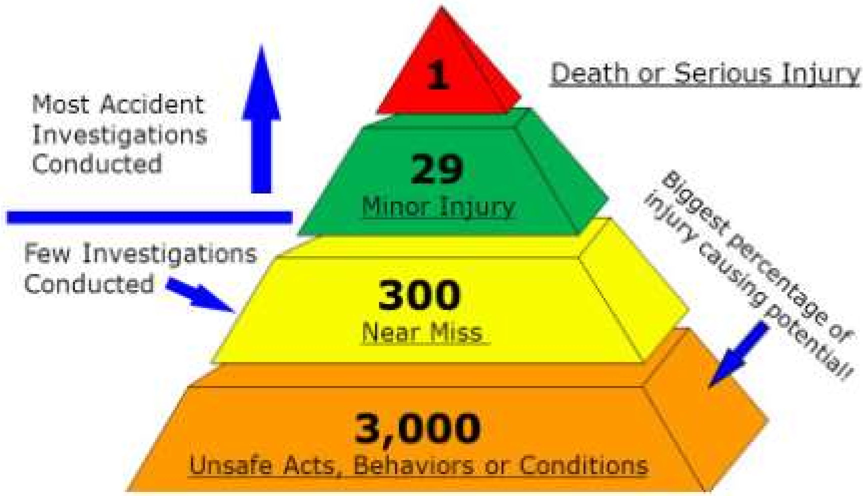
Figure 2.7 The Accident Pyramid



Note. From *Oil & Gas Safety* (p. 1), by Spouge, J., 2017, Journal of Major incident descriptions – a gap in offshore safety resources (https://blogs.dnvgl.com/oilgas/safety/major-incident-descriptions). Copyright 2017 DNV-GL.

Workplace injuries are only caused when multiple contributing factors come together. High impact incidents such as fatalities are only at the tip of the accident pyramid; however, some 500–2,000 less serious injuries take place prior to the occurrence of a fatality (Takala, 2002). This concept highlighted a shift in safety thinking from just analysing high-risk catastrophic incidents to also exploring the root causes of lower "day-to-day" risk incidents as well as hazards and near miss reports. The accident pyramid has been used as an effective tool by world-class organisations to improve their safety culture. This methodology of analysing hazards and near misses originated from the Frank Bird model or incident ratio model (see Figure 2.8).

Figure 2.8 Frank Bird's Accident Model



Note. From *Near Miss Concept* (p. 2), by Spouge, J., 2019, Journal of Gosafe Rail (http://www.gosaferail.eu/concept/near-miss-concept). Copyright 2019 Gosafe Rail.

Accident modelling was initiated in the early industrial age and was the first model to establish, through a graphical picture, a series of events that were thought to take place for a safety event to occur. One of the first accident models was developed in 1931 by Herbert Heinrich, and during the development of this model in the industrial age the concept of "modelling accidents" was introduced in an effort to clarify, using a scientific approach, how an accident occurs (Marsden, 2017).

Herbert's work was developed further in the 1970s by Frank E. Bird, who worked for an insurance company in North America. Bird had the task of analysing more than 1.7 million accidents that had been reported by 297 cooperating companies. These organisations consisted of 21 different industrial sectors employing over 1.7 million employees, which totalled over 3 billion work hours. Bird's occupation enabled him to analyse accidents and injury data collected by his employer. This study was sustained for over 30 years, and he was able to identify both the casual factors of industrial-related accidents, namely, unsafe acts and conditions of people. (Marsden, 2017)

(USSA Global, 2015) Bird's triangle was created in the 1960s. His conclusion about accident causation was that during the work process, one unsafe act can lead to another, which eventually results in the specific occurrence of an event. Through his studies he estimated that at-risk behaviour at work can lead to near misses and then ultimately turn into an event, resulting in either injury or harm to the employee.

Bird extended his research to reveal specific ratios in the occupational accidents reported to the insurance company: For every one reportable major injury (either resulting in a fatality or serious disability, lost time injury [LTI] or medically treated injury), there were 9.8 reported minor injuries (which required first aid treatment). Furthermore, from the 95 companies that were also investigated, a ratio of one LTI was reported per 15 medical treated injuries (Marsden, 2017).

This comprehensive and scientific approach to the analysis of decades of accident reporting records concluded that there was a specific golden ratio between fatal accidents, accidents, injuries and minor incidents (often reported as 1-10-30-600) and later named Heinrichs's Law or Heinrich's Ratio (Busch, 2018).

Injuries that are caused by specific workplace accidents have the potential to lead to a fatality only when a number of contributing factors align in a simultaneous fashion. High impact injuries, which can include severe permanent injuries as a well as fatal accidents, are only found at the top of the accident pyramid. Dependent on the type of work, some 500–2,000 minor injuries take place per fatality (Takala, 2002).

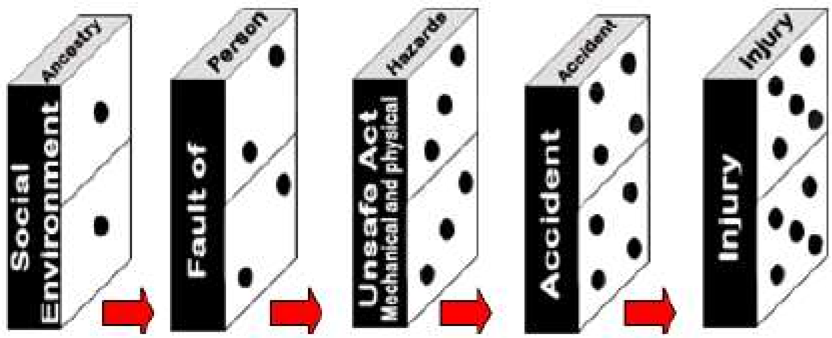
According to (Bird & Germain, 1990, p. 43), the accident model delivered a number of conclusions:

- All accidents whether major or minor consist of multiple causes; there is no such thing as an accidental accident.
- There are rarely accidents with a single cause particularly in large and complex technologies organisations.
- The causes of accidents are usually quite complex in nature and interactive.

A number of studies was completed to verify further the association between serious and minor accidents. In 1997, a specific study conducted. by (Health and Safety Executive, 1999) confirmed the concept of the accident pyramid

Heinrich also created the domino model of accident causation, a simple linear accident model (Marsden, 2017). The accident can be circumvented, according to Heinrich, by removing one of the dominoes—normally the middle domino, which represented the unsafe act. This theory was a major stepping stone in safety risk management and provided the critical foundations for the development of useful accident prevention measures designed to prevent unsafe acts or unsafe conditions. This concept is still taught and widely used in the present day in the occupational industry.

Figure 2.9 Domino Theory



Note. From *Accident Modelling of Railway Safety Occurrences: The Safety and Failure Event Network (SAFE-Net) Method* (p. 2), by Klockner, K., Toft, Y., 2015, Journal of Elsevier, V.3 (https://www.researchgate.net/figure/Heinrich-Domino-Theory_fig1_281572242).Copyright 2015 Procedia Manufacturing.

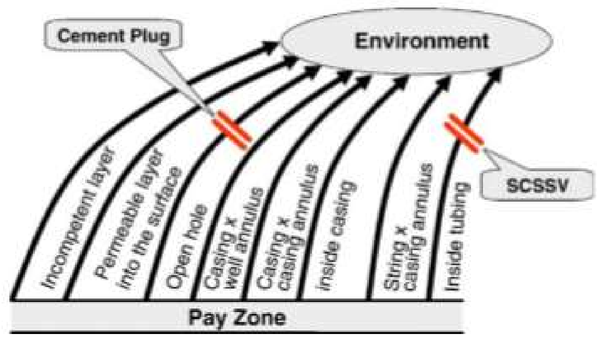
Furthermore, according to (Bird & Germain, 1990), the first major revised version of the domino theory was introduced by Bird and Loftus. This update presented two new concepts to the existing model:

1. Management and management error have a fundamental influence on accident causation
2. When there is an accident occurrence there is a degree of loss, this loss can result in the form of property or equipment damage, human loss via serious injury/impairment/disability and production or asset loss.

2.2.1.2 *Barrier Management and the Swiss Cheese Model*

A safety barrier is a physical barrier comprising one or more elements that has the potential to prevent or isolate an unwanted outcome along a specific determined route. Application of this specific barrier methodology to an offshore well would be in the context of a physical separation capable of stopping the unintended fluid flow from a permeable interval up to the surface through a designated path. Figure 2.10 demonstrates two examples: one example consists of a cement plug in the open hole path, and the second example is surface controlled subsurface safety valve in the inside tubing path (Miura, Morooka, Mendes, & Guilherme, 2006).

Figure 2.10 Totality of Possible Fluid Flow Paths

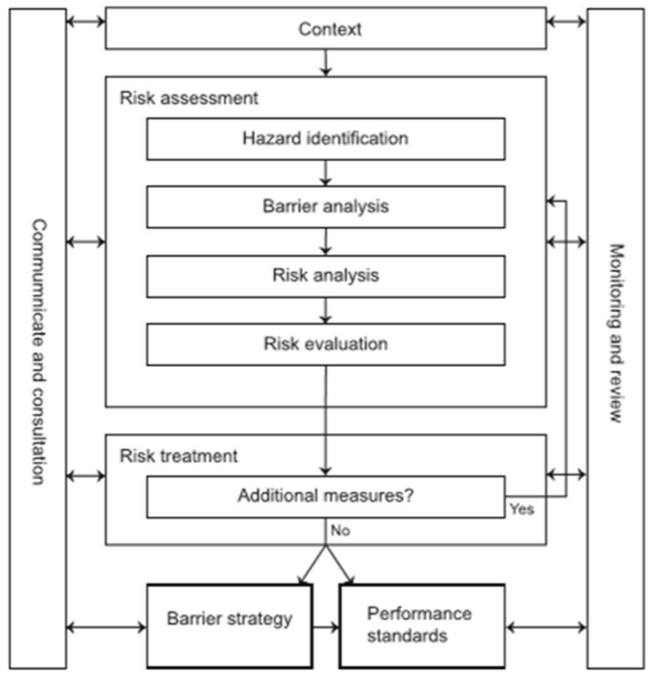


Note. From *Characterization of operational safety in offshore oil wells* (p. 113), by Miura et al., 2006, Journal of Petroleum Science & Engineering, 1(51) (http://www.sciencedirect.com/science/article/pii/S0920410505002111).Copyright 2006 by Science Direct.

The logic for using the barrier management principle was detailed by (Viner, 2015) who mentioned that the reason accidents occur is because of a loss of control of dangerous energy, so therefore it is imperative that this energy is separated from vulnerable targets. (Viner, 2015)

(Ognedal, 2013) defined barrier management as a coordinated activity to establish and maintain barriers so that they are able to maintain their function at all times. The Petroleum Safety Authority (PSA) divides barrier management into six different activities: establishing the context, risk assessment, risk treatment, communication and consultation, establishment of barrier strategies and performance standards, and monitoring and review, as shown in Figure 2.11.

Figure 2.11 The PSA Barrier Management Framework



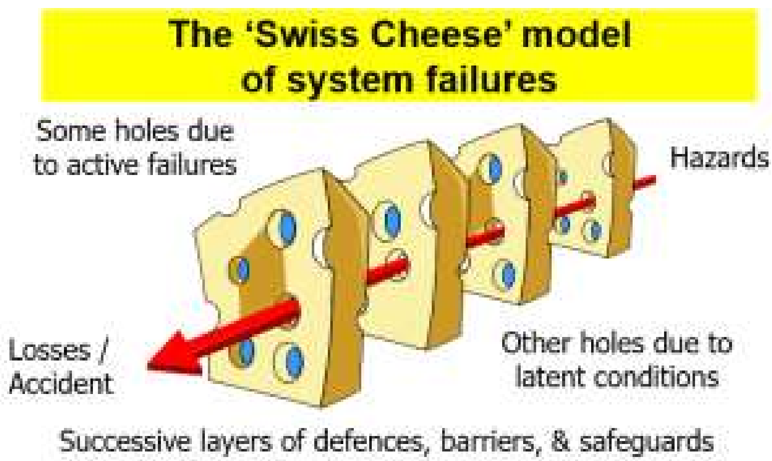
Note. From *Barrier Management* (p. 9), by Ogendal, M., 2013, Book of Principles for barrier management in the petroleum industry (https://www.ptil.no/contentassets/11851dc03a84473e8299a2d80e656356/principles-for-barrier-management-in-the-petroleum-industry_2013.pdf).Copyright 2013 by Petroleum Safety Authority Norway.

Barrier management has been proven an important tool, since this system has been used in a number of major accident investigations. For example, during the BP Deepwater Horizon incident in 2010, the barrier management system was used, and it was determined that this incident did in fact have multiple barrier failures, mainly due to a lack of systematic barrier management (Johansen & Rausand, 2015).

Upon thorough investigation of the event, it was found that the direct result of the BP incident was a complete loss of well integrity. Well integrity is the application of operational, technical and organisational means to decrease the risk of an uncontrolled release of formation fluids throughout the life cycle of a well. Safety barriers can be classified as both non-physical, or physical means aimed at control, prevention and mitigation of an unintended occurrence. Barriers can also fall into a number of different categories, such as active, passive, physical, technical or human and operational systems (Skogdalen & Vinnem, 2012). These barriers are discussed in detail in the Deepwater Horizon section 2.2.1.5.

Most workplace accidents almost certainly have more than one contributing cause. For many years safety professionals have utilised the Swiss cheese model as per Figure 2.12 to assist managers and workers in the process industries to improve their comprehension of incidents, failures and certain decisions that could lead to a potentially catastrophic occurrence or near miss.

Figure 2.12 The Swiss Cheese Model



Note. From *Implementation of Swiss Cheese for UniKL MIAT hangar* (p. 3), by Mat Ghani et.al, 2018, Journal of Sustainability in Aerospace Engineering and Technology (https://iopscience.iop.org/article/10.1088/1757-899X/405/1/012007/pdf).Copyright 2018 by IOP publishing.

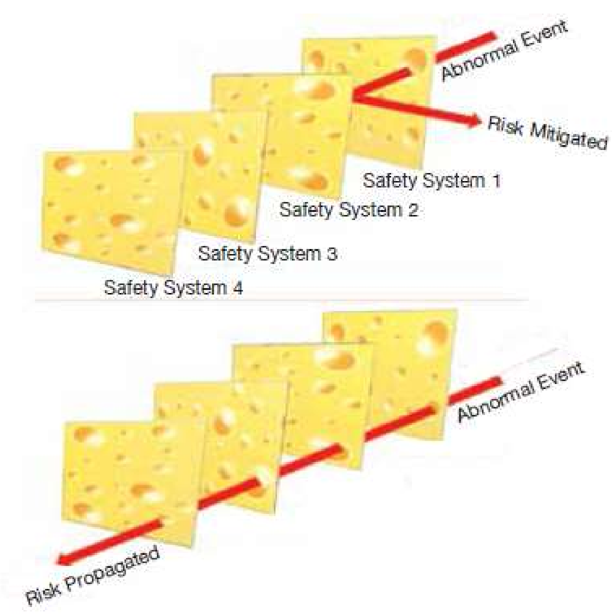
According to (Ness, 2015, p. 24),"this model and each layer of protection is depicted as a slice of Swiss cheese, and the holes represent potential failures in the protection layers, such as:

- Human errors
- Management decisions
- Single point equipment failures or malfunctions
- Knowledge deficiencies

- Management system inadequacies, such as failure to perform hazard analysis, failure to recognize and manage changes, or inadequate follow up on previously experienced incident warning signs." (p.24)

Furthermore, certain safety barriers can potentially degrade over time, safety controls can be rendered redundant and the system could slowly drift back towards a state of high risk if the size of the Swiss cheese holes increases. Consequently, barriers should be systematically reviewed, operated and maintained to enhance their performance throughout the system's lifespan. As discussed by (Ness, 2015), however, an effective process safety management system can reduce the number of holes and sizes of the holes in each of the system's layers, thus reducing the likelihood that they will align.

Figure 2.13 The Swiss Model Illustrates That When Weakness in Protection Aligns, an Incident Can Occur



Note. From *Lessons Learned from Recent Process Safety Incidents* (p. 24), by Ness, A., 2015, Journal of CEP (http://www.aiche.org/resources/publications/cep/2015/march/lessons-learned-recent-process-safety-incidents. Copyright 2015 by AIChe.

For better understanding of these models, several select oil and gas incidents are discussed below in detail. These incidents vary in the level of consequence, impact and human loss, but all can assist by providing key lessons for organisations in eliminating similar occurrences in the future. Following this, a conclusion will be drawn summarising the incidents, and common trends will be highlighted.

2.2.1.3 *Motiva Enterprises Sulphuric Acid Tank Explosion*

On 17th July 2001, a large explosion struck the Motiva Enterprise refinery in Delaware City. Just prior to the incident a team had been assigned to repair a walkway, which was positioned directly above a storage tank holding sulphuric acid. During this task, the team were required to conduct hot works, and a spark from their equipment ignited some flammable vapour in one of the nearby tanks. Later on during the investigation it was discovered that there had been holes in the roof of the tank's shell caused by heavy corrosion (CSB, 2019). This corrosion caused the tank to subsequently collapse, resulting in the death of one of the workers.

Eight workers were seriously injured as well. Later, investigation showed that sulphuric acid tanks had a historical issue of leaking; however, upon revision of historical records, it was apparent that Motiva had disregarded this issue. Motiva even disregarded the recommendation when their own tank inspectors formally suggested a complete internal examination as a priority in three consecutive annual reports prior to the disaster. One operator had submitted a condition report three weeks prior to the explosion and deemed that the tanks were unsafe because there were holes in two of the tanks and also mentioned that the hose used to cover the tank with non-flammable carbon dioxide had been illegally fitted. The investigative team found Motiva had in fact proceeded to investigate the unsafe condition report but had taken no physical action to correct the deficiencies. A recommendation was announced to have a section related to atmospheric storage tanks in process safety management (psm) standard (CSB, 2019). A clear act of negligence by Motiva was highlighted, which represented a clear breach of duty of care to eliminate hazards as far as reasonably practicable.

2.2.1.4 *British Petroleum America Refinery Explosion*

> It is commonly agreed that there is little, if any, correlation between the occurrence of personal accidents and process accidents. The Texas City disaster has highlighted, yet again, how striving for a reduction in personal safety performance can completely miss all the requirements necessary to ensure process integrity. (Umar, 2010, p. 17)

At approximately 1:20 pm on 23 March 2005, a number of explosions occurred at the BP Texas City refinery. These explosions had occurred just after the restarting of a hydrocarbon isomerisation unit. Fifteen workers were subsequently killed, and 180 others were injured in the aftermath. The main reason for the explosion was due to a distillation tower becoming flooded with flammable hydrocarbons, becoming over pressurised and causing a geyser-like release from the vent stack (CSB, 2019). Later, during the investigation phase the team identified many critical issues with the facility's preventive planned maintenance program that were also linked to the 23 March catastrophic disaster.

The investigation team concluded that the BP supervisory personnel had been mindful of the issues with the equipment, in particular the level transmitter, prior to the 23 March start-up but even so had decided to sign off on the routine inspection checklist for the equipment as if they had been completed. This clearly exposed the major pressures that staff were under at the refinery in terms of production. On the specific day of the accident occurrence, it was reported that a blowdown drum had a loss of containment of highly flammable material directly out to the atmosphere. In retrospect, it was found the drum had never been connected to a flare, even during its construction in the 1950s. It had been specifically stated in the Amoco safety refinery standards that it was highly recommended that the drum be connected to a flare; however, this was not completed. Following this catastrophic incident a recommendation was issued to reinforce the planned comprehensive enforcement of the PSM standard and to require a management of change review be conducted for any organisational changes (CSB, 2019).

Upon review of the general safety culture of Texas City employees, it was identified that non-compliance was accepted at many levels; this was highlighted as an underlying factor for both personal and process incidents. A major problem was the frequency of incidents, for example, process safety–related incidents occurred quite rarely whereas personal safety incidents were relatively commonplace. Even accidents that result in a fatality, such as activities in hazardous industries such as oil and gas, occur with greater frequency than process incidents. There are several reasons for this, which are primarily due to the different types of hazards and the depth of defences provided (Hudson, 2009).

2.2.1.5 *Deepwater Horizon: A Brief Analysis and Benchmarking Against the Texas Oil Disaster*

According to (Deepwater Horizon, 2018), on 20th April 2010, while drilling at the Macondo Prospect, an uncontrollable blowout was caused on the rig, which killed 11 crewmen and subsequently ignited a fireball visible from 40 miles (64 km) away. This fire could not be extinguished and after two days, on 22nd April, Deepwater Horizon sank, leaving the well continuing to gush oil into the Gulf of Mexico. A total of five million barrels of oil were spilled into the ocean, becoming the largest accidental oil spill in US history.

The operator of the rig always had a number of contractors assisting in carrying out a vast array of tasks; many of these tasks were extremely important to the facility's safety. Deepwater Horizon was owned and operated by Transocean. Another major contractor engaged was Halliburton, who was also involved in a number of decisions. As a result, this often-complicated relationship between multiple contractors had the potential to create both confusion and misunderstanding. Of all the obstacles facing offshore managers in relation to safety, it was the relationship between contractors that was the most challenging (Sutton, 2012).

Following the aftermath of the incident and investigation, a comprehensive report was produced by investigators and industry professionals, which highlighted the lack of effectiveness of safety management among the companies and subcontracting companies involved in BP's Deepwater Horizon well. In addition, a key point was made that there were glaring institutional failures in safety by the related subcontracting companies to BP.

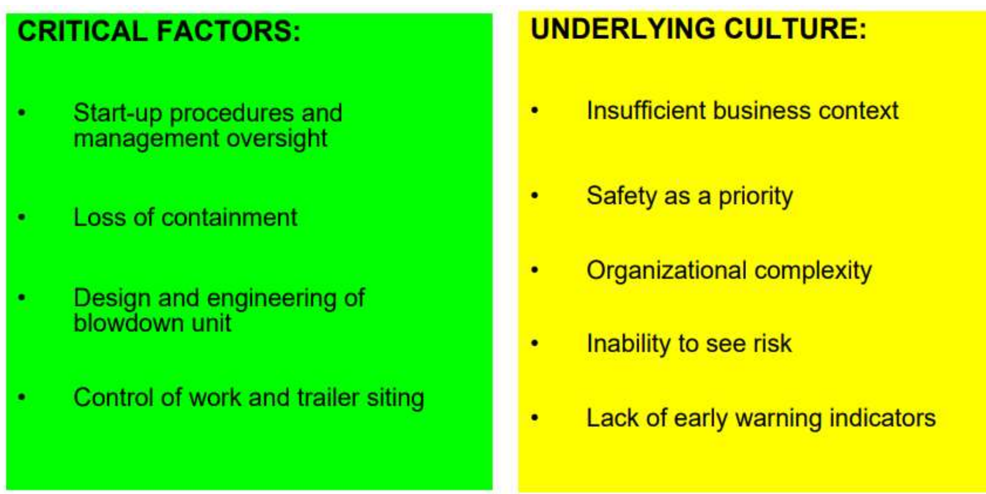
The two main subcontractors to BP were Halliburton (who was in charge of pouring cement during the drilling of BP's Macondo oil wells) and Transocean (Transocean owned the Deepwater Horizon drilling rig). BP as the head contractor was requested to pay $20 billion settlement in the court of law; however, the two subcontracting companies also played a critical part in causing this catastrophic accident.

Judge Barbier said, "BP should shoulder 67% of the blame for the 2010 spill, with drilling rig owner Transocean responsible for 30% and cement firm Halliburton responsible for 3%" (BBC, 2014). The judge also ruled that BP would be "subject to enhanced civil penalties" because of its "gross negligence" and "wilful misconduct". BP was found "grossly negligent" in 2010 (BBC, 2014). All three major companies involved in the spill had varying levels of safety shortcomings, which together created the “perfect storm” scenario that resulted in the catastrophic fire and ensuing massive chemical spill.

This incident raised the importance of a lack of duty of care, HSE responsibilities and management commitment when it came to subcontractor management. When these safety systems inevitably fail these result in far-reaching impacts to health, safety, environmental, economic and reputation of the organisation involved. The impacts from the BP oil spill are far reaching and will continue to affect the industry for generations to come (particularly from an environmental standpoint).

Therefore, employers, future leaders and persons in control of major organisations must learn from past lessons and strive to eliminate the probability of a similar future catastrophic incident occurring. It is worth pointing out that the Texas City oil explosion occurred in 2005, which at the time was the deadliest US refinery disaster in a decade. Following the safety investigation, the shortcomings shown in Figure 2.14 below were identified.

Figure 2.14 Critical Factors and Underlying Issues of the Texas City Disaster



Note. From *Lessons From Texas City* (p. 15), by Ness, A., 2008, Journal of Process Safety V.1 (http://docplayer.net/26712460-Lessons-from-texas-city-mike-broadribb-distinguished-advisor-process-safety-workforce-involvement-day-edinburgh-8-th-may-2008.html). Copyright 2008 by Docplayer .

When comparing these critical and underlying factors with the recent Deepwater Horizon incident, some profound similarities can be found between the two disasters, clearly indicating that the offshore industry had failed to learn from past incidents and is required to do more to eliminate this level of HSE risk in the future. As discussed in the report *Root Causes and Failures that Caused the BP Oil Disaster* (Hair & Narvaez, 2011, p. 4), below are the top root causes identified:

- Failure of industry management.
- BP's management process had not adequately identified, or addressed risks created by late changes to well design and procedures.
- Decision-making process at Macondo did not adequately ensure that personnel fully considered the risks created by time and money-saving decisions.
- The reason why the well blew out was because a number of external risk factors, oversights, and outright mistakes were combined subsequently overwhelming the initial safeguards meant to prevent such an event from happening.
- A fundamentally flawed well plan that did not include enough cement between the production and protection casings (The cement contained a specific nitrogen additive to make it lighter however decreased its sealing effectiveness).
- Better management systems and processes by both BP, Haliburton, and Transocean would almost certainly have prevented the blowout by improving the ability of individuals involved to identify the risk they faced and to properly evaluate, communicate and address them. (Hair & Narvaez, 2011, p. 4)
- Process safety was particularly overlooked in the case of Deepwater Horizon incident. Upon further investigation of hazard records, it was found that there had been a great emphasis on personal safety such as (slip, trips, and falls), but very little regarding process safety. Following the Deepwater Horizon incident, a great deal more training and awareness was conducted on process safety, particularly in the oil and gas industry where highly flammable chemicals were present.

Does this pose a legitimate question: Are we doomed to repeat our mistakes? As the late philosopher Edmund Burke said, those who don't remember the history are doomed to repeat it (Santayana, 2013). Furthermore, is it a human deficiency that we have an inherent tendency to fail to learn from our mistakes? Why did we fail to learn from Texas City oil explosion in 2005 and had a repeat accident of the Deepwater Horizon five years later in 201?

2.2.1.6 *Chevron Refinery Pipe Rupture and Fire*

A pipe rupture was observed on the Chevron Refinery in Richmond, California, on 6th August 2012. This led to a vapour release and subsequent explosion. As a result, 18 employees were caught in the vapour cloud, but thankfully found their way to safety prior to the ignition occurrence (Kendon, 2016).

As a result of the incident, a large amount of smoke and particulate clouds made its way to nearby communities. A total of 15,000 cases were reported from the surrounding community area of breathing problems, chest pains and general migraines. Twenty of the residents' symptoms were significant enough that they were admitted to hospital for further treatment (Kendon, 2016).

Upon closer inspection, the particular pipe in question was found to have been damaged by corrosion, which is typically known to be highly destructive on surfaces such as carbon steel piping. One of the key strategies of many organisations to combat this type of failure is to implement periodic inspections as part of the preventive maintenance strategy.

The main objective of a preventive maintenance routine is to ensure that equipment is continually maintained and to target any observable warning signs of potential failure in the future. Had a more vigorous maintenance schedule been in place, this incident might have been eliminated. Furthermore, as a result of this incident, a number of suggestions were issued to various government bodies in California, which resulted in the development of more effective PSM regulations in the state of California (CSB, 2017).

2.2.1.7 *Literature Summary: Catastrophic Incidents*

Work processes are typically designed with one or multiple layers of protection in an effort to minimise further the risk of failure. However, it is important to be aware that no safeguard is 100% perfect, and the imperfections are similar to the holes in each slice of the Swiss cheese model. Accidents happen when multiple failures, or holes, line up with each other, which subsequently result in an incident. The goal of PSM is to make these holes as small as possible and as few as possible to minimise the probability of an incident coming into effect. As many PSM-related incidents show, being technically competent is not the only critical component needed to prevent a serious accident; management systems as well as the general company culture also play significant roles in process safety. Trevor Kletz, one of the world-class specialists in process safety, is often quoted as saying that organisations don’t have memory, only people do (Futuremedia, 2015). The Motiva, BP Refinery and Chevron safety incidents demonstrate similarities in failing to act on inefficiencies and hazards in the work system as well as a total disregard for preventive maintenance.

Table 2.3 below has summarised a number of publications related to the analysis of major accidents in the global oil and gas industry.

Table 2.3 Analysis of Major Accidents

Name of the accident, author, year, country	Fatalities and serious injuries	Spill (barrels)	Property damage (cost USD)	Causes (contributing factors)				
				Management	**Human factors**	**Lack of communication**	**Lack of maintenance**	**Environmental conditions**
Bohai 2 (1979)	72	Unspecified	Unspecified		Failure in correctly stowing deck equipment prior to towing. Standard tow procedures were not followed			There was a storm while rig was being towed: Gale-force winds led to the ventilator pump breaking, resulting in flooding
Alexander L Kielland (1980)	123						A fatigue crack in the weld of an instrument connection brace was not found	Platform capsized after the failure of one of the bracings, because of strong winds and 12 m high waves
Piper Alpha (1988)	167	-	$3.4 billion	Management of change-design issues. Piper Alpha was poorly retrofitted to export oil		Insufficient transfer of information between crews, shifts and informal permit to work system		
Seacrest Drillship (1989)	84				The ship had 12,500 ft of drill pipe in its derrick, which resulted in unstable high centre of gravity			Drillship capsized by Typhoon Gay, which produced 12-foot-high waves

Name of the accident, author, year, country	Fatalities and serious injuries	Spill (barrels)	Property damage (cost USD)	Causes (contributing factors)				
Mumbai High North disaster (2005)	22	120,000 barrels of oil and 4.4 million m^3 of gas per day	Unspecified					Poor weather conditions: Strong swells pushed a support vessel towards the platform
BP America Refinery explosion (2005)	15			Numerous technical and organisational failings	Overfilling and overheating of hydrocarbons		Faulty safety in critical equipment. Inoperative pressure control valve	
Motiva Enterprises sulphuric acid tank explosion (2005)	1			Management failure to comply with environmental and safety regulations			Inadequate stringent tank inspection and repair program	
Perforadora Central Usumacinta jack-up (2009)	22	5000 barrels of oil	$780 million		Operators ignored the change of seafloor condition that was due to bad weather			Extreme weather conditions: Usumacinta jack-up oscillated in the storm-force winds, causing the cantilever deck to strike the Kab-101's well valves
Caribbean Petroleum refining tank explosion and fire (2009)	0			No Automatic overfill protection system No additional and secondary layers of				

Name of the accident, author, year, country	Fatalities and serious injuries	Spill (barrels)	Property damage (cost USD)	Causes (contributing factors)				
				protection to prevent an accident				
BP's Deepwater Horizon (2010)	11	4.9 million	$65 billion	BP, the well owner, was ultimately responsible through poor risk management and taking too many shortcuts and failing to act on the cement failure	A flawed well plan that did not include enough cement between the production and protection casings by contractor Halliburton	There was insufficient communication between the three companies involved (BP, Transocean and Halliburton)		
Chevron Refinery pipe rupture and fire (2012)	0						Inadequate routine inspections as part of the preventive maintenance strategy. Failed to pick up sulphidation failures	
Loss of well control at Suncor Altares (2012)				A lack of proper well control procedures, training as well as inexperienced drilling rig crew who did not have significant experience in drilling deep, high pressure wells				
Tesoro Martinez Refinery sulphuric acid spill (2014)	0	84,000 pounds		Lack of strong management and safety culture that led to 15 separate acid spills over a 5-year period, demonstrating a common chain of negligence	Lack of process safety management: insufficient tightening upon installation of a tube and a compression joint			

Upon further analysis of the offshore oil and gas incidents shown in Table 2.3, several common trends can be demonstrated. One area that was commonly highlighted among all safety incidents listed in Table 2.3 was negligence by top-level management. Management would have had the potential to eliminate the likelihood of these incidents occurring if they had sufficiently intervened. Four incidents directly indicated management negligence as a major cause. For example, the Tesoro Martinez Refinery spill demonstrated a lack of safety management failing to respond when similar incidents had occurred in the past; the Suncor Altarez incident showed how inexperienced employees were permitted to work on high-risk jobs; the Chevron Refinery pipe rupture indicated the importance of ensuring routine maintenance procedures occur and take precedence over production deadlines; the BP Refinery explosion indicated a high level of technical failings; and finally, the Motiva Sulphuric acid explosion demonstrated that management had failed to follow basic safety and health regulatory requirements.

All of the safety incidents highlighted a high degree of negligence by management with regard to ensuring common safety regulations and protocols were followed. Another contributing factor was contractor involvement, which played a significant role in all the listed incidents, including one of the biggest oil and gas incidents in history, the Deepwater Horizon incident, where a lack of communication between key parties, a flawed well plan and taking too many shortcuts led to the subsequent catastrophic event. A total of four incidents were related to a lack of preventive maintenance. Chevron, Motiva, BP Refinery and Alexander Kieland all demonstrated this gap. Table 2.3 also demonstrates a high frequency of incidents in which environmental conditions were a contributing factor, specifically platforms being exposed to extreme weather conditions resulting in catastrophic failure. The majority of failures in these platforms were shortcomings that stemmed from failing to prepare the facility during times of extreme weather conditions, as well as a lack of general maintenance to ensure that the facility can cope structurally with extreme weather conditions. This also highlighted the importance of maintaining the facility and ensuring its capability of withstanding the often-extreme geographical conditions presented at sea. Furthermore, a secondary resulting sub-cause not listed in Table 2.3 was attributed to the subsequent failure to safely evacuate personnel efficiently following the incident occurrence, resulting in further unnecessary human loss.

Only by understanding and sharing the lessons from process safety incidents can one learn to eliminate the occurrence of future incidents. Finally, all process safety–related incidents highlighted the importance of preventive maintenance. An effective and successful maintenance schedule will ensure plant and equipment reliability. Fewer failures will mean less unsafe contact with machinery, as well as cost savings and higher productivity and efficiency.

Additional hazards can arise when machinery becomes unpredictable and has various faults. Routine service diagnoses these faults at early stages and mitigates any risks. However, maintenance should be appropriately planned and carried out. Unsafe and incorrect maintenance can lead to fatalities and serious injuries either for the duration of the maintenance or to those using the poorly maintained plant and equipment.

To improve understanding of the mechanisms of accidents and to develop effective accident prevention and the hierarchy of controls strategies, it is crucial to learn from past experience and accident investigations. Unfortunately, one major barrier stands in the way of revealing why some accidents occur. Some organisations in the offshore industry in the past have been generally reluctant to reveal and share information, particularly regarding previous accidents and incidents, mainly because this could damage the reputation of the company. They tend to underplay their mistakes. This issue has been explained further by (Badoux, 1983) who discussed how the negative attitude of the industry and a tendency to cover up the truth has inadvertently resulted in a rise in the number of accidents and injuries. Furthermore, a large degree of these incidents can be attributed to recurrence and repeated failings. It is essential that companies to embrace “things going wrong” and ensuring that accident lessons are shared with everyone in the organisation to proactively eliminate the same incident occurring again. Educating staff on previous incidents is one strategy to reduce the recurrence of incidents in the future.

In summary, the use of accident causation models can be an effective tool for targeting accident prevention. The knowledge that accidents are the result of certain external factors and hence can be prevented makes it imperative for us to identify and analyse those factors that are likely to enhance the occurrence of accidents. By studying such factors, the root causes of accidents can be eliminated, and essential measures taken to avoid the repetition of accidents in future. Section 2.3 will cover the importance of a safety management system, and an integrated model best practice HSE management system, which will highlight the key components needed to be effective in managing HSE.

2.2.1.8 *Literature Summary: Analysis of Catastrophic Incidents*

The following three papers discussed in Table 2.4 review specific safety tools that are utilised in the industry to investigate and to determine contributing factors to major catastrophic oil-and-gas-related safety incidents. The first paper demonstrates the importance of using accident models such as the Swiss cheese model to extract specific contributing factors through analysis of five oil refinery offshore rig incidents. The second paper conducts a quantitative critical risk analysis of the Deepwater Horizon incident to determine glaring inefficiencies in the risk influencing factors (RIFs). The third paper conducts a critical analysis of the safety pioneers of the twenty-first century, including Herbert Heinrich who developed one of the most famous accident models, the domino theory. Present day analysis of Herbert's work has introduced some criticism; this paper evaluates these criticisms to determine if they are indeed valid or not.

As discussed in this section, several catastrophic incidents in the oil and gas industry over the past few decades have highlighted the importance of organisations having robust health and safety systems in place to protect their people and their assets. Subsequently, the next section (2.3) discusses the importance of having a well-structured HSE management plan and highlights the key elements needed to systematically manage risk and strive for health and safety best practice status.

Table 2.4 Review of Major and Minor Incidents in the Oil and Gas Industry and Root Cause Analysis

Author(s) Publication year Data collection country	Research aim	Study population	Research methodology and data analysis	Research limitations/ strengths	Key findings
Kendon, P. (2016)	This study aimed to show how systems fail. The Swiss cheese model was utilised to demonstrate this failure. A review of five oil refinery offshore rig incidents highlights the holes and faults in the Swiss Cheese model.	-	Qualitative research, literature research	*Limitations* Not all of the five oil refinery gas incidents were classified as major *Strengths* Highlighted the importance of accident models to determine contributing factors of major accidents and incidents	**Accident model analysis** Every incident has tragic consequences; there are significant consequences of failures in systems related to oil refining and offshore drilling. The key is to eradicate the "holes in each slice of cheese" for a greater reduction in the probability of a catastrophic accident occurrence.
Skogdalen J & Vinnem, J (2011) Norway	A qualitative risk assessment (QRA) of oil and gas drilling, using the Deepwater Horizon incident as a case study.	A total of 15 qualitative risk assessments for different installations were collected by 6 different operator companies. These risk assessments were based on a randomised sample among installations along the Norwegian Shelf	Qualitative research. The analysis mostly used the same generic data and accident statistics	*Limitations* The QRA process is not described in detail in the research paper *Strengths* Emphasised the importance of ensuring that risk influencing factors (RIFs) are always covered	**Quantitative risk assessment of oil and gas drilling** Upon review of QRA it was revealed that the risk influencing factors for individual facilities, operations and environment were scarcely covered. The QRAs do not include human organisational factors (HOFs). As demonstrated in the Deepwater Horizon incident, most of the findings were related to HOFs, such as lack of competency, work practices, poor communication, and mismanagement

Author(s) Publication year Data collection country	Research aim	Study population	Research methodology and data analysis	Research limitations/ strengths	Key findings
Busch, C. (2018). Sweden	Critical analysis of Herbert William Heinrich. To determine the validity of his work in the context of "new view" thinkers	There were no specific study populations. Various searches were conducted in databases like Scopus as well as bibliographic research	Qualitative research. An extensive literature and archaeological study was conducted critically and systematically	*Limitations* Literature-based research, especially when studying historical literature, brings a number of implicit limitations *Strengths* Further reinforced the work that Herbert Heinrich conducted	**Safety Pioneer Herbert Heinrich** The research paper concluded that Heinrich was actually part of a "new view" himself—a view that did not see accidents as things that just happened or happened because of carelessness, but a view that instead saw accidents as events that were caused and that could (and should) be prevented. It concludes that "new view" authors who critiqued Heinrich rarely employed "new view" approaches. They made claims with regards to Heinrich that were not substantiated

2.3 Safety Management

2.3.1 Importance and Purpose of an HSE Management Plan

The main objective of safety management is to deliver specific intervention mechanisms that are designed to stop a chain of unsafe activity (HSE, 1993). Safety management involves the avoidance of inherent failures in the risk assessment process (Gupta & Edwards, 2002).

A proactive safety management system shall encompass certain essential elements such as hazard identification and risk assessment, established rules and procedures, training, commitment to monitoring and mitigation of risks. This objective can only be accomplished through a clear policy as well as goals and objectives and an action plan. Other important points are to ensure that processes are transparently communicated between key stakeholders and ensuring responsibilities are clearly defined. An effective safety management plan needs all personnel to be committed to compliance with the system as well as being proactive in achieving safety targets, goals and objectives. Work procedures is one critical component in the development of successful safety management.

A successful safety management system involves a number of key components, these include goals, policy, procedures and standards in relation to the method in which the work will be conducted. These components must outline in written form through work documentation the specific activities of the organisation, how these tasks will be conducted and who is directly responsible for completing the work safely. This specific documentation depends on the work scope and organisation, but typically includes:

- safety policy statement
- management procedures and directives
- safety procedures and directives
- standard safe operating procedures
- preventive and reactive and maintenance procedures
- emergency management procedures.

These work documents provide detailed direction on how the organisation's activities should be carried out safely; however, their presence does not necessarily guarantee absolute safety—they are merely one critical aspect in the development of a successful safety culture. Another equally important undertaking is reviewing work procedures periodically to ensure that they are still relevant to the work operations and are compliant (Burrage, 1995):

> There are therefore five major elements to setting up and operating an effective Safety Management System in an organisation.
>
> 1. Identify policy and goals
> 2. Document the standards and train them in
> 3. Communicate to Management and Workforce
> 4. Monitor the working of the system
> 5. Investigate accidents, incidents and analyse communicate the results.
>
> All these elements are inter-related and will be subject to regular revision and change as a result of operating a proactive Safety Management approach. (Burrage, 1995, p. 246)

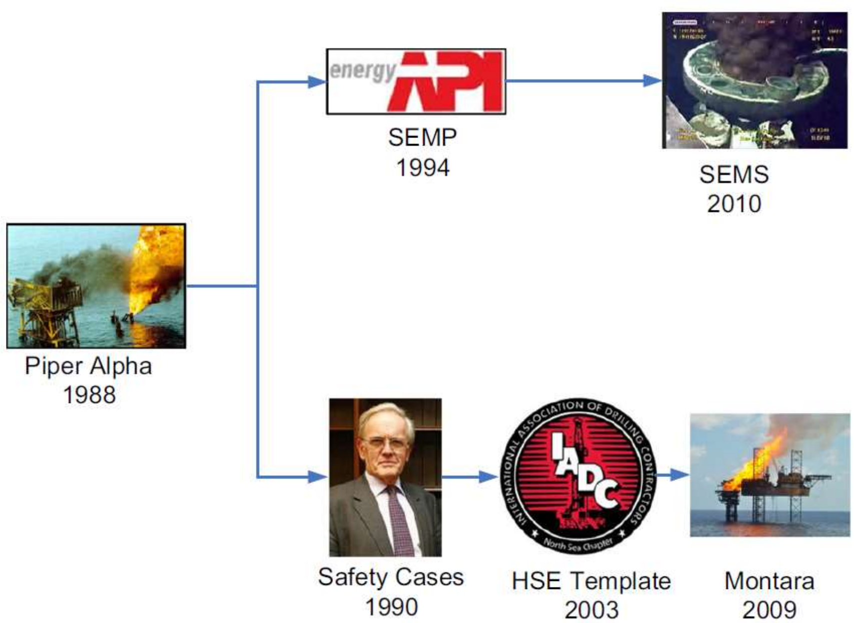
A safety management system (SMS) is an integral guide that supports both employers and employees to maintain guidelines and specifications for management of safety, environment and health. It also brings together critical documentation such as policies, procedures, risk assessments and training records. This documentation provides guidance to key stakeholders, enabling them to conduct their tasks safely; it also provides direction in relation to not only company management commitment to health and safety but also employee engagement and participation, as well as the level of safety culture that exists in the environment. However, it must be noted that an organisation can exhibit a world-class SMS but continue to injure its staff. This is mainly due to a lack of sufficient implementation of the management system. Sutton outlined in the following quotation below that the evolution of a SMS was due to a number of notable catastrophic oil and gas incidents which was the main catalyst for change in the industry.

> The development of formal SMSs for offshore oil and gas facilities can be said to have started with the Piper Alpha catastrophe that occurred in 1988. Offshore platforms had safety programs before that time, of course, but Piper Alpha ushered in a new and much more thorough approach to system safety. Following the accident, an investigation was conducted by a committee headed by the Scottish High Court judge, Lord Cullen. The committee's report was highly critical of the safety cases that had been in place prior to the accident. The event chain that led to the loss of the Piper Alpha installation in 1988 started in a blind flange where a Pressure Safety Valve (PSV) had been removed for preventive maintenance and not returned the same day after recertification. The accident led to the total loss of the platform and the deaths of 167 men. These failures and

their consequences were, in large part, the result of questionable or bad decisions, themselves rooted in management problems.

In response to the Cullen report, the offshore industry took two different tracks, (as shown in Figure 2.15) Companies operating in the North Sea (and, later on, other areas of the world such as Australia) continued with the safety case approach, (as shown in the bottom track of Figure 2.15), but radically improved the thoroughness and quality of the documents and put in place more stringent measures to ensure that the recommended measures were actually implemented. In the USA the response to the Piper Alpha incident was equally vigorous but followed a different path. Rather than following the safety case approach, it was recommended that companies develop a Safety and Environmental Management Program (SEMP). (Sutton, 2012, p. 65)

Figure 2.15 Impact of Piper Alpha:



Note. From *Implementing a SEMS Program* (p. 61), by Sutton, I., 2012, Book of Offshore Safety Management V.1 (https://www.elsevier.com/books/offshore-safety-management/sutton/978-1-4377-3524-6). Copyright 2012 by Elsevier. (

In the following section the key strategic elements of an SMS are broken down further, including the evolution of safety culture, the importance of process safety, the lodgement of a safety case and a brief summary of the key legislative and regulatory bodies in the oil and gas industry.

2.3.1.1 *Safety Management and Safety Culture*

According to (Kathryn Mearns, 2003), case studies of various catastrophic disasters have linked flaws in the widely used term “safety culture” with workplace accidents. The main concept of safety culture was established through time, as a result of a number of catastrophic cases occurring in the industry.

The idea of safety culture was mainly established when the Organisation for Economic Co-operation and Development (OECD) Nuclear Agency (1987) investigated the Chernobyl disaster and discovered an indication of poor safely culture at the plant. It also found a number of fundamental errors and non-compliance with operating procedures that had directly led to the catastrophic incident. The agency also came to the conclusion that this lack of safety culture was a common trend in the former Soviet nuclear industry in general (N. Pidgeon & O'Leary, 2000).

Pidgeon (1991) considered culture as a system of meaning and defined it as a collection of common beliefs, norms, attitudes, roles and practices that are shared within a social group or organisation (N. F. Pidgeon, 1991). According to Pidgeon (1991), “good safety culture can be characterised by three attributes: norms and rules for handling hazards, attitudes towards safety and reflexivity on safety practice” (N. F. Pidgeon, 1991, p. 129). This catastrophic incident triggered accelerated evolution and further development of safety culture in response to the many errors and non-compliances in operating procedures, as well as the obvious disregard of safety culture at the plant, which ultimately led to the catastrophic disaster. The UK advisory committee while conducting a safety assessment of various nuclear installations produced a definition of safety culture as the product of individual and attitudes, group values, competencies, perceptions and general patterns of behaviour that determines commitment to, and the proficiency and style of, health and safety management in an organisation (Fuller & Vassie, 2001).

In the decade following such catastrophic incidents as the 1988 Piper Alpha disaster, the first Cullen Report (Cullen, 1990) outlined that the very nature of the Piper Alpha operation was inherently dangerous extraction of volatile substances under dangerously high pressure in harsh environments which posed a significant risk. To give an idea regarding the extent of this injury, a total of 167 people died (of the 229 onboard) in only 22 minutes when Occidental Petroleum’s Alpha offshore production platform situated on the Piper field in the North Sea exploded following a gas leak, in which gas condensate had ignited.

In Piper Alpha the potential problem was that some 75% of the offshore working community consists of contractors, who are often regulated differently from the operators. The Piper Alpha incident also highlighted the worrying trend in relation to the neglect of contractors and subcontractors and how they were treated differently from other employees. While the offshore oil and gas industry had treated safety as a top priority, the disaster and the Cullen Report into its causes placed new emphasis on safety. The personnel implications of the Cullen Report are far reaching, with nearly 40 of its 106 recommendations directly affecting offshore personnel. Texaco responded with a program that included revision of its offshore training policies, new contractor safety policies and an enhanced program of emergency response training onshore and offshore (Rhonda Flin & Slaven, 1994).

The risk of contractors' safety can further be demonstrated in a study conducted by a specific UK offshore exploration and production division on an international oil company operating in the North Sea. At the time of the survey, it was estimated that a total of 800 contractors and employees were working on three separate production platforms. It was also established that the organisation had a common policy that safety standards and health and safety management were to be followed equally by both employees and contractors. At the conclusion of the study, the days away from work frequency per 200,000 hours (DAFWCF), which was a lag indicator used to determine safety performance, was found to be 0.16 for employees and 0.29 for contractors (Fuller & Vassie, 2001).

The Piper Alpha disaster was a key stepping stone in the industry because it led to a majority of the other offshore oil and gas processing organisations within the UK making similar changes to their health and safety processes (Cullen, 1990). Many of these changes were due to three separate initiatives, which comprised the recommendations of the Cullen Report, the formation of the Offshore Safety Division of the Health and Safety Executive and the roll out of the offshore installation (Safety Case) Regulations 1992. The Cullen Report represented a major advancement in the evolution of health and safety standards in the offshore industry.

For example, following the Piper Alpha event according to (Oil and Gas-UK, 2008, p. 2),

> Every offshore operator carried out immediate wide-ranging assessments of their installations and management systems. These included:
>
> - Improvements to the "permit to work" process
> - Relocation of some pipeline emergency shutdown valves
> - Installation of sub-sea pipeline isolation systems
> - Mitigation of smoke hazards

- Improvements to evacuation and escape systems
- Initiation of formal safety assessments. (Oil and Gas-UK, 2008, p. 2)

This research identified a common theme as a result of the comprehensive analysis and investigation of countless catastrophic disasters throughout this century. As a result, the researcher concluded that the cause or blame of an incident or accident should not be targeted on the action of a single employee but rather a weakness in the organisational safety culture and management system as a whole. Barrier management, as discussed in section 2.2.1.2, also played a major role in risk reduction and became an influential tool in accident prevention.

Through the use of accident investigation, it was determined that accidents were not caused by one single factor but by a complex set of sub-causes. Accidents are typically defined in many different ways; here are two examples:

- The Occupational Safety and Health Administration has a succinct definition for a workplace accident. It is an "unplanned event that results in personal injury or property damage". OSHA is a government body tasked with helping keep workplaces safe for its employees.
- Herbert William Henrich, a founder of different types of workplace safety movements, described workplace accidents as "unplanned and uncontrolled events" resulting in personal injury (Hendricks, 2019).

Typical examples of these sub-causes include cost-cutting to the safety budget, management not completely committing to following basic safety procedures and inadequate training and supervision of key staff. Therefore, it was logical to assume that safety culture and safe behaviours played a major part in accident prevention in the offshore industry.

Another key relationship according to (Oke, 2007, p. 245) was that as,

> the safety climate improves, managers and employees are likely to agree more about the causes of safe/unsafe behaviours and workplace accidents, ultimately increasing their ability to work in unison to prevent accidents and to respond appropriately when they do occur. Oke (2007)

This was an important stepping stone for determining the most effective way for a safety investigation to identify real root causes and demonstrate proactivity in accident prevention rather than a knee jerk reaction of purporting blame.

(Quayzin 2012) conducted a study on leadership, safety culture and catastrophes. The lessons derived from the 10 case studies of seven critical industries determined common core values, which were: management, expenditure and business pressure, safety culture, control and implementation, contractors' management and communication. This result evidently confirmed the significance of a commitment to safety and its control at all levels of the organisation, but also stressed the critical role that corporate governance played in setting up safety as a core value and precedence of an industry, an organisation and its relevant stakeholders.

To remain safe, safety management must relate to actual practices, functions and roles (Kennedy & Kirwan, 1998). An SMS for an offshore site is a useful tool that aids the operator to systematically achieve and maintain fundamental standards for managing health and safety in the workplace. This system effectively includes various policies and procedures required to mitigate effectively the risk related to the organisation. However, it is important to note that the SMS is more than merely policies and procedures. For example, conducting an audit of the documentation of the SMS may not necessarily gauge the effectiveness of work processes in the actual workplace and how those procedures are being implemented. An internal audit is an effective technique for determining what an organisation should be doing to keep their employees safe, but it does not necessarily demonstrate what is actually happening in the workplace and whether these procedures are being followed down the line (Zimolong & Elke, 2006).

Therefore, as discussed by (Syazwan Mat Ghani & Yi 2018) the level of success of an SMS is dependent upon the amount of employees engagement in the structure and work practices of the organisation and how the work is being undertaken. Management have a duty to ensure that a good safety culture is developed and monitored continuously.

Figure 2.16 Safety Management System

Note. From *Health & Safety Management Systems* (p. 1), by ESP, 2009, webpage of Environmental & Safety Professionals (http://www.environet.com.au/services.asp?cid=16&id=40). Copyright by Environmental & Safety Professionals.

A SMS can potentially forecast the future safety performance of a company. Some of the earliest studies identified common features of companies that were labelled as high safety performers in the industry regarding their SMSs. To support this claim, (Cohen, 2013) conducted multiple studies and concluded that:

1. Safety officers held a high ranking in the workplace operations hierarchy.
2. Management showed active personal engagement and participation in safety activities.
3. Training was exceptional for new personnel and refreshers were conducted frequently for existing employees.
4. Uniquely designed posters were used across the workplace to identify potential hazards and site-specific risks to the organisation.
5. There were well-specified procedures for promotion and job descriptions.
6. Daily communications with regards to safety between workers and supervisors were the norm and were supported.
7. Site inspections were frequent and were also completed by management personnel in addition to the workers.

Another study by (Petersen, 1989) outlined 10 obligations of safety management, as listed below:

- Progress of safety is not measured by safety ratios.
- Safety becomes integrated into the system, more than just a program.
- Accidents and injuries are comprehensively investigated.
- Technical principles and tools for the statistical control of the process are implemented.
- There is a strong emphasis on continually trying to improve the system.
- Ergonomic wellbeing is projected inside the place of work.
- The participation of workers in the resolution of challenges is required.
- The traps within the system that trigger human errors are eliminated.
- Statistical techniques drive continuous improvement.

In contrast, (Shafai-Sahrai, 1971) analysed 11 pairs of companies by conducting onsite interviews and site inspections at each. Following the study, it was identified that marginally lower injury rates in organisations were due to senior management being directly engaged in the day-to-day safety activities of the organisation through safety committee meetings, accident investigations and reviews of safety specific procedures. This top-down safety approach had a significant impact on the safety performance of the organisation. He identified that organisations with lower accident rates were characterised by the presence of senior managers who were directly involved in safety activities, the prioritisation of safety in meetings and decisions relating to work practice, and thorough investigation of incidents.

In a further review of these studies, it was made abundantly clear that common themes were the involvement of all key stakeholders in health and safety, and empowering employees to openly report and communicate hazards and risk in the work environment. These actions helped develop and enable offshore organisations' opportunities to achieve not only safety accreditation status but also best-in-class best practice in health and safety.

Another relevant study explored the perceptions and thought processes of employers and employees in relation to safety climate in the workplace. When the climate was considered poor, employees believed that managers were directly accountable and responsible for workplace safety, while managers believed employees were responsible. However, as the safety climate began to develop and improve, managers' and employees' perceptions converged, and they equally took responsibility for safety (Oke, 2007). This convergence clearly highlights the importance of every stakeholder in the offshore industry having a duty of care and taking ownership and responsibility for safety—one of the key components of achieving a positive safety culture.

However, this is not to say that management does not play an important role in this system. According to (Quayzin 2012), research conducted previously had suggested that employees' positive perception of management's commitment to safety can play a significant role in reducing accidents, incidents and injury. Therefore, research on safety culture always places a strong emphasis on managers and leaders of organisations exhibiting safety leadership, setting the standard and being a positive role model for their employees

According to Quayzin an organisation can be exposed to risk through a number of different factors. The factors can be classified into three categories: organisation, system and people. Quayzin proposed to summarise the organisational factors in six main factors: Vision, Goals, Strategy; Leadership; Financial , Investment strategy; Human Resource Management (people management internal and external, e.g. contractors) ; Communication and culture (Quayzin 2012). These are represented in Figure 2.17.

Figure 2.17 Main Organisational Risk Factors

Note. From *Leadership, Safety Culture And Catastrophe: Lessons From 10 Cases Studies From 7 Safety Critical Industries* (p. 2), by Quayzin, X., 2012, Journal of Aspect, 2(13) (https://pdfs.semanticscholar.org/0ebc/b4b31c6e89d8d31914b1931e61c32bf1a9d6.pdf). Copyright 2012 by Institution of Railway Signal Engineers.

Australian Standard AS/NZS 4801:2001 *Occupational Health and Safety Management Systems* provides general guidelines on principles, systems and supporting techniques. This standard specifically describes taking a systematic approach to risk control. The standard also provides a comprehensive guide not only for organisations to meet the minimum regulatory requirements but also to lead to sustained improvement in safety and risk management performance. Many offshore companies are audited against this standard, and by meeting all the essential criteria they are certified to this standard. (AS/NZS 4801, 2001)

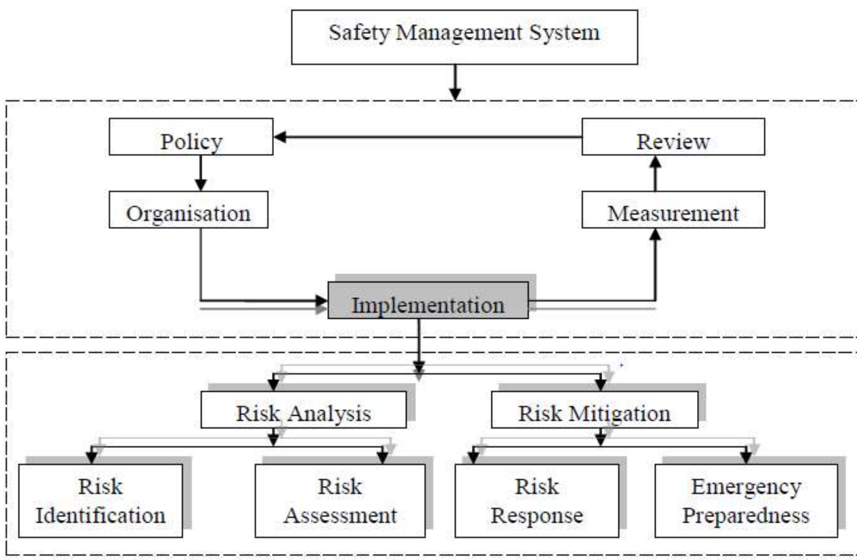
In October 2018, Standards Australia adopted the new ISO *Occupational Health and Safety Management Systems* AS/NZS ISO 45001:2018. All Australian organisation were given a three-year transitional period to move from using AS/NZS 4801 to AS/NZS 45001. There are a few major differences in the new ISO45001; "the most important differences for businesses are outlined below:

- Senior management has now been given greater responsibility and accountability.
- Organisations are now required to develop procedures for areas such as hazard management as well as safety training.
- Organisations are required to make further amendments to their health and safety policy, in relation to their commitments and elimination of all site-specific hazards and safety risks.
- Organisations must identify all risk and opportunities in relation to maintaining the SMS.
- Organisations are now also responsible for workplace health and safety procedures for contractors and other relevant parties."(Mcmanus, 2020)

ISO 31000:2018 *Risk management* comprises a number of internationally based standards related primarily to the concept of risk management. The main purpose of standard ISO 31000:2018 is to provide principles and generic guidelines on risk management. The standard has a broad scope, meaning it can be applied to different types of organisational risk (e.g. financial, safety, project risks) and is not specific to any industry or sector. One of the main objectives of this standard is that it enables organisations to conduct a critical review of their risk management processes. The standard also discusses key definitions such as risk and risk appetite. Risk is defined as the effect of uncertainty on an organisation's ability to meet its objectives, and risk appetite is the amount and type of risk that an organisation is prepared to pursue, retain or take in pursuit of its objectives (Marsden, 2016).

According to (Umar, 2010), for an SMS to be classified as proactive it must have a number of key elements. These consist of hazard identification, rules and procedures, safety training and evidence of a strong commitment to monitoring and reduction of risks. However, this can only be accomplished through transparent policy, goals and objectives as well as having an action plan in place. Other important elements include effective communication mechanisms, defined structure and clear and specific responsibilities. Also, according to (S. Mannan, Mentzer, & Zhang, 2013), in accordance with the research findings, a best-in-class SMS requires full commitment from management. A fully integrated safety management plan is provided and described below:

Figure 2.18 Safety Framework Design for Offshore Oil and Gas Platforms



Note. From *Design for Safety Framework For Offshore Oil and Gas Platforms* (p. 22), by Umar, A., 2010, Thesis of School of Civil Engineering https://core.ac.uk/download/pdf/75882.pdf . Copyright 2010 by University of Birmingham Research Archive

2.3.1.1.1 Policy

The health and safety policy must be structured in a clear and formalised way; commitments, obligations and responsibilities must be outlined. The policy must also consider the organisation's general values and beliefs as well as highlight that the organisation strives for best practice in all elements of health and safety and has a strong safety culture. The policy must be signed off by management of the organisation, thereby demonstrating full commitment to each of its criteria, and prominently displayed in the organisation for everyone to view.

2.3.1.1.2 Organisation

This requires clear definition of key work responsibilities in the organisation and the development of work processes to promote health and safety in the organisation. Other fundamental organisational factors include having structured communication mechanisms in place and periodic safety training of employees to ensure successful execution of the policy.

2.3.1.1.3 Implementation

This is an important element of planning, which relates mainly to the prevention of operational risk. It comprises two critical areas: risk analysis and risk mitigation. Risk analysis identifies hazards and assesses their risks while risk mitigation primarily explores reducing these risks to be as low as reasonably practicable through the hierarchy of controls such as elimination of hazards.

2.3.1.1.4 Measurement

One effective way of ensuring the SMS is performing adequately is to measure its performance. This can be achieved by looking at the organisation's qualitative and quantitative indicators, as well as benchmarking organisational goals and objectives. This exercise is important because it exposes any weaknesses. It also provides an opportunity for management to make necessary safety improvements.

2.3.1.1.5 Review

The review of a safety management system can take place through an in-depth internal auditing exercise. This is an effective way of testing to ensure that the system is effective and reliable. The purpose of the audit is to determine that adequate risk controls, management response and preventive measures are in place.

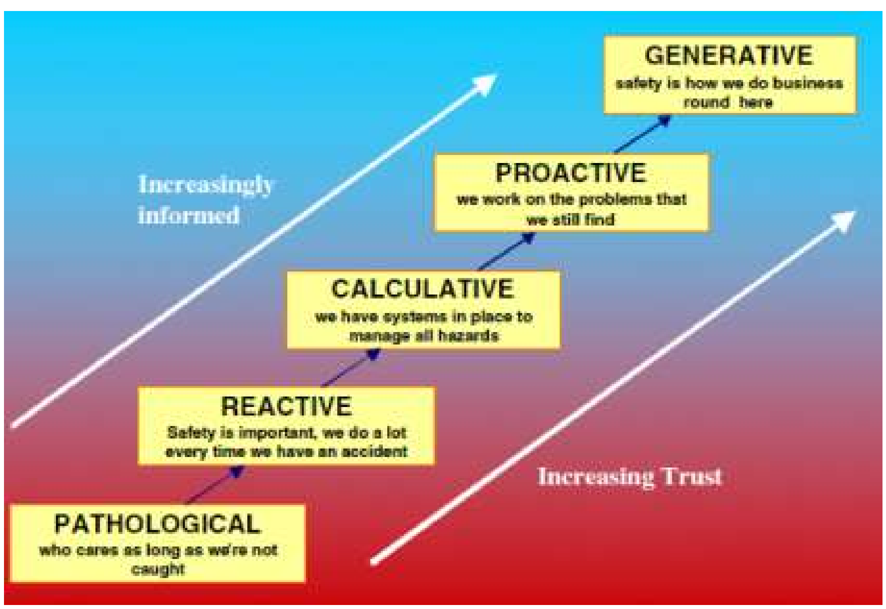
2.3.1.2 *HSE Innovation and Safety Culture*

The model outlines in figure 2.19 highlights the importance of developing a safety culture and the key components required for it to succeed (Zwetsloot & Steijger, 2013).

1. **Pathological.** Any safety matter raised is viewed as a problem instigated by workers. The main push for safety is via the business with an intention not to be caught by the regulator.
2. **Reactive.** Organisations begin to take safety seriously; however, action only takes place after an incident/injury has occurred. Little work is done in the area of risk prevention.
3. **Calculative.** Safety is driven by robust management systems, with a significant collection of data. Safety is still mainly backed by management and imposed/enforced rather than looked out for by the employees.
4. **Proactive.** With improved performance, employees begin to take ownership of safety. Safety issues are reported and followed through to the point where the hazard is controlled and closed out.
5. **Generative.** Safety is actively part of the organisation and is followed by everyone. Safety is perceived to be an inherent part of the business, and safety is communicated periodically throughout all levels of the business.

Hudson in 2001 created the cultural maturity model (see Figure 2.19), demonstrating how increased levels of understanding and awareness of risk and safety in combination with increased trust and openness within an organisation allow it to advance through stages and maturity on the safety culture ladder (FSA, 2017).

Figure 2.19 The Hierarchy of Safety Cultures (Maturity Model)



Note. From *Towards and Occupational Safety and Health Culture* (P. 4), by Zwetsloot & Steijger., 2013, webpage of OSH Wiki: Networking Knowledge (https://oshwiki.eu/wiki/Towards_an_occupational_safety_and_health_culture). Copyright 2013 by Organisation for Applied Scientific Research.

As per Figure 2.19, the HSE management plan for a service provider company in this research was designed in a way to demonstrate "calculative, proactive and generative" culture qualities. This goal was achieved through the successful implementation of the safety management plan. All critical HSE elements were managed effectively. Safety was ingrained as a way of life for all its staff. The company demonstrated a highly developed culture in which HSE was part of all processes, and everyone strived to take part in improving and making the environment safer.

For example, employees were trained to speak openly about hazard and risks, and all staff including supervisors, leading hands and technicians take safety as a first priority and always looked after each other. This level of safety behaviour was not formed merely by accident but through 2 years of continues development. Proactive organisations use their procedures and systems to foresee safety problems before they occur. The service provider company has shown great promise in evolving into a "generative" culture and is well on the way to developing this further in the future.

2.3.1.3 *Process Safety*

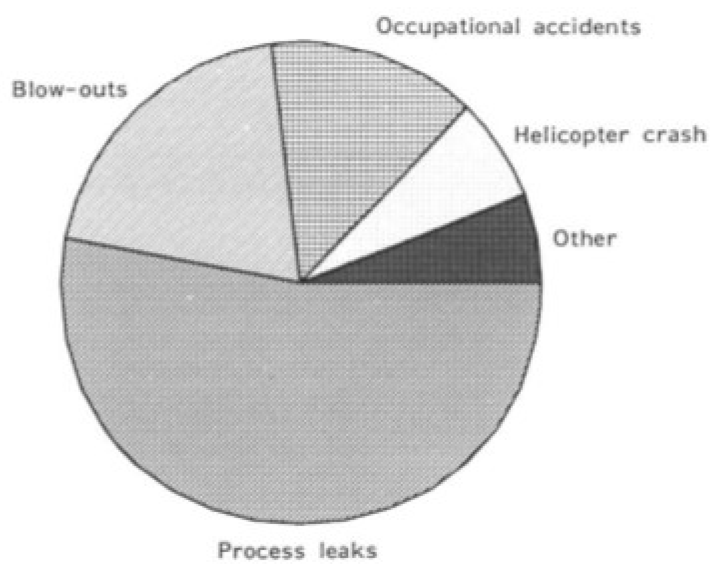
Process safety is mainly centred on managing systems related to processes that handle hazardous substances. This type of safety relies greatly on principles such as engineering, design, maintenance and operating methods. Process safety considers the adequate prevention and control of work situations that have the potential to release hazardous materials, chemicals and energy that can have a serious impact on the plant and environment (IOGP, 2019).

The main objective of process safety is to prevent unsafe occurrences such as unplanned hydrocarbon releases, which have the potential to result in a catastrophic incident. A major incident is typically initiated by some type of hazardous release; it may also result from a structural failure or loss of stability that could escalate to become a major catastrophic incident (IOGP, 2019).

Failure of process safety incidents can be potentially deadly and costly to those involved. These types of incidents demonstrate that even small mistakes in a work process have the potential for disastrous consequences. As discussed by Tveit (1944), one of the major hazards to employees includes process leaks, which have the potential to develop into a major fire or sudden explosion. This can lead to further unintended consequences, such as blowouts. (Tveit, 1994)

Figure 2.20 below shows the level of unwanted incidents that occur on an integrated production platform from blowouts, occupational accidents, process leaks and helicopter crashes.

Figure 2.20 Relative Contribution Through an Example of Risk Analysis of an Integrated Production Platform

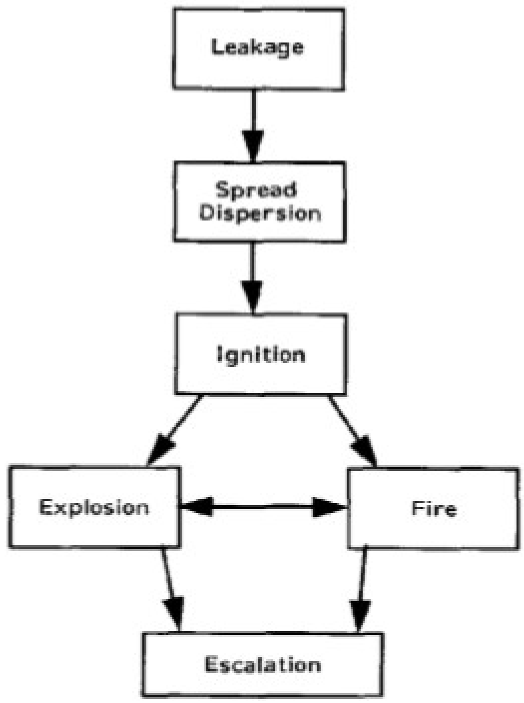


Note. From *Safety Issues on Offshore Process Installations* (p. 288), by Tveit, O., 1994, *Journal of* Loss Prevention in the Process Industries, 7(4) (https://www.sciencedirect.com/science/article/abs/pii/0950423094800391?via%3Dihub) Copyright 1994 by Elsevier.

From a business standpoint, there are many reasons to have an effective process safety management (PSM) system in place. Two of the quantitative benefits for having a sound process safety system are risk reduction through process safety measures preventing human injury; and process safety helping to prevent significant losses and environmental damages. In the off shore oil and gas industry it is both the contracting company and the contractor company's responsibility to help protect each other and the environment. Putting systems in place to manage process safety helps to reduce the potential for major disasters involving the consequences of catastrophic releases of toxic, reactive, flammable, and/or explosive chemicals. The safety case identifies safety critical aspects of the facility both technical and managerial. A Safety Case has to be made to NOPSEMA (the Regulator) that all work processes are safe with risks of harm controlled as far as is reasonably practical, that emergency preparedness, emergency management and appropriate mitigation measures are in place (IGOP, 2019).

Figure 2.21 below shows the main elements or stages of a major accident scenario: Process Leak.

Figure 2.21 Elements of a Major Accident Scenario: Process Leak

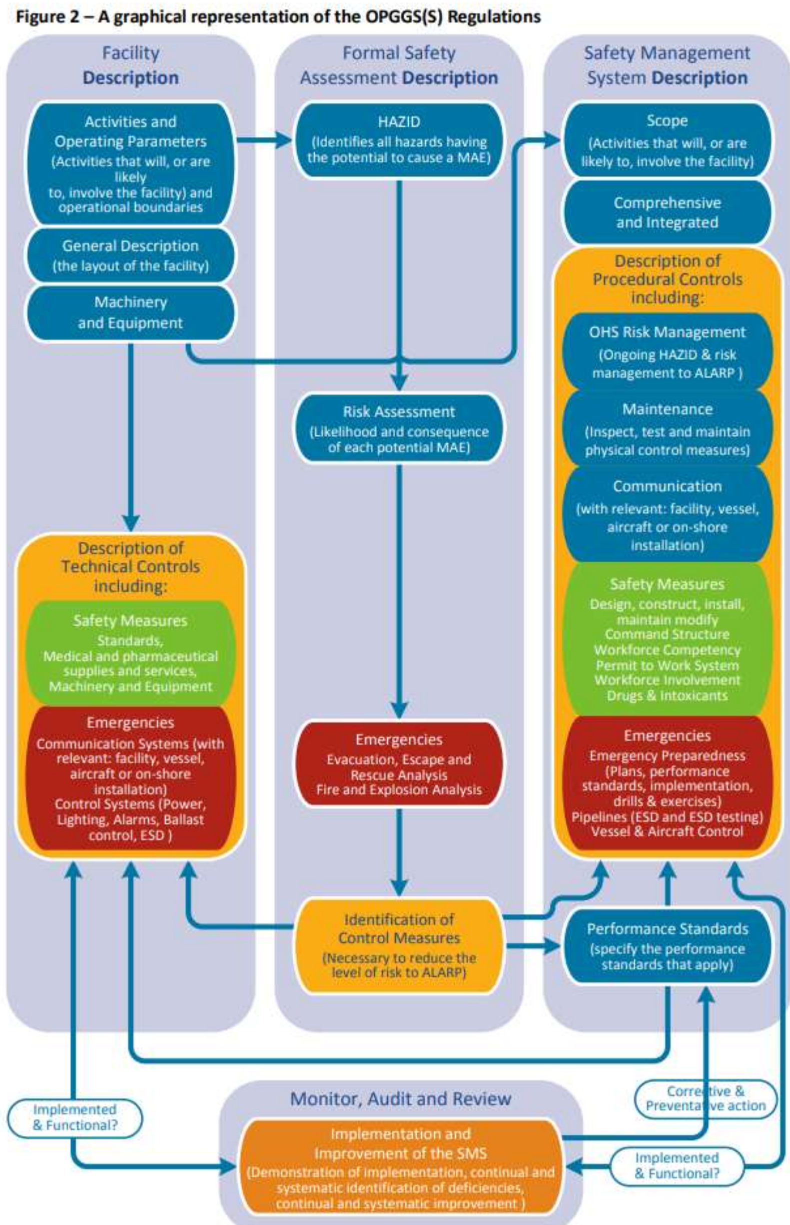


Note. From *Safety Issues on Offshore Process Installations* (p 270), by Tveit, O., 1994, Journal of Loss Prevention in the Process Industries, 7(4) (https://www.sciencedirect.com/science/article/abs/pii/0950423094800391?via%3Dihub). Copyright 1994 by Elsevier.

It is imperative that all key stakeholders in the work process, including engineers and designers, learn from previous incidents to actively reduce the likelihood of a similar incident occurring again in the future. Analysis of catastrophic incidents, historical processes and related accidents that occurred over the past 25 years provides insight into process safety–related inconsistencies, particularly highlighting a common trend of negligence related to secondary maintenance of critical process-related equipment (IGOP, 2019).

2.3.1.4 *Offshore Safety Case*

Figure 2.22 Graphical Representation of the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations



Note. From *The Safety Case in Context: An Overview of the Safety Case Regime* (p. 11), by NOPSEMA, 2013, webpage of Australian Offshore Energy Regulator (https://www.nopsema.gov.au/assets/Guidance-notes/A86480.pdf). Copyright 2013 by National Offshore Petroleum Safety and Environmental Management Authority.

A safety case outlines the exact requirements and specifications of an operator as specified in the Offshore Petroleum and Greenhouse Gas Storage (Safety) OPGGS(S) Regulations 2009, demonstrating clearly how the facility will be operated safely. It is also a tool that requires hazards to be identified and risks to be adequately assessed and effectively controlled. The SMS must be established and demonstrated in the safety case to provide evidence that controls have been effectively and consistently applied. The safety case is a standalone document, which must be completed and submitted to National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) prior to any safety critical work activities being undertaken. Figure 2.22 demonstrates the critical elements that constitute a safety case and their inter-relationship as they are set out in the OPGGS(S) Regulations. This figure shows that the regulations are required to be included in the safety case (NOPSEMA, 2013).

According to (HSE, 2006), the Offshore Installations (Safety Case) Regulations 2005 came into force on the 6 April 2006. The main objective of these specific regulations was to systematically decrease the inherent occupational risks from identified major hazards facilities and offshore installations and to protect the health and safety of all employees who worked on these facilities.

> A safety case is a document, which provides evidence of the duty holders ability and means to effectively control the risks of major accidents. Major hazards have the potential to cause major accidents. A major accident in the oil and gas industry is often understood as an accident out of control with the potential to cause five fatalities or more, caused by failure of one or more of the systems safety barriers.(Skogdalen & Vinnem, 2012, p. 58)

The implementation of the Regulations was a major recommendation of Lord Cullen's report on the review into the Piper Alpha disaster. Operators of offshore installations want to ensure that their operations are safe and do not expose their people or their business to undesirable levels of risk (Bureau Veritas 2018).

An offshore safety case is generated by the operator of the facility prior to operation of a project. The safety case must explicitly detail what site-specific occupational hazards and risks are to be involved in the jobs being undertaken offshore as well as the critical safety aspects of the facility from both a technical and managerial standpoint. This is critical since it has been evident in the past that many catastrophic offshore incidents have occurred as a result of a combination of both technical and managerial shortcomings.

According to (Bureau Veritas 2018), a safety case is evaluated under three principals of adequacy criteria:

1. adequacy of safety management systems to guarantee compliance with health and safety–related legislative requirements
2. adequacy of auditing and reporting.
3. adequacy of risk assessment: significant hazards are identified assessed and controlled.

The safety case must sufficiently indicate to the client that all key areas of the safety management plan will be adhered to (including job-specific policies and procedures); training requirements and identifying the key responsibilities of different occupational disciplines must also be considered. Furthermore, the evidence must demonstrate that risks are systematically controlled through a risk management process. According to (NOPSEMA, 2018e), safety cases must be created solely by the operator of an installation.

There is an expectation that the employer understands the principle of adequately valuing their employees' input into hazard and risk management. As mentioned by (HSE, 2019a), taking a rational approach to controlling operational risk is about involving the employee who created the risks in the risk management process, so therefore also involving them in managing and controlling this same risk. Those who create and are exposed to risk on a daily basis are the best individuals to manage these hazards; this concept must be embraced particularly by management and frontline supervisors to ensure that employee feedback is acknowledged and valued. It is the duty of the operator to identify risk by evaluating their processes, procedures and systems. All the identified risks must be evaluated properly by the operator, who also has the responsibility to ensure that adequate risk controls have been carried out, because the operator has full knowledge of their installation and operations. However, for this to be completely successful the employee must choose to participate and be proactive in initially reporting hazards openly and without judgement.

The safety case must also ensure that adequate information is provided on indicating the extent that the workforce will be actively involved in the tasks. "Workforce involvement is necessary, so they know what happens in practice and why. This makes it more likely that they do the right thing because they know why, rather than relying on a rules-based culture" (NOPSEMA, 2018a). The safety case must be able to demonstrate how staff are engaged and involved in the safety management system as well as various HSE initiatives to promote a consistent safety culture.

One of the key responsibilities of the regulatory body NOPSEMA is to critically assess safety cases. It has the task of accepting or either rejecting safety cases based on the level of content. One of the key aspects that this document must outline is that operational risk must be reduced to as low as reasonably practicable levels (ALARP). "In the UK, the safety regulatory authority uses the philosophy of ALARP, compelling industry to reduce risk a limit As Low as Reasonably practicable in the circumstances of that particular industry" (Burrage, 1995, p. 247). If a safety case has been deemed acceptable, NOPSEMA will still conduct periodic inspections in relation to the facility to ensure that the content outlined in the safety case is being followed (NOPSEMA, 2018e, p. 1).

In relation to contractor management, NOPSEMA observed that during inspections conducted between 2010 and 2012, it was determined that contractors had limited knowledge of the facility's safety case; this represented a major safety gap. Also, NOPSEMA observed that training competence for contract employees was poorly documented. Moreover, where training matrices existed, NOPSEMA identified multiple gaps in initial and refresher training (NOPSEMA, 2012)

Table 2.5 Contractor Management—Key Observations

Contractor management – key observations	
Area for improvement	**Inspection observation/finding**
Contractor training	Lack of training in functional emergency responsibilities for contract workers who regularly belong to a facility's workforce
	Contractor training records not current, not available or not accessible on the facility
	Operator induction courses warrant more focus on site or facility-specific areas
Safety management system familiarity	Lack of contractor familiarity with operator safety management system
	Lack of evidence of documents 'bridging' contractor and operator safety management systems
	Insufficient quality control over contractor-supplied tools and equipment prior to arrival on the facility
	Lack of coordination of contract worker performance audits (by operator and contractor) to better identify shortcomings and promote continuous improvement

Note. From *Offshore Safety Management: Implementing a SEMS Program* (p. 61), by Sutton. S., 2012, Journal of Safety Management (https://www.elsevier.com/books/offshore-safety-management/sutton/978-1-4377-3524-6) .Copyright 2012 by Elsevier.

2.3.1.5 *International Labour Organization*

The International Labour Organization (ILO) is a united nations agency whose main role is to actively work towards improving occupational safety and health standards and hazard reduction. To ensure workers' health and safety was maintained, one section of the ILO promoted the implementation of risk reduction measures in order to protect employees from workplace hazards and risks (ILO, 1996). The ILO has been a "central pillar" of health and safety promotion worldwide.

According to the ILO's director general (Juan, 2005), with reference to statistics, although work-related death, injuries and diseases are declining worldwide, there is still cause for concern in relation to occupational health and safety. With reference to the ILO's "conventions, recommendations and guidelines", the statistics highlights the need for improvement in areas such as "better planning and coordination" with regards to health and safety to save lives as well as to prevent work-related diseases.

The ILO adopted the first convention for labour in 1930, being aware that the all the industries needed special attention to reduce fatalities, injuries and disease, and to improve health and safety issues. Following this, ILO Convention 155, *Occupational Safety and Health Convention, 1981 (No.155)* was adopted. All OHS legislation in Australia is based on this, for example legislation covering general duty of care, worker participation through OHS representatives and committees, requirement for supervision and training, fitting the work to the person's skills and abilities, communication and cooperation, review, hazard identification, risk assessment and risk control requirements, use of safe equipment which includes the role of designers, manufactures and installers of equipment, change management consultation, occupational health requirements, and the right of workers to remove themselves form any situation that they consider dangerous with no adverse consequences from their employer (ILO, 1981). ILO Convention 155 was ratified by the Australian Government for use Australia-wide; this was followed by the *Safety and Health in Construction Convention, 1988 (No.167)* and its related recommendations *Part-Time Work Convention, 1994 (No. 175)*. (FSW, 2005)

Safety and health management is one of the essential elements of the oil and gas industry's activities because most of the operational conditions, chemicals and end products (hydrocarbons and other compounds) with oil and gas production are well known for posing serious safety and health threats to workers (WIPRO, 2019, p. 1).

In Australia, the government of Australia regulates all relevant petroleum exploration and development laws. Commonwealth and state share their obligations: "For any exploration and investment in Western Australia's upstream petroleum and geothermal energy industries, the Petroleum and Geothermal Explorer's Guide offers general information and guidelines on the Commonwealth and State Governments' role and the legislative framework" (Department of Mines Industry Regulation and Safety, 2019b).

The ILO guidelines offer harmonised international direction that represents basic requirements for workers' occupational safety and health. The state and Commonwealth target those with influence or decision-making power in order to form OHS provisions and change workplace practices.

The ILO organises a diplomatic forum for member states to be held in Geneva every year in June. Member states include Australia, New Zealand, the UK and most European nations, Canada and China. The conference addresses advancement in OHS regulations across various countries and essentially establishes a generic and broad set of principle-based recommendations for developing adaptable and progressive OHS policy (ILO, 2012).

Although ILO standards are viewed as effective forms of legislation worldwide, there is one key ILO standard included in ILO Convention 155 that is hardly ever recognised, respected or enforced by fellow employees in most industries. This relates to the right to refuse dangerous work without victimisation during work; this is a major concern in developing countries. In these developing countries, the right to refuse dangerous work can mean having to choose between taking dirty and dangerous work and not having a job at all (ILO, 2012) & (ILO, 1981).

2.3.1.6 *State Act*

The *Petroleum and Geothermal Energy Resources Act 1967* (WA*)* covers all onshore areas of the state, including its islands and, in certain circumstances, areas of submerged lands internal to the state (i.e. those waters landward of the baseline), other than "subsisting" permit areas under the *Petroleum (Submerged Lands) Act 1982* (Department of Mines Industry Regulation and Safety, 2019b, p. 2).

The *Petroleum (Submerged Lands) Act 1982* applies to WA's territorial sea to the three-nautical-mile mark, including the territorial sea around state islands and, under certain circumstances, some areas of internal waters. The *Petroleum Pipelines Act 1969* applies to petroleum pipelines on land within the WA state (Department of Mines Industry Regulation and Safety, 2019b, p. 2).

2.3.1.7 *Commonwealth Act*

"The *Offshore Petroleum and Greenhouse Gas Storage Act No. 14 of 2006* (Aust.) applies to continental shelf waters past the three-nautical-mile boundary" (Department of Mines Industry Regulation and Safety, 2019b).

A compilation of all the aforementioned Acts provides useful resources to form an important universal code of practice document in relation to safety and health in the oil and gas industry. The key objective of these Acts is to provide everyone with practical guidance on the legal, technical, administrative and structural aspects of safety and health with a focus on prevention of accidents and illness, to meet standards in design and projects, offer ways to analyse from a safety and health perspective and propose measurements in planning, control and implementation.

2.3.1.8 *Partnership Arrangements*

Fuller & Vassie (2001) identified a gap in HSE management systems due to the way that contracting companies implemented different safety systems. There was a sudden exponential interest in partnership arrangements in the industry, which was mainly due to the recognised advantages that partnerships can bring to organisations (Fuller & Vassie, 2001).

By presenting standardised procurement processes and equipment specifications, significant savings could be made in such areas as time productivity related to design and administration, as well as large gains in safety and design optimisation. Relative to the early 2000s, capital project costs in the oil and gas industry have escalated up to three times. Approximately 70% of industry-wide capex escalation results from inefficient practices Standardisation may hold the key to eliminating some of these inadequacies and assist to improving upcoming major oil projects. (Haziraei-Yazdi, 2017)

In an effort to achieve cost savings on projects, operators throughout the oil and gas industry are looking at standardisation as one key method of streamlining processes from design and construction through to the installation and start-up, in order to create safer, more predictable and reliable facilities that start up on time and stay up. While some companies in the oil and gas industry have been improving safety standardisation within their own businesses, the industry in its entirety generally lags behind in comparison with other occupational sectors, such as the automotive and aviation sectors. (Haziraei-Yazdi, 2017)

> A recent study was conducted in 2010 regarding safety standardisation on offshore managers and employees. Both positive and negative effects of safety standardisation were outlined below:
>
> - Better plans and prioritising of offshore operation and maintenance activities.
> - Compliance to the operating procedures of a common governing system.
> - Experience transfer through rotation of personnel.
>
> Negative effects from standardisation:
>
> - Disempowerment

- Loss of local knowledge. Increased bureaucracy.
- Less hands-on management. (Antonsen, Skarholt, & Ringstad, 2012, p. 2001)

Substantial paybacks in project cost and schedule can be driven from minimising preferential engineering: by not re-writing equipment specifications on each project, costs and work time are reduced. Eliminating inconsistencies and redundant requirements also lead to less fabrication defects, subsequently, enhancing equipment reliability, quality and safety (Haziraei-Yazdi, 2017).

In a high-risk operation, the best kind of operation is a predictable one (Liou, 2015). The implementation of safety standardisation of key HSE-related policies, processes, and procedures, irrespective of the site, allows for the increased probability of a successful project life cycle. Safety standardisation can be found in the following forms:

- **Cutting costs and time.** Once best practice benchmarks have been established in HSE SMSs, these can be utilised by all oil and gas companies through repeatable processes. This would ensure a quicker project planning phase and less confusion regarding the adherence to safety policies and procedures, where there will ultimately be one set of safety rules to be followed by the whole industry (Hydra, 2011).
- **Governance and control.** Standardising projects and documenting best practices provide clear direction to all project members that specific best practice HSE procedures must be followed (Hydra, 2011).
- **Applying lessons learned.** There is a clear reduction in operational risk when learning from previous projects, particularly from an HSE perspective. All oil and gas companies can learn from previous safety injuries, incidents, near misses and hazards through the frequent dissemination of critical HSE information, recording the lessons learned and applying knowledge to upcoming projects. Every time issues are identified, and improvements are made, the standardisation process is optimised since it is a constantly evolving process. This provides the opportunity to define strategies and to deliver safer projects proactively in the future (Zhao, 2006).
- **Collaborating for success.** Maximise efficiency and streamline decision-making processes by creating a more collaborative environment between suppliers, contractors, and project teams. Through standardisation, a longer-term relationship can be developed with suppliers and vendors, resulting in a reduction in delivery cycles and risk of errors (Zhao, 2006).

An example of an initiative that was adopted internationally was the “Step Change in Safety” program of the UK oil and gas industry. Step Change in Safety is a member-led organisation with the main objective of making the UK one of the safest oil provinces in the world in which to work. This organisation was formed with the premise of bringing together multi-disciplinary managers and professionals in the industry to streamline and standardise safety standards, drive safety innovation and share ideas as a united front to learn from past incidents.

However, for the organisations to be truly successful, it requires collaboration from everyone. The Step Change in Safety program enables both operators, contractor, trade unions, regulators, and the onshore and offshore workforce to work together. The main purpose of Step Change in Safety was to improve safety standards and to communicate and share good practices to reduce the risk of complacency (Step Change in Safety, 2019). Also, (Bresnen M. and Marshall, 2000) reinforced this idea by discussing and emphasising the significance of measuring and evaluating cultures in partnering organisations so that cultural alignment can be achieved.

Closer to home in Australia over the past few years, a similar movement was formed, namely “Safer Together”, which was also designed as a member-led organisation of operating companies and contract partner companies to create the direction and collaboration needed to build a strong and consistent safety culture in the oil and gas industry. This movement has been successfully implemented in Queensland from 2014 and is now currently being actively implemented in WA and the Northern Territory (NT) with over 130-member companies involved in the initiative. The Safer Together initiative is set to have a major impact in standardising HSE standards in the oil and gas industry.

The Safer Together WA and NT movement plans to improve the industry’s safety outcomes, and will also deliver benefits for the industry through simplification, standardisation and improved efficiency by:

- sharing best practice
- development and implementation of industry standards
- establishment of practical programs designed to address current and anticipated safety risks (Safer Together, 2018).

The Safer Together movement has developed specific working groups that relate to different sectors of the oil and gas industry (e.g. Rig Site Safety, Process Safety). This movement comprises subject matter experts and user representatives from member companies. Each working group is assigned to develop solutions to specific safety issues that have been challenging the industry (Safer Together, 2018).

The five specific working groups are outlined below:

1. **Safety Leaders Work Group—**The safety leaders workgroup exists to support leaders demonstrate effective and visible safety leadership and behaviours. The emphasis on the group is everyone, at all levels of the organisation being a visible safety leader
2. **Competence and Behaviour—**The competence and behaviour workgroup exist to define a standard of safe working behaviour expected of all people in the industry and a common standard of competence to enable duties to be performed safely.
3. **Land Transport and Logistics—**The land transport and logistics working group exists to minimise the industry's total recordable injury frequency rate attributable to road use and to promote safe operations in the logistics sector of the oil and gas industry.
4. **Process Safety Work Group—**The process safety workgroup exists to industry's management of major accident hazards
5. **Rig Site Safety—**The rig site safety workgroup exists to improve the industry's drilling and completions safety performance. (Safer Together, 2018, p. 10)

The common goal for all major oil and gas projects globally is to deliver safe and economically feasible facilities, which will consistently start up on time and continue to stay up. Standardisation has the potential to support this goal, and industry-wide collaboration is required to realise the full benefits. The accomplishment of the standardisation initiative in the oil and gas industry will be subject to on how widely the developed specifications are used by companies globally (Haziraei-Yazdi, 2017).

Safer Together is presently still in the process of recruiting member companies and is now determining various initiatives and projects to implement in the coming years. Furthermore, safety surveys have been conducted in the industry to gauge the extent of gaps in process and work behaviour. However, tangible results have not yet been realised by this movement and will take several years to emerge.

This is evidently more of a culture change challenge than a technical one. The true economic benefits of standardisation will only become evident after several years once standardised equipment is delivered across the industry. The operators participating in this initiative are committed to continuing delivery of industry-wide standardisation through additional standardised equipment specifications and by supporting the necessary culture change for embedding the published specifications in practice. (Haziraei-Yazdi, 2017)

As part of this study, a number of health and safety management plans were analysed and key ingredients from these plans were extracted to form an integrated best practice HSE management plan. This plan is designed to be executed by any contracting company operating in the oil and gas industry. Further details of this plan are outlined below.

2.3.1.9 *HSE Management Plan Literature Summary*

The papers summarised below in Table 2.6 primarily researched the two topics of safety management systems as well as safety culture, which was the foundation of this PhD research. Furthermore, the research papers explored the key components necessary to be best in class in health and safety in the oil and gas industry. The papers also detailed that not only is specific documentation such as training records, standards and procedures important in enabling a successful safety management plan, but management commitment must be present and led from the top down to deliver any positive HSE outcomes.

This section discussed the critical importance of having a well-structured HSE management plan implemented through a structured and systematic process. The next chapter (Chapter 3: Methodology) explains the research methodology of the study. In particular the chapter focuses on the specific techniques employed to identify, process and analyse information related to the topic of standardising health and safety management plans for contracting companies in the oil and gas industry and how this affects the bottom line, for instance, the organisations' lag indicators (e.g. accident and incident rate).

2.4 Chapter Summary

This chapter conducted a historical analysis of oil and gas incidents both nationally and internationally. Throughout the literature review analysis, it was determined that there has been a number of notable catastrophic incidents in the industry which had resulted in a significant loss to life, environmental impact, partial or total production loss, equipment and property damage as well as reputational damage to the organisation. The safety techniques of root cause analysis were applied to understand better how these incidents could have been prevented.

Furthermore, the literature review also highlighted the importance of strong safety management systems to combat future incidents which requires several key elements which must be implemented by an organisation to reduce the risk of future incidents.

Table 2.6 HSE Management Plans

Author(s) Publication year Data collection country	Research aim	Study population	Research methodology and data analysis	Research limitations/ strengths	Key findings
Russ, F (2011)	To ensure all oil and gas organisations who work on the US outer continental shelf develop and successfully implement a safety and environmental management system (SEMS)	-	Qualitative research, archival literature review of relevant papers on topic	*Limitations* The paper had not published the audit results *Strengths* Specified the key requirements to auditing SEMS as well as the key requirements to having a successful SEMS program	**Development of a SEMS** The paper specified key audit requirements (13 elements) in the SEMS
Umar, A (2010)	Development of a safety framework for offshore platforms using the knowledge-based risk assessment method (KBRAM)	-	Failure frequency data and professional responses to interviews and questionnaires	*Limitations* The HSE framework model had been identified as lacking in leadership *Strengths* The KBRAM improved the ability to process information and produce more definitive risk levels, and ensured more effective risk identification and risk estimation	**Development of a safety framework** This composite framework was utilised as the groundwork for the development of a new knowledge-based model for the risk assessment of offshore platforms

Author(s) Publication year Data collection country	Research aim	Study population	Research methodology and data analysis	Research limitations/ strengths	Key findings
Mannan,S (2013)	To determine the practical characteristics of a best-in-class safety management and culture	-	Qualitative research, archival literature review of relevant papers on topic	*Limitations* No direct surveys or interviews were conducted of relevant organisations *Strengths* Provided a comprehensive guide on how to have a best practice safety management culture	**Best-in-class safety management** This paper presented an ideal framework for best practice process safety management culture for high reliability corporations. The framework consisted of 10 elements to assess the safety performance of organisations
Elke, G (2006)	Research the broad topic of safety management and to highlight all key areas which have had a good track record of positively influencing safety	-	Qualitative research, archival literature review of relevant papers on topic	*Limitations* No direct surveys or interviews were conducted of relevant organisations related to this topic, only review of previous research papers *Strength* Provided a comprehensive guide on how to have a best practice safety management system	**Effective safety management** This paper highlighted the key safety management principles that must be abided by to be successful in the oil and gas industry

Chapter 3: **METHODOLOGY**

3.1 Research Method

This chapter's main goal is to outline and summarise the research methodology used throughout this study. The scope and goal of this research was to explore the importance of a standardised health and safety management plan for contracting companies in the oil and gas industry, and its influence on the reduction of accident and incidents. The methodology used in this study consisted of qualitative and quantitative data analysis.

This chapter demonstrates the sampling procedures, recruitment of participants and process of obtaining participant's consent; maintaining participants' confidentiality and method of collecting data; the limitations of data collection; the injury and incident statistics for the selected contracting company and the methods of data analysis; and the selected control measures applied to identify the validity and reliability of the results, and discussion of the ethical consideration of the study.

3.1.1 Study Design

This research study was conducted as a case study. A case study approach is suitable for intensive study of a specific subject. It is a thorough and deep investigation and evaluation of a person, group or an event. The investigator conducts a comprehensive and in-depth examination of a person, group or an event. Case studies are one of the greatest methods to establish a new research field. Once a case study is complete, and if the outcomes are valuable, they can become a foundation for a more advanced research field in which the information can be developed further. A good number of research studies already conducted would not have been possible without completing case studies first. Case studies can provide insight into phenomena that cannot be understood in any other way (Universal Class, 2019).

This particular research study is a new research topic, and there have been no similar studies conducted in the past in this industry; hence, the case study was chosen as a new gateway into this research study area, which allowed the researcher to become completely immersed in the case. According to Milesi et al. (2007), whenever an exploratory and innovative research study is conducted for which obtaining deeper understanding and analysis of the case is required, and it is evident that the literature review and preceding studies in this area of research are limited, then the case study is the best to choose as a preferred study design method (Marc Milesi, Yvan Chastel, Msrc Brrnacki, Roland E. Loge, & Pierre-Oliver Bouchard, 2007).

Hence, for the purpose of this research study it was concluded that using the case research study design would be more beneficial for obtaining a deeper understanding of the pre-incident variables. This method provided the greatest chance to obtain clean data, which was gathered for the purpose of this study only. It was also recognised that utilising a case study design would help eliminate obstacles such as coding issues, interpretation and biases by producing a specialised database that could be used to analyse data for this research study.

Furthermore, the study was unique in the sense that this was the first time that case study methods have been utilised to analyse contracting companies' health and safety management systems.

3.1.2 Case Organisation Selection

There are a number of different entities involved either directly or indirectly in the oil and gas industry. The main client, the service providers, or contractor/sub-contractors as well as the overarching regulator (NOPSEMA). Each one of these entities plays an important part in ensuring workplace health and safety is always adhered to.

The main client is the oil producer and is responsible for maintaining a high health and safety standard across the asset, prior to operating they require a comprehensive safety case to operate, as well as a site specific safety management plan which identifies how they will operate safely. Furthermore, due to the enormous responsibilities in oil and gas extraction (including maintenance of the asset), the client almost always will request certain contractors to assist in this process. These contractors must also provide evidence that they will abide by the main client's safety management system and have their own established safety systems of work in place. One of the responsibilities of the main client is to ensure that contractors are adhering to their site-specific safety standards, this can be ensured through periodic safety auditing assessments.

Finally the main regulator's responsibility lies in the facilitation and communication and promotion of occupational health and safety (OHS) of persons engaged in offshore petroleum operations or offshore greenhouse gas storage operations and the development and implementation of effective monitoring and enforcement strategies to ensure compliance under the OPGGS Act and regulations. NOPSEMA has relevant powers of authority and is an enforcement agency. They are responsible for ensuring both the client and relevant contractors are following the overarching safety case of the facility.

The contracting company engaged in this research study was chosen for the main reasons outlined below:

- They had already been working with a major oil and gas supplier for a period of time.
- They had demonstrated a poor safety performance prior to the study, indicating a clear need for safety improvement. This indicated a prime opportunity for the implementation of the integrated best practice health and safety management plan.
- They were already well known across the industry (highlighted as a key player in the industry) and had proven established relationships with both the industry representatives and the regulator.
- They allowed access to their facilities, workshops, and documentation such as policies, procedures and existing safety management systems which further assisted in the research.

The model health and safety management plan was implemented by one contracting company in relation to maintenance operations in the Western Australian offshore oil and gas industry. The justification for analysing only one contracting company's data is that the research study took a detailed, holistic and comprehensive approach, targeting critical areas for one of the typical key player contracting companies in the oil and gas industry, which provided a true reflection of similar contracting companies in the oil and gas industry. This model was implemented throughout this organisation. A detailed comprehensive case study was undertaken. Following implementation, the accident and injury incident rate was reviewed after 12 and 24 months to determine whether any further improvements could be made.

During the research study, the bulk of offshore safety data from the regulator NOPSEMA was collected through an analysis of their annual reports. These reports provided a comprehensive status of the offshore operations and activities and details adequately the safety performance of the industry. There was no need for direct dialogue with NOPSEMA as the information collected through these reports was adequate. Similarly, the author had access to the professional organisation, Safer Together's, various resources such as flyers, bulletins and alerts and was actively engaged in their Industry Safety Forums where important updates were shared with the group. The author also had contact with Safer Together members within the specific work groups.

3.1.3 Methods of Data Collection

The chosen research was a combination of the following:

- **Observation and participant observation**

  An in-depth observation and analysis were undertaken of multiple HSE management plans across different industries. Analysis of safety management plans took place from mining and construction industries in an effort to ensure adequate coverage of planned reviews through multiple industries. Furthermore, the contracting company's safety processes and procedures was examined.

- **Interview**
  - **Obtaining participant's consent.** The research representative conducted the interviews using the questionnaires presented in Appendix 6, which were randomly used to interview 10 participants. A consent form had been developed prior to commencing these interviews, which was provided to each participant. The consent form illustrated a concise summary of the research process and provided contact details to ensure that participants could reach out to the principal researcher or the independent representative to clarify any ambiguity. The participants were also supplied with more information related to the research via the Participant Information Statement Form (Appendix 4). This form offered the participant a greater understanding of the research. Further information including the participant's information letter and consent forms can be accessed in Appendix 3 and 4.
  - **Conducting interviews.** One-on-one interviews were conducted with key contractor personnel. To obtain reliable data throughout the entirety of the research process a total of 10 interviews were conducted with participants; two of these participants were from management and eight from the field. The pre-intervention of the HSE plan interview consisted of a range of specific questions targeting participants' expectations of the level of safety participation and awareness in the organisation. See Appendix 5 and 6 for the interview questions.

- **Surveys**
  - **Sample size.** Each survey was conducted with a total of 20 participants, which represented 70% of the workforce. Niles (2006) advised about the importance of ensuring confidence in the survey and including a large number of randomly-

selected participants in each group of survey (Niles, 2006). Furthermore, sample size depends on the target population's diversity. If the target population demonstrated large variability (i.e. standard deviation) in the behaviours and attitudes during the examination, a large sample would have been needed. However, in this research study, all the employees underwent screening before being hired to ensure they met certain criteria for a particular role, during which it was noticed that most of the population behaved in a certain way, which indicated less variability. According to Mora (2019), in this type of scenario a 50% sample size would also be acceptable. To be conservative, it is a common practice to use 50% as the event probability in sample size calculations since it represents the highest variability that can be expected in the population (Mora, 2019). In this research study the sample size used was 70% of the population or workforce, which is a very good representative sample.

- **Conducting surveys**. The research representative and research principal distributed the survey to sampled participants in a random manner; therefore, the employee (workers offshore) or employer (management) participating in the research study had an equal opportunity of inclusion in the survey. A consent form had been created prior to commencing the survey, which was provided to each participant. The consent form provided a concise summary of the research process and contact details to ensure that participants could reach out to the principle researcher or the independent representative to clarify any ambiguity. The participants were also supplied with additional information related to the research via the Participant Information Statement Form (Appendix 4). This form offered the participant a greater understanding of and insight into the research. The additional information, including the participant's information letter and consent forms, is available in Appendixes 4 and 5.

  Following the interviews, three safety surveys were conducted post-research intervention. See Appendix 7 and 8 for these surveys. Of the three surveys sent out to participants, the safety culture survey had an annual execution frequency, and the offshore safety survey report was completed Bi-annually. A safety or customer survey was conducted quarterly to gauge the perception of safety performance by the offshore contractors as well as the main contractor. See Appendix E for a copy of this third survey.

All the questions in the interviews and surveys were conducted in a 'generic nature', which meant that all personnel in the chosen organisation had the opportunity to participate.

- **Secondary data analysis and archival study**

  Analysis of HSE-related incident data through regulatory reports and databases took place to determine if there was a significant difference between the reported injury and incident statistics and the researched company's data pre- and post-intervention.

This study took a theoretical and systematic approach towards analysing accidents and incidents using pattern matching safety data to accurately determine the most effective risk control measures and best practice measures to eliminate risk in the offshore industry.

The study design was a mixed methods research approach with both qualitative and quantitative data collected and analysed. "The term mixed methods refers to an emergent methodology of research that advances the systematic integration, or 'mixing,' of quantitative and qualitative data within a single investigation or sustained program of inquiry" (Wisdom & Creswell, 2013, p. 2). The limitations of one type of data are balanced by the strengths of the other, thus providing clear benefits to add to the validity of the research. Overall, this ensured a greater multifaceted understanding of the research topic.

> One of the most advantageous characteristics of conducting mixed methods research is the possibility of triangulation, i.e., the use of several means (methods, data sources and researchers) to examine the same phenomenon. Triangulation allows one to identify aspects of a phenomenon more accurately by approaching it from different vantage points using different methods and techniques. (FRC, 2016, p. 3)

As further identified in the quotation below, the core characteristics of a well-designed mixed methods study in research include the following:

1. Collecting and analysing both quantitative (closed-ended) and qualitative (open-ended) data.
2. Using rigorous procedures in collecting and analysing data appropriate to each method's tradition, such as ensuring the appropriate sample size for quantitative and qualitative analysis.
3. Integrating the data during data collection, analysis or discussion.
4. Using procedures that implement qualitative and quantitative components either concurrently or sequentially, with the same sample or with different samples.
5. Framing the procedures within philosophical and theoretical models of research, such as within a social constructionist model that seeks to understand multiple perspectives on a single issue. (Wisdom & Creswell, 2013, p. 3)

3.2 Data Analysis

3.2.1 Qualitative Data

The Research data was collected through observation and ten interviews which generated the qualitative data. The survey was conducted with 20 participants which was too small a number for analytical statistics to be used.

Pattern matching was used to analyse qualitative data using interviews and surveys. Furthermore, inter-rater reliability was ensured during the research. This was demonstrated through the use of a secondary researcher who revised interview and survey result transcripts, as well as various incident and injury data, to identify an independent trend based on the information data analysed. Following this process, consensus was reached between the two researchers, who interpreted each theme emerging from the participants' data. This subsequently provided adequate evidence of inter-rater reliability through peer review analysis.

3.2.2 Quantitative Data Analysis

As part of this study, the injury and incident statistics for the selected contracting company were analysed pre- and post-intervention of the plan from January 2012 to December 2019 using the descriptive statistics of number and percent (%).

Company data analysed included:

- contracting company total recordable injury (TRI) rate in comparison with work hours 2012–2019 (lag indicator)
- contracting company lead HSE indicators (2016–2018)
- NOPSEMA inspection records (2009–2018)—leading indicators
- customer feedback score 2018—leading indicator
- contracting company TRI rate per 200,000 work hours (2016–2018)
- contracting company Safe card participation (Jan 2018 – Dec 2018)
- contracting company number of hazards and observations reported (Jan 2018 – Dec 2018)
- contracting company hazard and observation category (Jan 2018 – Dec 2018)
- contracting company percentage of injuries by bodily location (Jan 18 – Dec 18)

- contracting company mechanism of injury (2016–2018)
- contracting company injured employee profile by age (2016–2018)
- contracting company human factors (2016–2018)

The pre- and post-implementation of the HSE plan company injury results were compared with the injury statistics published by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

> NOPSEMA is an Australian Commonwealth statutory agency established under the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act). NOPSEMA serves as the national regulator for the health and safety, well integrity and environmental management aspects of offshore oil and gas operations in Australian Commonwealth waters. (NOPSEMA, 2018, p. 1)

NOPSEMA data comparisons with the company data, pre- and post-intervention were conducted as follows:

- NOMSEMA lag indicators—total recordable cases—injury rate (2009–2018).
- NOPSEMA mechanism of injury – total offshore incidents (2015–2017).
- NOPSEMA accidents basic causes (2015–2018).

International offshore incident data were used from the National Safety Council (NSC) in the research survey. The NSC produces statistics on workers' safety and fatigue with the mission of eliminating death at work in the US. Furthermore, historical catastrophic incident data were compared with the researched company results using accident causation models to determine root causes (e.g. domino theory, Swiss cheese model).

3.3 Validity and Reliability

According to (Leininger, 1988, p. 68), validity "refers to gaining knowledge and understanding of the true nature of a particular phenomenon and reliability focuses on identifying and documenting recurrent, accurate and consistent or inconsistent factors". Validity is essential in scientific research because without it there is no scientific foundation to the research. Only valid research data can be considered accurate information (Leininger, 1985). One type of validity is content validity.

To ensure validity and reliability of the study, the research tools were based on a review of published literature, which were safety management plans, or other tools used for similar studies. In addition to the above, a pilot study of interview, questionnaires and surveys took place in order to evaluate feasibility, duration, cost and adverse events and to improve upon the study design prior to undertaking a full-scale research project. The pilot study consisted of executing a small-scale questionnaire, which was managed by two qualified HSE professionals employed in the oil and gas industry who were primarily responsible for health and safety in their organisations. These individuals were considered subject matter experts in their chosen field and were considered ideal candidates to engage in the pilot study. Following the completion of the questionnaires by the HSE professionals the results were analysed and discussed to fine tune the questions that would be asked in the interviews and surveys to achieve the best results.

The contracting company has 50 permanent employees and 30 of these employees are working in offshore division. The study conducted multiple survey and analysis using minimum 20 participant which is around 70% of the offshore employees. Although the sample size seems small, however a lot of data analysis were completed. Furthermore, it was important that the researcher didn't just look at the lag indicators, but also the lead indicators. The safety culture survey was a good example of this where there was a clear shift in safety behaviour and thinking. Therefore, both of these areas sufficiently demonstrated that improvement was made following implementation of the new created HSE plan in 2018/2019.

A similar approach combining literature review and a pilot study was taken with regards to identifying the best data analysis tools. Research tools consisted of critical secondary data analysis of HSE-based literature on oil-and-gas-industry major accidents published in journals and books. Analysis and in-depth observations were undertaken of multiple safety management plans across different industries to ensure adequate coverage of planned reviews through multiple industries, as well as quantitative analysis of data from the chosen oil and gas contracting company. The chosen approach was a combination of 10 one-on-one interviews with key contractor personnel and 20 participants participating in 8 various surveys.

This study took a theoretical and systematic approach towards analysing accidents and incidents through the use of pattern matching safety data to accurately determine the most effective risk control measures and best practice measures to eliminate risk in the offshore industry. The study design was a mixed methods research approach with both qualitative and quantitative data collected and analysed.

3.3.1 Content Validity

Guion (1978) and Leininger (1985) advised that in order to verify a series of primary theories about the research and the questions and issues with it, various tools need to be created on both theoretical and logical foundations. To enable validity in the subject matter, a comprehensive review of various HSE-based literature was undertaken, so that the survey and interview questions could be developed. The questions were reviewed by subject matter experts who had extensive experience in the field of health and safety management in the oil and gas industry.

Furthermore, two qualified HSE individuals who were in charge of managing health and safety in their organisation reviewed the questionnaires and analysed data research tools to ensure the researcher had achieved the best possible outcome, which was valid and reliable.

3.3.2 Face Validity

The concept of face validity refers to a specific question assessing what it is supposed to assess (Leininger, 1985). An example of face validity is asking various questions such as about age, gender, total years engaged in employment, work position and how many people are in the organisation. The answers to these questions are not opened ended and are not interpretative in nature. The results from the pilot study concluded that the interview questions assessed what they were intended to assess and thus provided face validity.

3.3.3 Internal Validity

Leininger (1985) described that the main objective of any research study is to determine the main cause of the result; this is what is referred to as internal validity. Maxwell (2009) created a checklist to overcome certain limitations to validity to assist the researcher. This checklist was used in this research study, and it consisted of the following:

- Rich and comprehensive data were collected from the participants to cover the questions asked in the interview and the answers.
- Respondents' validation was used to acquire feedback from the research participants to ensure that there was data accuracy.
- A search for any discrepancies in the evidence and negative cases was followed through to test conflicting explanations.

- A comparison of the results was followed through across the different people, settings, and events.

3.3.4 Reliability

As part of this research study, participants were asked a standard set of questions throughout all the interviews conducted. A pilot study of the interview questions and surveys was completed to ensure ultimate reliability was achieved. This was to check that all types of research participants could easily understand all the questions.

3.3.5 Ethical Considerations

Ethics approval from the Curtin University Ethics Committee was obtained prior to the commencement of data collection for this research (please refer to Appendix 1). The ethics approval number for this research was 71244. The researcher did not ask any questions that could harm the participants, either mentally or emotionally. The conduct of interviews was undertaken with the principles of avoidance of harm and maintaining confidentiality.

3.4 Chapter Summary

The mixed methods approach consisting of qualitative and quantitative research tools was determined to be the best method to conduct this study because it explored the various experiences and levels of safety participation and awareness of personnel working in the oil and gas industry and determined a commonality in experience within the target group. The review of published HSE-related literature, analysis of various safety management plans and completion of the pilot study by participants all assisted to develop and refine the interview questions asked of the research participants.

This chapter described the implementation of various research methods, including both quantitative and qualitative data collection, used in this research study to investigate the importance of a standardised health and safety management plan for contracting companies in the oil and gas industry, and its influence on the reduction of accidents and incidents. Three methods of data collection were used, namely observation and participation observation in terms of responding to a change in a workplace parameter, interviews and surveys. Throughout the research study, it was highlighted that contracting companies in the oil and gas industry would benefit from having a standardised health and safety management plan; therefore, the next chapter showcases the key elements of a model health and SMS.

Chapter 4: **INTEGRATED BEST PRACTICE HEALTH, SAFETY AND ENVIRONMENT MANAGEMENT PLAN**

This chapter showcases the integrated best practice health and safety management plan, following a review of various safety management plans in the oil and gas industry and other industries, such as asset services, healthcare and construction. The model health, safety and environmental (HSE) management plan is produced in this chapter section 4.2. To validate the effectiveness of the integrated HSE management plan, the model HSE management plan was implemented by one contracting company in relation to offshore maintenance operations in the Western Australian oil and gas industry. The justification for analysing only one contracting company's data was that the research study took a detailed, holistic, comprehensive approach, targeting critical areas, which in turn provided a true reflection of similar contracting companies in the oil and gas industry. This model was implemented throughout this organisation, and a detailed comprehensive case study was undertaken. Following implementation, the accident and injury incident rate was reviewed after 24 months and it was determined that there had been a noticeable improvement in HSE performance.

4.1 Integrated Best Practice HSE Management Plan Structure—Comprehensive Review

Historically, the oil and gas industry has been known to neglect health and safety processes and procedures and has often placed them second to production. This industry has suffered a number of horrific disasters throughout the decades. This has led to oil and gas organisations investing more heavily in health and safety, moving away from a reactive culture of merely satisfy the minimum regulatory requirements to a more proactive platform of actively protecting employee's wellbeing and promoting a healthy best-in-class safety culture work environment. However, as of today, there are still potential gaps in the industry; consequently, certain companies are still suffering from a lack of guidance and the absence of a comprehensively structured HSE plan.

The next sections 4.1 and 4.2 discuss the key areas that a HSE management plan must cover including reference to specific Australian and international standards. This plan has been developed by the researcher.

4.2 Environmental and Health and Safety Management Programs and Plans

According to AS/NZS 4801:2001, OHSAS18001:2007 and ISO14001:2015 HSE management programs and plans should be established to achieve objectives and targets. The management plan should identify how potential risks with health and safety activities carried out by the organisation will be managed. The plan should be supported by regulations, requirements and safe work procedures intended to minimise the occurrence of hazards and to ensure the health and safety of all employees involved (AS/NZS 4801, 2001),(OHSAS 18001, 2007) , (ISO14001, 2015).

To support this element of an HSE management plan, the following internal company documentation and procedures were developed:

- OHSE Objectives, Targets and Program Procedure.

The processes and procedures used in ISO 14001:2015 Environmental Management System, AS 4801:2001 and OHSAS 18001:2007 Occupational Health and Safety Management System provide direction regarding how to achieve best practice in health and safety. The HSE management plan outlined below provides a comprehensive structure and outlines the essential requirements to be best in class in health and safety in the oil and gas industry. However, it must be noted that merely having an HSE plan does not guarantee success, this specific plan must be followed by all key stakeholders of the organisation, driven in particular by upper management, and necessary time and resources must be put in place to allow for this to occur and enable success.

The principal elements of a successful HSE management plan in accordance with AS4801:2001 consists of:

- context of the organisation
- scope of quality, health, safety standards and environmental aspects
- HSE policy
- hazard identification, risk assessment and risk control
- legal and additional obligations
- targets
- environmental and OHS management plans

- organisational structure, responsibility, accountability and authority
- training, awareness and competence
- communication, involvement and consultation
- document management
- operational management
- emergency response
- monitoring and measurement, evaluation of compliance
- incident investigation, non-conformance, and corrective and preventive action
- records control
- management system audits
- management review.

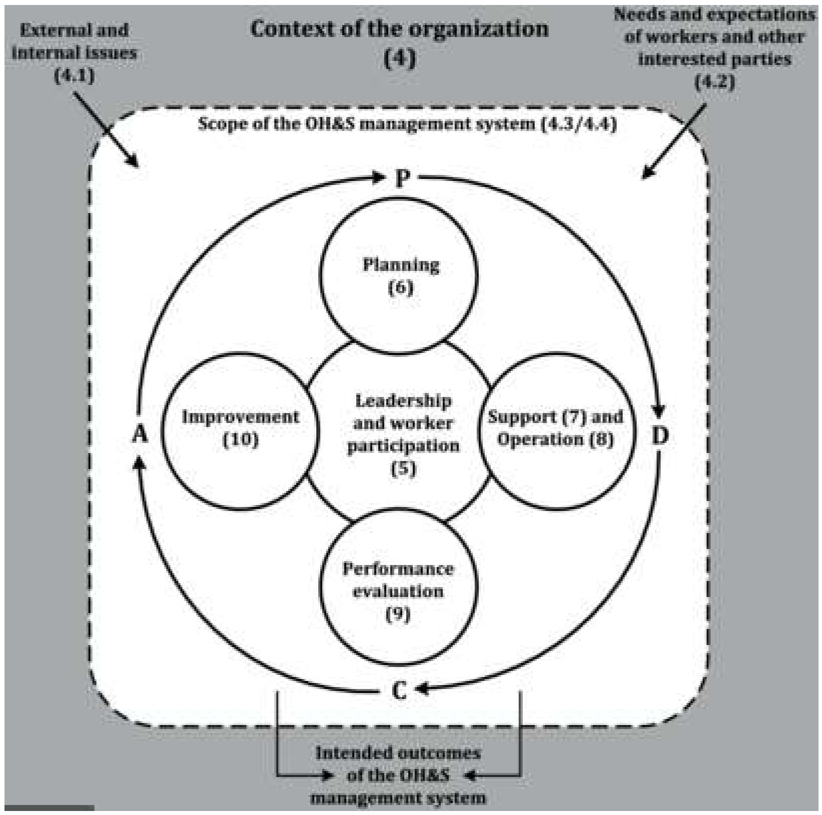
The next section discusses in more detail the HSE Australian and international standards, as well as identifying a new safety standard, ISO 45001:2018, which must be followed by organisations.

4.2.1 Determining the Scope of ISO 14001, ISO 45001, ISO 9001, AS 4801 and OHSAS 18001

To ensure that the organisation is functioning correctly and best in class, the safety standard must always be adhered to. Safety standards must be complied with by all staff (especially including management). In addition, anyone in any role— such as front line or working in any other departments—should be accountable and liable for their specific roles regarding process safety. According to (Wikipedia Safety Standards, 2016), safety standards are standards created to guarantee the safety of products, activities or processes. These standards may be advisory or compulsory and are usually created by an advisory or regulatory body.

Safety standards can come in the form of company-specific safety procedures and standards (e.g. working at heights, confined spaces) or Australian and ISO standards, which mandate how a task should be completed (e.g. AS/NSZ 4801:2001 *Safety Management System*; AS/NSZ 4360:2004 *Risk Management Standards*; ISO 45001:2018 *Occupational Health and Safety Management System*). All these Australian and international standards will support an organisation by offering a comprehensive framework to improve workplace safety, reduce as far as reasonably practicable workplace risks and create a safer culture in which employees feel safe conducting their work without fear of injury. However, any effective Occupational Health and Safety Management System (OHSMS) needs to reflect health and safety concerns within the organisation in which it is used. The fundamental methodology used in ISO 45001:2018 is shown in Figure 4.1.

Figure 4.1 OHS Management System Model



Note. From *Occupational Health and Safety Management Systems- Requirements with Guidance for Use* (p. 11), By ISO., 2018, webpage of International Standards Organisation (https://www.iso.org/obp/ui/#iso:std:iso:45001:ed-1:v1:en). Copyright 2018 by International Standard Organization.

An organisation's safety and environmental management system (SEMS) offers a mechanism for environmental, health and safety management across all areas of the operation. This covers all aspects of environmental and health and safety risks that the organisation directly controls and manages.

To ensure that organisations maintain a safe work environment, tit is recommended that they obtain certified HSE management systems. Holding a certified system demonstrates that the organisation maintains a strong, consistent workplace and an effective sustainable energy policy;

as a result, the organisation will have a better competitive edge and higher probability of increased profitability (DEKRA, 2019).

ISO 14001:2015 outlines the key principles needed for a comprehensive safety and environmental management system (EMS), and it is also certifiable under the legislation. This international standard maps out the specific criteria that an organisation should follow to establish a successful environmental management system and enhance its environmental performance. This ISO standard can be utilised by any organisation irrespective of its specific work activity. ISO 45001:2018 outlines the requirements for the organisation to develop efficient safety systems. It also demonstrates that interested parties and stakeholders should be committed to the health and safety of employees and maintain a safe work environment. An important sign of a business's capability is to reduce costs through prevention of workplace injuries and illness. AS 4801 is the most widely recognised OHS standard in Australian industry. It is applicable to organisations of all sizes, all industries and all products and services.

The new ISO 45001 mainly targets organisations to systematically identify and adequately control workplace risks, as opposed to OHSAS 18001, which mainly concerns hazard management. OHSAS 18001 has been superseded by the new international standard for OHS, ISO 45001. Organisations who are currently certified with OHSAS 18001 are required to migrate to ISO 45001 by March 2021 to maintain recognition of certification. ISO 9001 is the international standard for a quality management system (QMS). To obtain ISO 9001 standard certification, a company is obliged to follow the requirements set forth in the ISO 9001 standard. Organisations implement this ISO standard to demonstrate that their products and services meet customer and regulatory requirements and that they are constantly improved (ISO, 2019).

4.2.1.1 *Environmental Aspects*

This refers to any of the organisation's products, services or activities that can interact and affect the environment. This interaction can be direct or indirect:

- **Direct environmental aspect**

  This element of environmental aspect refers to activities that companies can influence and have control over. For example, this could be emissions from processes and operations.

- **Indirect environmental aspect**

  This element refers to actual or potential activities that the organisation can influence but has no direct control over. For example how your subcontractor manages waste on your site, chain controlled aspects, customer controlled aspects, (Ganguly, 2019).

An organisation must identify the environmental aspects that it controls and manages or has an influence over and determine which of those aspects are deemed as substantial (Block, 1999). The organisation must also have a company document called an environmental risk register, which lists all the potential environmental aspect risks (pre- and post-control) and the environmental management controls of the organisation. The environmental risk register captures and quantifies the key organisation's environmental risks identified by staff, including senior management. environmental risks are identified and rated accordingly, as per ISO 14001:2015 standard, Clause 6.1.2. This environmental risk register is one critical element of an organisation's environmental management system (ISO14001, 2015).

Over the past few years, a business strategy and protection of the environment has been one of the focus areas for many businesses. Business have invested a large amount of resources to improve business response and environmental performance. In addition, businesses look at finding a relationship between environmental management and competitive strategy producing results from research into standards and systems, organisation and management, corporate environment management tools and responses of business to contemporary environmental issues (Welford, 2018).

It is essential to understand the organisation and its context. This determines both the external and internal problems that are related to the organisation and how these have a direct influence on the effectiveness of the environmental management system and the impact on global environmental and sustainability issues. As a result, organisations should consider the following environmental issues when developing and implementing their business strategy:

- natural resources and their depletion
- air quality, including both local and global impacts such as global warming potential and ozone depletion potential
- water quality and preventing water contamination
- land use and preventing land contamination

- protection and enhancement of local ecology and biodiversity and that of the wider community.

There are two types of environment in an organisation: internal and external. The human resources (HR) component of an organisation represents the internal environment, as does the manner in which employees perform their tasks consistent with the main objective of the organisation. Through management and planning processes, the internal environment can be changeable and controllable.

In comparison, the external environment cannot be controlled. Managers and owners of a business do not have any authority over other business competitors, nor can they alter legislation or general economic situations. However, managers do exhibit some level of control regarding adjustments in the external environment (Leoisaac, 2019).

4.2.1.1.1 External Issues

An organisation should consider implications and risk to the business in respect to external issues as below:

- legal and regulatory regulations and guidance within the industry
- overall economic trends shift plans for future
- financial implications, including the availability of government funding and grants
- cultural and social responsibility
- competitive factors (e.g. HSE performance of competitors)
- health, safety, and environmental events that may affect an organisation's image
- advances in technology (e.g. technology in reducing waste and air emission)
- use best available technologies where financially practical and feasible
- external interested parties (e.g. customers and neighbours) and their expectations
- market conditions and circumstances (e.g. client demographic and market confidence)
- effects of climate instability
- amendments to the regional environmental setting (e.g. development and designation of conservation areas)

- fuel and raw material expenses – worldwide tensions, domestic market pressures government taxation regime, etc.

The table below highlights critical areas of the external environment in which the organisation conducts its operations. The organisation cannot control these aspects but is capable of responding to change if required. Business managers must have the ability to respond early to change in the external environment. Some environmental-related factors, such as economic conditions, are reported on a daily basis in the mass media; as a result, managers have a great deal of information available to produce certain strategic plans. However, some external factors may be challenging to identify, particularly if the pace of change is very slow or is hidden from view (Leoisaac, 2019).

Table 4.1 Factors in the External Environment and Their Effect on the Organisation

Factor	Influence on organisation
Economic conditions	The shift in economic conditions of a nation will have a direct impact on the spending patterns of its citizens. Both interest rates and employment levels have a major impact on the economy; when both of these rates rise at the same time, they have a direct impact on spending resulting in less demand on the use of non-vital goods and services. For example, when individuals are under increased financial strain, they tend to spend less on recreational- and entertainment-related goods and services. Economic conditions are both global as well as national, and during the worldwide economic crisis in 2007, shifts in the external environment were quite dramatic.
Market (competition)	Business competition is generally dynamic in nature, meaning it is a continuously shifting factor in the general business environment. Depending on the conditions and the environment, rivals in this market have a potential to come and go, and they have the potential to change both prices and product lines. To survive in this market managers of businesses must always be mindful of what their rivals are doing in order to stay relevant and competitive.
Technology	The rate of technological change has been fast paced and has evolved significantly in the last 50 years. However, this technological change has exerted a certain degree of pressure on organisations to adapt. If businesses fail to adapt to this technological change, they could run the risk of losing a large portion of the market share. It is not just technological or technical aspects that can affect the design of products, but even the supply of services can be affected.
Climate change	Climate change has been labelled as a sinister threat. This level of unprecedented change in our climate can only be suitably recognisable if viewed on a decade by

Factor	Influence on organisation
	decade basis. Furthermore, every country will experience varying effects of climate change. One key impact of climate change is reduced rainfall, which can lead to organisations having a limited supply of water for agricultural means. This can have a major impact on not only single organisations but on the whole economy.
Legal	Taxation is one effect through legislation. Differences in taxation can occur on a daily basis, sometimes with very little warning for organisation to prepare. Other changes in law can affect organisations; these can include industrial relations, consumer protection, environmental law and workplace health and safety legislation.
Media	The media continually undergoes dynamic change. The main reason for this change is technology and the evolution and influence of the internet. For example, once newspapers displayed a large number of advertisements related to job vacancies, but now websites such as Seek advertise jobs online.
Political	Like law, certain adjustments in governmental policy could either be well publicised and debated, or alternatively changed with little to no notice. For example, a large proportion of organisations depend financially on government support packages. However, when there is a change in government, this grant assistance can suddenly vanish and become redundant in a short period of time.
Demographic	The population make-up is constantly changing. These changes can consist of an increased proportion of elderly citizens, increased number of two-income families, couples deciding to marry at a much later time, a decrease in the number of young homebuyers because of higher costs of living. All these demographical differences have effects on the local region. For example, membership of a local children's sports club, which once had a large number of attendees, over time may decline because families have less children.

Note. From *Environmental Factors in Strategic Planning* (p. 1), by Leoisaac, 2019, webpage of Online learning for sports management (http://www.leoisaac.com/planning/strat016.htm). Copyright 2019 by Online learning for sports management.

4.2.1.1.2 Internal Issues

An organisation should consider implications and risk to the business in respect to internal issues as below:

- level of management commitment and support

- organisation's strategies, policies, and procedures
- availability of resources, workforce competency and training in HSE management
- nature of the organisation's activities, products, and services
- structure and size of the organisation
- culture within the organisation
- risk appetite
- relationship with staff and stakeholders, including suppliers
- material usage preference, such as recycled, reusable, or biodegradable materials
- energy management
- cash flow and overall financial power of business to support financing demands
- ability to implement new technologies
- financial gain through the effective application of development and operational processes
- influence over involved parties within the product life cycle, thereby enhancing the overall environmental performance

Table 4.2 below classifies critical aspects of the internal environment that have the potential to influence the general wellbeing of an organisation. Usually the strategic planning process will assess both the strengths and weaknesses of the organisation, and it is likely that significant discussion will centre on the relative strengths of internal environmental considerations (Leoisaac, 2019).

Table 4.2 Factors in the Internal Environment and their Effect on the Business and Organisation

Factor	Influence on the organisation
Human resources	The collective knowledge, extensive experience and general capability of an organisation's labour force is an important factor for enabling success. Organisations devote a great deal of attention to the recruitment of personnel and implement staff training to develop the organisation's capability. In pursuing both recruitment and training strategies, an organisation could be somewhat constrained by its financial strength. Nevertheless, training of staff is a very important characteristic of effective

Factor	Influence on the organisation
	business management, and even in times of financial hardship can be an achievable target.
Organisational culture	The general culture of an organisation is a critical factor in ensuring a business succeeds. The morale, drive and general attitude of staff, and their ability to "try their best" can have a significant impact overall. Conversely, negative attitudes can severely affect the organisation's ability to implement strategies for development, despite thorough planning processes being in place. There are many benefits to employing staff with a positive attitude: tasks usually become easier to complete and the customers also benefit and appreciate this.
Organisational structure	Businesses and organisations may be hindered by their structure, constitution and or forms of governance. Organisational structure refers to how the work is required to be carried out and how the mission of the organisation is divided among its workforce. In a non-profit organisation, the organisation will include the management board or committee (i.e. president, secretary, treasurer and ordinary committee members), the salaried staff of the organisation and all the volunteers that have roles as coordinators of various business functions (e.g. event coordinator, promotions coordinator and coaching coordinator). In contrast, when an organisation is a for-profit business that operates in a highly competitive environment, its organisational structure may help or hinder the ability of the organisation to react to change. For example, when the organisational structure has multiple levels of management, decision-making can be tediously slow. This is due to information being moved up and down the hierarchy. For this reason, "flatter" organisation structures are often the preferred choice. A flat organization refers to an organization structure with few or no levels of management between management and staff level employees. Volunteers are more generally part of the non-profit organisation than the profit business. Although it is often hard to find volunteers, the organisational structure of the non-profit organisation can be very flexible by appointing volunteers when required.
Management	The expertise and capability of the organisation's management team as well as the certain leadership styles utilised by managers will have a significant impact on the morale of staff (and volunteers in a non-profit organisation) and organisational culture. More contemporary forms of management engage workers in decision-

Factor	Influence on the organisation
	making processes. Although managers and workers often have differing viewpoints, they both largely benefit by working collectively to achieve the business objectives.
Assets	The internal environment of the organisation can be made richer or poorer by its assets. For example, the organisation work environment can be aesthetically pleasing, inspirational and encouraging, or conversely, depressing and gloomy. The availability of equipment is another asset that can significantly affect the internal environment. If certain equipment is required to complete tasks and is in short supply or not of the required specification, then staff may be hindered in the performance of their duties; or if such equipment is operated by customers, then customer satisfaction will decline.
Financial strength	Financial strength is a factor in its own right that influences the internal environment of the organisation. Despite how good other internal factors may be, it can be increasingly difficult for an organisation that is too short of money to implement strategies within the strategic plan. If an organisation is struggling financially, this can impact on staff morale and confidence because budgets in such situations need to be extremely tight.

Note. From *Environmental Factors in Strategic Planning* (p. 1), by Leoisaac, 2019, webpage of Online learning for sports management (http://www.leoisaac.com/planning/strat016.htm). Copyright 2019 by Online learning for sports management.

According to ISO 14001:2015 standard, Clause 4.1, in applying the above criteria and techniques, the organisation actively manages and implements programs, procedures and its business strategy to mitigate pollution and harm to the environment and global climate change. These aspects will form the core strategy of the organisation when managing both its risks and opportunities for enhancing the local and global environment. These key strategies will form the core values of an organisation when implementing and managing its environmental management system. The external and internal issues identified should be continuously monitored and reviewed (ISO14001, 2015).

The environmental aspects should be reviewed at least annually by the management team or alternatively when there a new or modified process is introduced at the organisation. The HSE team should maintain the records for identified environmental aspects (ISO14001, 2015).

To satisfy this element of the HSE management plan, the following internal company documentation and procedures were developed by the researcher in collaboration with the HSE team:

- Environmental Impacts and Significant Aspects Identification Procedure
- Environmental impact and aspect (EIA) Identification Form
- Environmental Aspects and Impacts Register.

The next section details the importance of other important legal requirements, such as creating and updating procedures and developing a legal register.

4.2.2 Legal and Other Requirements

The organisation should create a procedure for identifying, accessing, and communicating legal requirements and other obligations that are relevant to the organisation. There must also be a legal register detailing legislative sources such as Australian standards, codes of practice and guidance notes for the different business activities or operations undertaken by the organisation. Furthermore, updates or amendments to the legislation should be implemented by the HSE team, and these changes must be communicated back to the work team. The mechanism of communication can be in the form of HSE bulletins or through verbal direction at toolbox or committee meetings (AS/NZS 4801, 2001; ISO14001, 2015; OHSAS 18001, 2007).

Regarding the legal requirements (compliance obligations), a business must:

- understand and comply with all applicable legal (and other) requirements and update this knowledge.
- apply (relate) this to the hazards, aspects and organisation.
- take the obligations into account in many parts of the EMS/SMS.
- adequately communicate all legal requirements to staff and interested parties.
- consistently comply with legal requirements (or be addressing any non-compliances).
- conduct periodic compliance audits against these requirements.
- raise significant changes in legislation at management reviews (Hamilton, 2016).

To support this element of the HSE management plan, the following internal company documentation and procedures were developed by the researcher in collaboration with the HSE team:

- OHSE Legislative Compliance Procedure.

The next section highlights the importance of key stakeholders or “interested parties” in reference to the international standard requirements.

4.2.3 Understanding the Needs and Expectations of Interested Parties

Interested parties are the individuals who acquire products or service, who potentially may be affected by them, or parties who may have a significant interest in the organisation. Once parties’ criteria are recognised, the next stage is to consider which requirements generate legal and compliance obligations for ISO standards. The legal requirements should always be recognised first, prior to looking at any other requirements (Keen, 2019).

In the past, researchers have recommended that organisations complete a comprehensive analysis of interested parties to determine the requirements that relate to business-related activities and those that affect the management system. This information should be collected, evaluated and regularly monitored through formalised methods, such as management review meetings. (Vanguard Management Systems, 2019)

As per ISO 19001:2015, ISO 14001:2015 and ISO 45001:2018 standard, Clause 4.2; an organisation should determine the interested parties who are relevant to its health, safety and environmental management system and continue to monitor and analyse information about these involved and interested parties and their relevant obligations (ISO14001, 2015), (ISO 9001, 2015) (ISO 45001, 2018).

Table 4.3 summarises who the interested parties might be in an organisation and what their expectations might be.

Table 4.3 Table of Requirements and Expectations

Interested parties	Requirements and expectations	Compliance obligation
Owners/ shareholders	- Good financial performance and sustainable profitability and return on investment - Compliance with legal and other requirements - Risk mitigation - Increase of market capitalisation	√ √ √ -
Customers	- Quick response to HSE complaint and issues - Proper communication channel and point of contact - Good HSE performance - Compliance with legal and other requirements - Meeting all contractual KPIs	√ - √ √ √
Competitors	- Better HSE performance - Removal of current business	√ -
Employees	- Career and professional development - Prompt payment - Safe work environment - Work–life balance - Employment security - Recognition and reward	- √ √ - - -
Statutory and regulatory body (local, state and federal)	- Identification of all relevant statutory and regulatory requirements - Understanding of the requirements - Compliance with all applicable statutory and regulatory requirements	- - √
Bank/finance provider	- Good financial performance - Good cash flow	√ √
Insurers	- No claims - Prompt payment - Low risk	- - -
Suppliers	- Mutual benefit and continuity of business - Prompt payment	- -
Neighbours, local, community and society	- No grievances relating to noise, parking, health and safety, pollution, waste and so forth.	√

Note. Table 4.3 was created by the author (Chegenizadeh, 2019m)

Communication with stakeholders in relation to compliance is extremely important. This communication should be dictated by the performance data generated by the organisational management system. This involves consistent vigorous monitoring and measurement to ensure that data are accurate and reliable. As per the ISO certification requirements, it is necessary that interested parties in the organisation understand their stakeholders needs and expectations. Organisations should allow additional time to prepare for each audit in order to establish a suitable understanding of the relevant interests of relevant interested parties that affect the QMS (Vanguard Management Systems, 2019).

As part of the HSE management plan internal audit, the auditor should always look out for evidence that the organisation has undergone an initial process to identify examples of interested parties and requirements that are relevant to the organisation's QMS. Furthermore, the auditor should also determine whether these groups' requirements are regularly reviewed and updated as changes in their requirements occur (continual improvement), or when changes to the organisation's QMS are planned (Keen, 2019).

The next section highlights the importance of ensuring that there are adequate communication mechanisms in place in the organisation that distribute relevant HSE information to its staff.

4.2.4 Communication, Participation and Consultation

For an organisation to aim towards achieving zero harm, everyone in the business is required to actively communicate and share relevant information with one another. This type of communication includes identifying hazards and risks, discussing relevant health and safety issues and collaboration between the leaders who are in charge of the work as well as employees (team members) that carry out the work. A high level of communication is required to handle safety and environment– issues. Furthermore, it is also necessary under legislation and Australian standards to maintain management systems, which will assist the organisation in meeting its consultation requirements specified under the specific states relevant *Work Health and Safety Act* and its regulations (Tasnetworks, 2019).

Organisation should have a procedure in place for both internal and external communications regarding OHSE information. This process focuses on communication in the organisation. It also concerns receiving, documenting, and responding to relevant communications from external interested parties. "Employees will be informed of all environmental, health and safety-related issues and consulted to improve performance and reduce risks" (Coating, 2005). Furthermore, certain communication media identified below should be utilised to aid in the communication of HSE matters:

- daily morning pre-start and toolbox meetings
- management Meetings
- health and safety representative meetings
- safety committee meetings
- email, newsletters and hazard bulletins (AS/NZS 4801, 2001), (OHSAS 18001, 2007), (ISO14001, 2015).

Consultation with employees can be implemented through several different approaches. A formalised method does not necessarily have to be taken. The process can be as simple as communicating with employees regularly and considering the views of others when making health and safety–related decisions. Consultation can also be conducted through health and safety representatives via safety committee meetings. However, the specific states *Work Health and Safety Act* clearly states that this is not necessarily required by the establishment unless:

- in relation to a health and safety representative, a request is made by a worker
- in relation to a health and safety committee, a request is made by five or more workers or a health and safety representative.

A workplace may develop any form of consultation that they see fit, to suit their workers and workplace situations, including agreed consultation procedures, as long as those arrangements are consistent with the requirements of the specific states *WHS Act* (Safe Work Australia, 2011b).

To support this element of the HSE management plan, the following internal company procedure was developed by the researcher in collaboration with the HSE team:

- OHSE Communication, Consultation and Reporting Procedure.

The next section highlights the importance of the organisation's HSE policy and what needs to be included in this document.

4.2.5 HSE Policy

Another key HSE document that the organisation requires is a health and safety policy. This policy outlines the overall approach, commitment and duty of care obligations of both the employer and employees, and it describes how health and safety issues are dealt with in the organisation through effective reduction in risk of hazards in the workplace. The policy is signed by the managing director (owner) of the business, confirming managements commitments to the policy.

The purpose of the HSE policy is to demonstrate clear commitment to consistently and systematically identify, assess and control organisational site-specific hazards and risk through the elimination of work-related injuries and ill health, the prevention of pollution and a commitment to meeting and exceeding relevant legislation, regulations and other legislative requirements. To maintain its effectiveness and relevance, the HSE policy should be reviewed annually by senior management and be clearly displayed in the workplace as well as communicated to all employees and made available to the public, visitors and clients. Furthermore, the HSE policy must discuss the importance of HSE culture in the organisation, with all interested parties, to consistently improve the health, safety, and environmental management system. The HSE policy should comply with all the mandatory health and safety requirements as a minimum and strive to excel beyond regulatory boundaries to become a pioneering leader in HSE management and establish benchmarks.

As per ISO 14001:2015 standard, Clause 5.2, OHSAS 18001 standard, Clause 4.2 and AS 4801 standard, Clause 4.2: "Objectives and targets are created to support policy commitments and are regularly reviewed to ensure ongoing support of the policy" (ISO14001, 2015), (OHSAS 18001, 2007),(AS/NZS 4801, 2001).

To satisfy this element of the HSE management plan, the internal company documentation and procedures developed as part of this research study were by the researcher in collaboration with the HSE team:

- HSE Policy
- Drug and Alcohol Policy.

An example of an HSE policy can be found in Appendix 14. The next section highlights the importance of leaders in the organisation setting (SMART) goals, objectives and targets to strive for best practice in HSE.

4.2.6 Objectives and Targets

Senior management should establish specific HSE goals and targets to help shape the direction of the organisation. However, these goals and targets must be developed with employee input at all levels of the organisation. Particularly when it comes to the development of policies and procedures, those who work directly with risk on a day-to-day basis are the best people to determine the most effective control measures.

As illustrated in Figure 4.2, the board of directors and senior management are to set objectives and expectations regarding safety performance of the organisation. To be best in class, management should communicate to employees the most positive possible message of safety goals and objectives. Many world-class organisations select specific HSE messages such as "towards zero harm" as a specific vision, while also establishing specific yearly goals to improve performance continuously.

Figure 4.2 Goals and Policies Flow Route

Note. From *Framework for Creating a Best in Class Safety Culture* (p. 1426), by Mannan.M.S et al., 2013, Journal of Loss Prevention in the Process Industries, 26(6) (https://www.sciencedirect.com/science/article/b/pii/S0950423013001848). Copyright 2013 by Elsevier.

To reduce the impacts of environmental, occupational health and safety risk and for continual improvement, OHSE Objectives, Targets, Program, Plan and Procedures are required to be developed. This procedure allows the organisation to set both effective as well as measurable objectives in relation to the ongoing company business and the policy statement.

HSE objectives and targets should take into consideration the inherent safety operational risks of the organisation and actively respond to these risks in an appropriate manner by considering the priorities of people, environment, assets and reputation.

Below are some examples of such objectives:

- The organisation will perform its duties in a manner that does not cause harm to its employees. It will attempt to reduce safety risk to ALARP under appropriate supervision and risk controls. All employees have a duty of care to speak up if they observe a situation that may cause potential harm to themselves or their fellow workmates.
- The organisation will strive to reduce its impact on the environment by ensuring that all raw material usage is optimised, and waste products are reduced as much as possible. All waste should be considered for recycling if possible. There will be no emissions other than those agreed with the governing authorities of the state.

Once the HSE objectives are created then the targets can be created around them. Examples of such targets are:

- Work towards zero harm to employees.
- Work towards zero environmental spills.
- Work towards zero unauthorised emissions.
- Reduce to X tons of non-recyclable waste per month.
- Replace X with non-toxic materials by <date>.
- Phase out X [toxic materials] by <date> (Allinson, 2018).

Objectives and targets also identify the commitment to providing a world-class work environment. As well as promoting health, safety, wellbeing and environmental sustainability, the main objective in an organisation should be to cause no harm to people. Examples of targets set to achieve this objective are:

- A commitment to support the good health, safety, and wellbeing of everyone in the workplace.
- Everyone has a responsibility for the safety of their own health and safety as well as not endangering others.
- Injuries can be avoided, and a work environment free of incidents is actively pursued.
- Communication and consultation are key to creating a safer, healthier, and happier workplace.

When setting objectives, an organisation should also consider environmental aspects; OH&S hazards and risks; technological options; financial, operational and business plans; and the views of interested parties (AS/NZS 4801, 2001), (OHSAS 18001, 2007), (ISO14001, 2015).

To support this element of the HSE management plan, the following internal company documentation and procedures were developed by the researcher in collaboration with the HSE team:

- OHSE Objectives, Targets and Program Procedure.

The next section highlights the importance of and differences between responsibility and accountability in an organisational environment.

4.2.7 Organisational Structure, Responsibility, Accountability and Authority

In simple terms, being in a position of authority means being in a position of power. Responsibility is defined as an obligation to do something. Accountability means being responsible for the work being carried out. All these terms—authority, responsibility and accountability—are deep-rooted terms and are all similarly important in management (Topper, 2019).

In management science, there are three terms that summarise the key set of managerial activities; these are authority, responsibility, and accountability. These three terms are positively linked and at the same time not understood in their proper context (Seema, 2019).

Table 4.4 outlines the differences between responsibility and accountability, these two terms represent key differences in an organisational environment and is an effective technique in determining responsibilities of key stakeholders.

Table 4.4 Difference Between Responsibility and Accountability

Difference between Responsibility and Accountability

Basis of distinction	Responsibility	Accountability
Meaning	It is an obligation by an employee to perform certain duties or to make sure that they are completed	It is the obligation created by accepting duties and responsibilities from higher management.
NATURE	It flows downwards	It flows upwards
DELEGATION	It can be delegated but not entirely	It cannot be delegated.

Note. From *Authority, Responsibility and It's Delegation* (p. 113), by Ahuja S., 2018, webpage of SlideShare (https://www.slideshare.net/Smileahuja/authority-responsibility-and-delegation). Copyright 2018 by SlideShare.

Any roles in the OHSE management system, their responsibilities and authorities should be defined clearly within the organisation and recorded formally in system manuals, procedures and work instructions. The HSE management representative has the main responsibility for managing, maintaining and reporting on the QHSE management system performance (AS/NZS 4801, 2001; OHSAS 18001, 2007), (ISO14001, 2015).

To support this element of the HSE management plan, the following internal company documentation was developed by the researcher in collaboration with the HSE team:

- HSE Roles and Responsibilities.

The next section describes each critical step of the systematic risk assessment process, and how the organisation must follow this process.

4.2.8 Hazard Identification, Risk Assessment and Risk Control

> A person who, at a workplace, is an employer, the main contractor, a self-employed person, a person having control of the workplace or a person having control of access to the workplace must, as far as practicable:
> (a) identify each hazard to which a person at the workplace is likely to be exposed.
> (b) assess the risk of injury or harm to a person resulting from each hazard, if any, identified under paragraph (a); and
> (c) consider the means by which the risk may be reduced. (Occupational Safety and Health Regulations, 1996, p. 26)

Workplace hazard identification, risk assessment and risk control activities are an ongoing process. An organisation should work with consultation from employees, safety and health representatives and work supervisors to identify hazards actively, assess their risks and implement necessary controls of the overall activities of the organisation. The risk assessment process includes ranking each hazard for its potential severity of impact as well as the likelihood of occurrence, which provides a relative measure of risk. The risk assessment also documents operational controls and provides a way to track the recommended actions. Any employee can identify a hazard at any time and may even recommend some actions to address the hazard; however, the actions should be monitored by the HSE team (OHSAS 18001, 2007), (AS/NZS 4801, 2001).

Systematic management of risk is effective in that it is designed to improve workers' health and safety, there is also an additional benefit of increased productivity as a result of fewer injuries and reduced downtime. Eliminating and controlling risks in the workplace also helps to:

- prevent and reduce the number and severity of workplace injuries, illnesses, and related costs
- promote and improve workers' health, wellbeing, and capacity to conduct work
- support and promote innovation and improve quality and productivity of work (Safe Work Australia, 2019).

Following the completion of the risk assessment, controls must be reviewed by the relevant team members in the event of a task, process or environmental change that may potentially render the previous control redundant.

Identified below are five key steps in determining appropriate risk control measures:

1. Assess the likelihood and consequence of the risk with the hazard causing injury or illness: Is an accident or incident likely to occur because of the risk?
2. Investigate the degree of harm that could result if the hazard or risk of the hazard eventuated in an incident: Does the accident or incident have a potential to result in serious harm or even death?
3. Question what the relevant employees know about the specific hazard or risk, and ask if there are any techniques of eliminating or reducing the hazard or risk: Have you gathered enough information about the risk and investigated possible ways of reducing or eliminating the risk as much as possible?
4. Evaluate the availability and suitability of ways to eliminate or reduce the hazard or risk: Are appropriate remedial measures available on the market, or could they be manufactured or designed? Is there a different work process that could be adopted? (Use the hierarchy of control for this.)
5. Balance the factors above with the cost of eliminating or reducing the hazard or risk (Weekes, 2017).

To support this element of the HSE management plan, the following internal company documentation and procedures were developed by the researcher in collaboration with the HSE team:

- Hazard identification, risk assessment and risk control (HIRARC) Procedure
- Hazard identification, risk assessment and risk control (HIRARC) Worksheet
- Hazards and risks register.

The next section discusses operational controls, or the "hierarchy of controls", which are used to reduce the risk of site-specific hazards.

4.2.9 Operation Control

Operational controls include such measures as administration, engineering, personal protective equipment (PPE) and other protective measures (e.g. machine guarding and barricading). Administrative controls include such methods as safety signage, policies, procedures, guidelines, and instruction. Operational controls are considerable in means and actions to appropriately manage and control health and safety hazards and risks, environmental aspects, and significant impacts. They also assist in achieving the requirements of organisational OHS policy and supporting policies by establishing objectives and targets and ensuring compliance with legal and other requirements.

The organisation should regularly review:

- legal and regulatory requirements
- occupations, facilities, and activities where the level of risk is such that further control measures are required
- environmental aspect evaluations where the significance is such that further control measures are needed.

When considering the outcome of such reviews, the organisation develops operational controls:

- to control identified health and safety hazards and risks (including those that could be introduced by others, such as contractors and visitors) and significant environmental impacts
- to stipulate operating criteria
- to facilitate design of workplace, process, installations, machinery, operational controls and the work organisation (e.g. 8-hour and 12-hour shifts), including their adaptation to human capabilities to eliminate or control adverse environmental impacts, and health and safety risks at their source
- to cover situations where the absence of operational controls could lead to non-conformance with legal and other requirements, the company sustainable development policy and supporting policies, and established objectives and targets. The organisation should regularly review and update its operational controls for suitability and effectiveness in controlling health and safety risks and adverse environmental impacts. (Prodigy, 2017).

The management team is accountable for identifying operations and activities linked to environmental aspects or high-risk hazard. Management is responsible for ensuring there are adequate risk controls in place through engineering design, procedures, or work practices. Employees will also be consulted to determine appropriate controls. Usually, operational controls are summarised on the EIA (environmental impact aspect) and HIRARC forms (AS/NZS 4801, 2001), (OHSAS 18001, 2007), (ISO14001, 2015).

To support this element of the HSE management plan, the following internal company procedures and documentation were developed:

- Waste Management Procedure
- Standard Operating Procedure for operating any Equipment
- Standard Operating Procedure for Spray Painting
- Standard Operating Procedure for Welding
- Plant and Equipment Management Procedure
- Electrical Equipment Procedure
- Noise Management Procedure
- Fitness for Work
- HIRARC Procedure
- Hazardous Substances Procedure
- Environmental Sustainability Management
- Electrical Equipment Procedure
- Personal Protective Equipment
- Fatigue Management Procedure.

The following section discusses the key principles of emergency management and how an organisation should respond in the event of an emergency situation.

4.2.10 Emergency Preparedness and Response

An emergency can generate a number of different hazards for employees in the affected area. Ensuring that management and employees of the organisation are prepared prior to an emergency incident plays an integral part in making sure that both employers and employees understand what to do and how to appropriately respond in the event of an emergency (United States Department of Labours, 2019).

Figure 4.3 Emergency Management

Note. From *Emergency Management Principles* (p. 1), 2019, webpage of BU Emergency Management (https://www.bu.edu/emd/emergency-management/emergency-management-principles/). Copyright 2019 by BU Emergency Management.

The emergency management plan should be prepared to enhance the organisation's ability to react to accidents and emergency situations, and to avoid and alleviate the direct or indirect environmental impacts. The emergency response plan needs to be developed, tested and reviewed in accordance with the designated procedure (AS/NZS 4801, 2001), (OHSAS 18001, 2007), (ISO14001, 2015).

To support this element of the HSE management plan, the following internal company plan was developed by the researcher in collaboration with the HSE team:

- Emergency Management Plan.

The next section details the importance of having relevant documentation to support the HSE management plan.

4.2.11 Documentation Related to the HSE Management Plan

The HSE management plan and the master document list and register outline all documentations related to the HSE management system. Documentation should be accessible electronically across the organisation.

To support this element of the HSE management plan, the following internal company procedure was developed:

- Master Documents Register.

The next section highlights the importance of having full control of documentation via a document controller.

4.2.12 Document Control

A document controller occupies a document management position, the main aim of which is to implement controlled processes and practices for the creation, review, modification, issuance, distribution and availability of documentation throughout an organisation. The role also ensures that documents in use are both trusted by its users and contain information that is up to date with current standards, provides reliable accurate information and is periodically reviewed and formally approved by the organisations' management team (Consepsys, 2015).

The organisation should produce a protocol for managing all documents. This process illustrates where documents can be accessed and how and when they need to be reviewed. As part of this protocol, it is important that the current editions of documents are readily accessible at all times and that obsolete versions of the documents are immediately removed from action. Controlled documents can be obtained from the HSE team (AS/NZS 4801, 2001), (OHSAS 18001, 2007), (ISO14001, 2015).

To support this element of the HSE management plan, the following internal company procedure was developed:

- Document Control Procedure
- Master Documents Register.

The next section explains the importance of ensuring that HSE-related records, such as inspections, risk assessment and training records, are kept in a safe, secure location.

4.2.13 Record Control

Procedures need to be established for the identification, preservation, and disposal of records. Records can consist of a wide range of company-specific documentation, which can include training records, risk assessments, audits, and inspections, as well as employee health information and health surveillance data. They should be readily accessible and protected against damage.

Legislatively, a health record must be kept for all employees in the organisation. Furthermore, the retention of specific health records is important because the records allow links to be made between certain levels of exposure and any health effects. Health records, or a copy, should be stored using an appropriate method for a minimum of 40 years from the date of last entry, mainly because often medical ailments can take many years to emerge, from the exposure point to the onset of ill health, particularly with chronic diseases (ISO14001, 2015), (OHSAS 18001, 2007),(AS/NZS 4801, 2001).

To support this element of the HSE management plan, the following internal company procedure was developed by the researcher in collaboration with the HSE team:

- Record Control Procedure.

The next section details the importance of ensuring that all staff receive adequate training dependent on their role and responsibilities in the organisation.

4.2.14 Training, Awareness and Competence

To be truly successful in safety and health performance, companies must consistently educate their staff on a day-to-day basis so that the safety culture is ingrained in every individual. Best-in-class organisations strive for continuous learning. HSE training is a fundamental tool that ensures employees are educated about the work risks in their environment. World-class companies use a document called a competency matrix, which states exactly what HSE training is needed depending on the worker’s position offshore (see Appendix 12). However, any staff that are required to go offshore must complete a minimum set of key training competencies. These can include:

- BOSIET (Basic Offshore Safety Induction and Emergency Training)
- HUET (Helicopter Underwater Escape Training)
- Confined spaces
- Working at heights
- CSTP (common safety training program).

Training programs should be adequately resourced, designed very carefully and constantly updated and refreshed in line with relevant legislation. They should also cater for the particular high-risk industry in which the employee works. In high hazard industries, training scenarios may provide the only experience workers have in certain hazardous situations or potential emergencies. Therefore, training should be exceptionally thorough and comprehensive. Training can also occur on the job through revision of safety processes and key lessons in toolbox meetings, as well as by more experienced staff shadowing “green hats” (new starters) at the offshore site, which would target those employees with less experience and knowledge of the physical hazards in the offshore environment.

Safety training in the workplace is an integral part of workplace safety. It allows management to ensure that the workplace environment is always safe. In addition, it helps employees to acknowledge safety hazards and risks, and to rectify them. It also enables employees to recognise best safety standards and expectations (Jack Revelle & Stephenson, 1995).

Safety awareness training sessions are brief presentations that are presented by site personnel or external providers. These sessions are usually presented during toolbox or pre-start meetings. They can be used to:

- present workers with critical information related to common workplace safety hazards
- encourage discussions within the team regarding general safety and health topics
- highlight any recent safety occurrences (e.g. the *NOPSEMA Safety Significant Incident Report* published by the department) to share the lessons learned.

Examples of safety awareness training sessions include:

- mental health
- wellbeing
- fire awareness safety

- snake handler safety
- lighting safety
- hazard-specific awareness (e.g. sources of hazardous energies on a plant)

(Department of Mines Industry Regulation and Safety, 2019a).

The organisation needs to identify, plan, monitor and record trainings that are required for employees whose work may have a substantial influence on the environment or the OHS of the workplace. The employer must arrange training for employees so that they are familiar with the policy, significant environmental aspects and workplace hazards, and their roles and responsibilities to comply with HSE management system in terms of the policy and procedures, and any other requirements. Training documents should be maintained either by HR or the OHS department. Appropriate records should be monitored and reviewed on a scheduled basis to validate the competency of employees (AS/NZS 4801, 2001), (OHSAS 18001, 2007), (ISO14001, 2015).

To support this element of the HSE management plan, the following internal company procedure was developed by the researcher in collaboration with the HSE team:

- Competency, Training and Awareness Procedure.

The next section highlights the importance of ensuring health surveillance data are kept for every employee, particularly in environments where employees can be exposed to potential hazards that lead to chronic effects.

4.2.15 Health Surveillance

Employers have a duty of care to set up a health surveillance system to pinpoint differences in their employees' health status during their employment. Risk-based health assessments are required in situations where a worker may be exposed to hazardous agents, chemicals or other substances that can lead to ill health or disease, such as lead or mercury. Health surveillance programs should also ensure that control measures in the workplace are adequate and provide instances to reinforce specific preventive measures and safe work practices to employees.

The extent of health surveillance necessary will depend largely on the type of hazardous agent or substance to which an employee could potentially be exposed. Common examples of health surveillance in the workplace include:

- occupational and medical history
- health advice
- physical examination
- records of exposure
- respiratory (lung) function tests
- biological monitoring.

The medical practitioner or approved person under whose supervision a health assessment (including any biological monitoring) is conducted may require the worker to undertake further surveillance. The medical practitioner should inform the employee of the results of the assessment and provide an explanation of the results. The employer should also be notified of the outcome of the assessment and advice on the needs for remedial action, if any (Department of Mines Industry Regulation and Safety, 2019a).

The organisation should develop procedures clearly stating the importance of employee health surveillance. Senior management should keep in mind that health surveillance does not count as a control measure. Health surveillance can only assist in evaluating the effectiveness of the control measures.

Personal health assessments need to be completed prior to employment for all employees as part of the procedure. The pre-employment and pre-placement medical assessment should be completed by an approved medical practitioner with the intention to ascertain if the applicant has any medical condition, which potentially could:

- affect their capability to complete the inherent occupational obligations of the role
- lead to the employee being exposed to an elevated risk of injury, illness or reoccurrence of a pre-existing condition when undertaking the day-to-day activities of their proposed position.

Where employees are directly exposed to specific occupational hazards that can affect their health and wellbeing, the organisation should provide employee health monitoring. The organisation should be responsible for conducting thorough health checks of new starters, particularly offshore staff who are exposed to noise, vibration, ionising radiation, solvents, fumes, dust (including crystalline silica dust), biological agents and other substances hazardous to health. Health surveillance is a critical need as well as a legal obligation in a workplace where employees are subjected to these hazardous elements. Depending on the specific hazardous nature of the work environment, a recommended selection of health tests may be required, such as:

- pathology—example, blood test
- spirometry—example, lung function examination
- audiometry—example, hearing function examination
- biochemical—example, kidney or liver function test.

Further details can be found in (AS/NZS 4801, 2001) and two internal work procedures which are the occupational health surveillance procedure and drug, alcohol policy and procedure. These are examples of procedures that should be developed separately to support this section.

To support this element of the HSE management plan, the following internal company procedures were developed:

- occupational health surveillance procedure
- drug and alcohol policy.

The next section discusses the importance of ensuring that all relevant measuring equipment used in the organisation is calibrated.

4.2.16 Monitoring and Measurement: Evaluation of Compliance

The organisation should guarantee that monitoring and measuring equipment is calibrated correctly. The organisation should evaluate its environmental performance and the effectiveness of its EMS. Environmental performance must be communicated both internally and externally, as required by the organisation's compliance obligations. In addition, each organisation is required to keep appropriate documented information as evidence of monitoring, measurement, analysis and evaluation results (Standardstores, 2019).

A procedure should be established to monitor and measure the essential attributes of operations and activities that can significantly affect the environment or the health and safety of the employees (AS/NZS 4801, 2001), (OHSAS 18001, 2007), (ISO14001, 2015). Furthermore, the organisation is responsible for identifying, monitoring and ensuring compliance with all health and safety regulations, codes of practice, compliance codes, standards and other requirements with the activities, products and service in accordance with the defined scope of work. Legislative compliance reviews can be monitored through a biannual compliance audit or when an OHS-related compliance gap is identified.

To support this element of HSE management plan, the following internal company procedure was developed by the researcher in collaboration with the HSE team:

- OHSE Performance Measurement and Monitoring Procedure.

The next section highlights the importance of ensuring that the organisation has adequate accident and incident investigation processes in place.

4.2.17 Incident Investigation, Non-conformance and Corrective and Preventive Action

The incident investigation, non-conformance, corrective and preventive action procedure specifies roles and responsibilities and includes instructions for filling out essential paperwork. When an organisation experiences a non-conformance, this refers to a particular product or service breaking down or failing to adhere to specifications or requirements. Specific procedures relating to non-conformance and corrective and preventive action are used to outline the responsibility and authority to manage an investigation, take proactive action to reduce current impacts and initiate and complete corrective and preventive action.

The main objective of an HSE-related accident investigation is to:

- identify all the contributing factors in an incident, near miss or hazard and outline relevant corrective actions
- determine legislative requirements to document the details concerning an incident and determine the corrective actions
- maintain records as evidence for insurance purposes as part of an insurance claim, workers compensation claim or common-law proceeding.

If the investigation has been sufficiently thorough and relevant actions have been successfully implemented, then the risk of a recurrence is significantly reduced.

The objective of this guideline is to define the obligations and process for:

- the initiation of an incident investigation by HR

- the method for completing an incident investigation
- the required input of relevant stakeholder groups to an incident investigation.

Any amendments to procedures resulting from either corrective and preventive actions should be implemented, recorded and documented using the applicable procedure (AS/NZS 4801, 2001),(OHSAS 18001, 2007), (ISO14001, 2015).

A part of this research a standardised template has been produced which can be utilised by all contracting companies.

Procedure Template for Incident Investigation, Non-conformity, and Corrective Action

1.0 PURPOSE

To establish, implement and maintain a procedure for:

- handling and investigating non-conformances
- taking the required actions to lessen any impacts and risks caused, and initiating and completing corrective actions
- defining responsibility and authority for the handling and investigating of non-conformances.

2.0 SCOPE

The scope encompasses all activities, processes, products, and services covered under the HSE management system.

3.0 RESPONSIBILITY

The heads of department (HOD) concerned are responsible for monitoring and investigating non-conformance and taking corrective and preventive actions in their particular area.

4.0 PROCEDURE

4.1 The non-conformance should be identified as:

- deviations from the documented procedure and instructions
- unsafe practices and unsafe conditions
- accidental emissions and discharges
- deviation from norms and specified limits
- spillage, leakage, emission, accident, and incident due to improper handling, improper maintenance and deviation from operational control procedures (OCP) and documented procedures
- any incident and accident having a significant impact on or risk to the environment, or health or safety of persons
- non-compliance with applicable legal requirements
- inadequate handling of hazardous materials and waste
- deviations from the specified OCP's and emergency response plan (ERP)
- deviations from the specification mentioned in the operation control procedure.

4.2 Respective team members should identify and record non-conformance incidents and should take appropriate actions through investigation and analysis.

4.3 Respective team members should identify non-conformance incidents periodically in the environmental incident register (EHS-RG-05). Team members should record incidents such as near misses and accidents in the incident report (EHS-F-08) accordingly and inform the concerned department head so that he or she can take appropriate action.

4.4 Concerned HOD or his or her designated officer should review and investigate the non-conformance incidents and decide on the action to be initiated to mitigate the immediate impact.

4.5 Initiating corrective and preventive actions as detailed in the subsequent steps should control the non-conformance identified.

4.6 Respective department heads should investigate the non-conformance by involving concerned workers, employees, and by recording and analysing details of the investigation.

4.7 The procedure for corrective and preventive action is designed to ensure that appropriate corrective and preventive actions are initiated based on input from the following, as appropriate:

- identified non-conformance incident
- Internal and external HSE audit results
- emergency situations (Biswas, 2019).

To support this element of the HSE management plan, the following internal company procedures were developed by the researcher in collaboration with the HSE team:

- Hazard and Incident Investigation Procedure
- Non-conformance Management Procedure
- Corrective and Preventive Action Procedure.

4.2.18 Management System Audits

Internal auditing is a dynamic role intended to assist organisations to achieve their key objectives. This type of auditing is designed to improve the effectiveness of risk management, control and governance processes in an organisation.

To achieve this, the internal auditor must work with management to review systems and operations analytically. The purpose of these reviews (audits) is to identify how effectively safety risks are controlled, including whether the correct processes are in place, and whether agreed procedures are being followed by all relevant parties. Audits also have the benefit of identifying where efficiencies could be improved upon or innovations made. Internal audits should be arranged under an ongoing program of review, and the advisory activity based on the strategic needs of an organisation (The institute of Internal Auditors, 2019).

Annual periodic audits should be conducted to validate that:

- the entirety of the SMS documentation complies fully with statutory legislation
- the SMS is consistently attaining its objectives and targets
- the SMS is being adhered to and the performance criteria are maintained
- the auditing system is operational and effective

- any change compliance audits are completed when required.

The outcomes of these audits should be presented to management for final examination and assessment. Any non-conformances identified from the external audits will be actioned immediately, and an action plan will be implemented to ensure that the non-conformance is rectified in a timely manner. Both external and internal audits must be completed according to a schedule, which is based on the relative risk and importance of the activity and results of previous audits (AS/NZS 4801, 2001), (OHSAS 18001, 2007) , (ISO14001, 2015).

4.2.18.1 *What is the Difference Between Internal and External Auditor?*

Very often in industry, internal auditors are confused with external auditors; however, upon closer inspection there is a considerable difference between the two roles. External auditors concentrate on the accuracy of the annual report and financial statement. In contrast, the internal auditor has a wide-reaching brief that considers anything that might be important to an organisation's success (The institute of Internal Auditors, 2019).

To support this element of the HSE management plan, the following internal company procedure was developed by the researcher in collaboration with the HSE team:

Internal Audit Procedure.

The next section explains more about the HSE management plan and the frequency with which it should be reviewed.

4.2.19 Management Review

The HSE management system should be reviewed at least annually to ensure continued effectiveness as well as relevance of the system. The management review will take the form of a formal meeting and will be attended by the senior (executive) management team. Records of the management review should be documented in the form of meeting minutes. During the management review meeting, all specific HSE-related issues must be openly reviewed by the team at the highest possible level to ensure all hierarchical levels of management affecting HSE are made aware of changes and updates.

The HSE team should be responsible for planning the agenda and collecting all information required in order to review system performance. The agenda of the management review includes:

- follow up of previous management review actions
- review of audit results and evaluation of compliance
- closure status of external audit findings
- review of HSE policy, objectives and targets, and identification of changes (if any)
- the extent to which targets have been met
- setting and approving new objectives and targets (if any)
- review of HSE performance
- results of participation and consultation
- review of communication or complaints from external interested parties (if any)
- review of previous incident and accident investigations, as well as the effectiveness of implemented corrective and preventive actions
- identification of any change of circumstances that may affect HSE, such as legal and other requirements (if any)
- recommendations for improvement.

Outputs from the management review process include the continual improvement commitment of the organisation and may include decisions and actions related to possible changes to:

- HSE performance
- HSE policy, objectives and targets
- resource needs
- other elements of the HSE management system.

The management team is also responsible for providing all resources to implement the decisions and actions arising from the management review meeting. All actions should have responsibilities assigned as well as a time frame for completion. Responsibility for implementation and completion of assigned actions should fall on the member of management accountable for the process or a chosen person. The minutes of the meeting should be distributed to all attendees by the HSE team (AS/NZS 4801, 2001), (OHSAS 18001, 2007), (ISO14001, 2015).

The final section summarises the key principles outlined in the HSE management plan and concludes the chapter by introducing a new tool, the health and safety management plan toolkit, which can be used by any organisation to audit their current management plan, as well as a complete flow chart of the model health and safety management plan.

4.3 Chapter Summary

The oil and gas industry is classified as a high-risk-based work environment. The powerful competitive forces in the oil and gas industry at times can work against positive occupational safety and health performance. The industry endeavours to complete projects both on budget and on time. However, too often safety is neglected and HSE regulations are somewhat more reactive than proactive (Boateng, 2012).

This has been a cause for concern, especially in developing countries where there has been a lack of time and resources devoted to safety and health and, in contrast, a much greater drive towards maximising profits and increasing the financial bottom line (MacAvoy & Rosental, 2005).

These pressures are further aggravated when unrealistic targets are placed on the contractor by the client to meet tight deadlines. Furthermore, most organisations are characterised as small businesses with limited budgets to invest in safety and health. This has resulted in unsatisfactory safety performance (White, 2018).

The current study has identified significant findings in the oil and gas industry in relation to failed safety performance. These include the petroleum industry's environment, lack of management commitment, lack of safety management systems, shortage of skilled labour, inadequate implementation of occupational safety and health legislation, and the poor safety performance of subcontractors and their non-existent uptake of safety programs and safety culture. All of these components are contributing factors to ill effects experienced in the industry in the past and through to the present day (Leveson, 2011).

The following quote below summarises the key steps required to improve HSE in any organisation. A total of 12 steps were proposed by Peyton et al. (1991) that represent an effective safety program. The 12 key steps are as follows:

- The safety program should reflect the size of the business.
- Management should be committed fully to safety above all else.
- Safety responsibilities should be clearly defined.
- Adequate funds should be budgeted for safety programs.

- Management should lead by example in implementing safety programs.
- Open communication should exist between management and employees.
- Hazard identification and assessment through inspections must take place.
- Active employee participation is required.
- Safety should be planned from the bid process until workers leave the job site.
- Written employee disciplinary programs must be in place.
- Safety training and orientation should be incorporated.
- Periodic safety performance reviews must be undertaken (including accident statistics, reports of injuries and results of safety inspections). (Charles, Pillay, & Ryan, 2007)

There are several components that are required by an organisation to have a successful health and safety management plan. The table below demonstrates this HSE management plan toolkit.

Table 4.5 Developing and Implementing a Health Management Plan Toolkit

Tool 1	**Prepare** Determining the scope of ISO14001, ISO 45001, ISO 9001, AS 4801 and OHSAS 18001 Legal and other requirements
Tool 2	**Consult** Understanding the needs and expectations of interested parties Communication, participation, and consultation
Tool 3	**Commit** HSE policy Objectives and targets
Tool 4	**Accountability** Organisational structure, responsibility, accountability and authority
Tool 5	**Identify** Hazard identification
Tool 6	**Assess** Risk assessment
Tool 7	**Control** Risk control Operation control Emergency preparedness and response
Tool 8	**Implement** Documentation related to HSE management plan Document control
Tool 9	**Record** Record control Training, Awareness, and competence Health surveillance
Tool 10	**Audit** Monitoring and measurement, evaluation of compliance Incident investigation, non-conformance, and corrective and preventive action Management system audits Management review

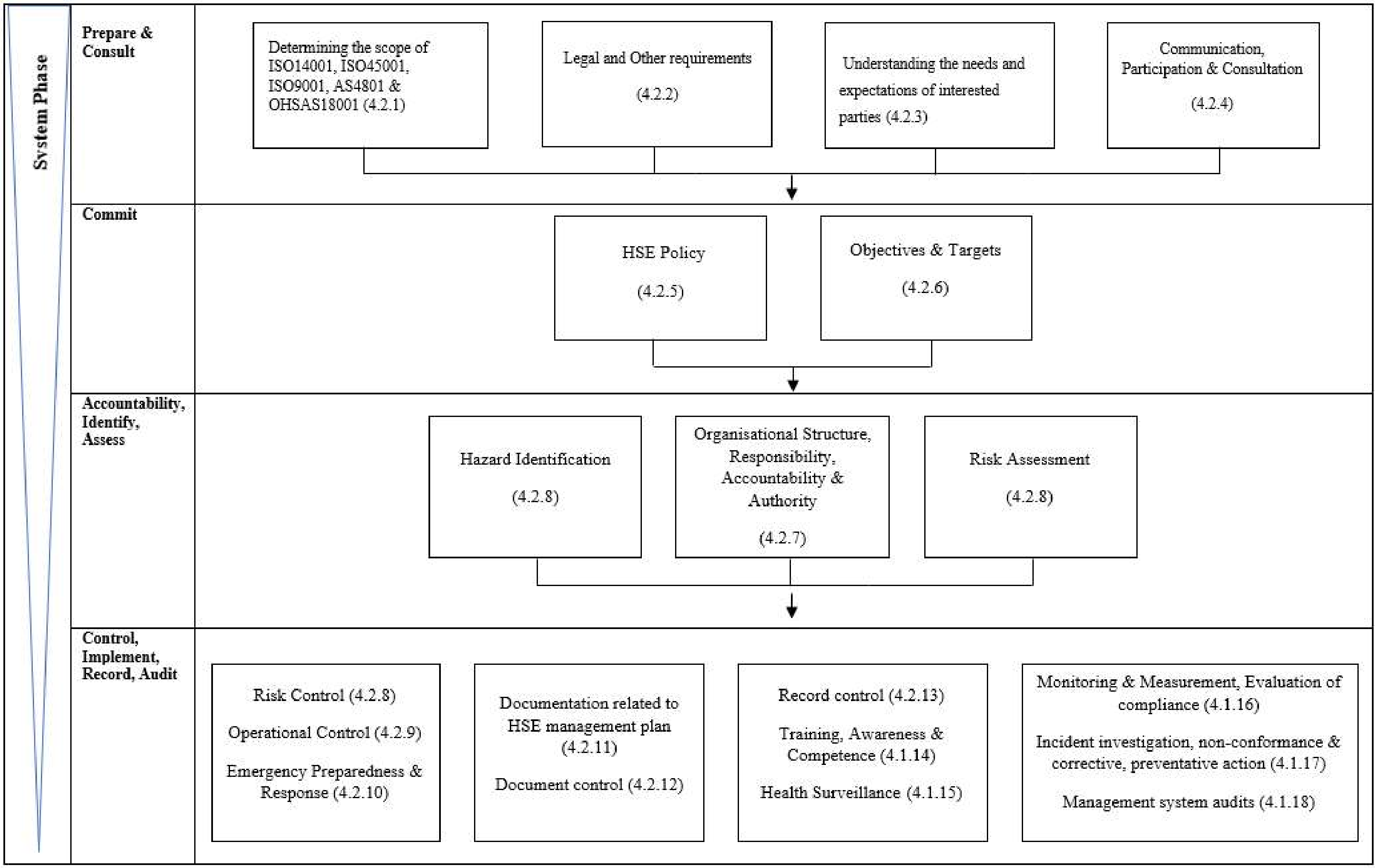
Note. Table 4.5 was created by the author (Chegenizadeh, 2019b)

The Western Australian petroleum industry is capable of becoming a world-class performer in occupational safety and health in relation to other similar high-risk industries.

The next chapter (Chapter 5: Pilot Study) explains the comprehensive and detailed pilot study that was undertaken following the implementation of the HSE management plan discussed in Chapter 4 above. The accident and injury incident rates were reviewed after 24 months and it was determined that there had been a noticeable improvement in HSE performance.

The HSE model below demonstrates in detail what key components are needed in an HSE management system.

Figure 4.4 Model of HSE Management System



Note. Figure 4.4 was created by the author (Chegenizadeh, 2019g)

Chapter 5: **PILOT STUDY OF OFFSHORE CONTRACTING COMPANY HSE MANAGEMENT PLAN**

As part of this study, the best practice HSE management plan was further developed for a company real that works as a subcontractor for one of the largest oil and gas companies in Australia and performs a significant number of projects offshore. The contracting company had a total of 50 permanent employees in total and 30 of these employees worked in the offshore division. This company's main goal was to be a one stop shop solution for oil and gas producers. The contracting company operates mainly in Western Australia with a fabrication workshops based in Perth. They provide a number of different services to the offshore oil and gas sector which includes fabrication and welding, engineering design and drafting, project management, survey and scoping and campaign maintenance. They supply electricians, heating, ventilation, air-condition (HVAC) technicians and coordinators, mechanical fitters, painters, riggers, and scaffolders.

In 2019 due to the increase in number of projects and hours of works the contracting company had to alter the roster arrangements and utilise a different panel of workers who service the offshore operation. In 2019, the company had 25 mechanical fitters, 20 Inlec (Electrical Coordinators), 12 Rigger, 8 Scaffolder and 8 heating, venting air-con (HVAC) coordinators and 5 painters. A total of 78 employees were employed in the organisation in 2019 however around 45 of them were considered as subcontractors.

The integration of this plan into the company's processes is detailed below. This management plan outlines specific instructions on how to maintain a safe work environment in the offshore industry. However, for other organisations to be successful in managing their HSE obligations and requirements, all the HSE components must be adhered to by all key stakeholders in the organisation.

The Integrated HSE Management plan not only provides benefits for the contracting company internally through improved HSE outcomes, it also ensures that the expectations and requirements of the client is also met.

There is a great deal of influence by the client on the health and safety activities of the contractor. There are a number of safety strategies in place by the client, to ensure that the contractor is maintaining relevant safety management processes that aligns with the contracting companies WHS management plan. These include:

- 6 monthly safety audits of the contractor's health and safety management plan
- Monthly management meetings between the client and contractor to discuss key performance indicators, any recent incident, hazards near misses, safety innovations or key developments.
- That the contractor is heavily involved in the clients work processes (e.g. permitry, inspections, safety rules)

However, this element of influence by the client is considered healthy, as this has the opportunity for both the client and contractor to learn from each other and share key safety innovations and developments, which in turn will improve both the contractor and the clients relationship and improve safety culture. In the end irrespective of the employee working for either the client or the contractor they are both conducting similar work tasks and with the same safety hazards and risks, which is why it is important that the standard of work between the two remain the same.

Although the contracting company was being periodically audited by the client, this did not guarantee an improvement in safety performance. With respect to the original HSE management plan there were several safety related non-conformances identified within these audits, however these non-conformances although actioned were not rectified. As a result, there was an extended period of poor safety performance which followed prior to implementation of the newly developed integrated HSE management plan.

Another reason why the contractor's safety performance was relatively poor during this period was that there was a high frequency of accidents and injuries occurring in their onshore fabrication's workshops. The onshore operation of work was not being as closely monitored as the offshore work, including less involvement by the client. As safety standards were not being both rigorously adhered to and enforced as their offshore counterparts, as a result there was a spike in onshore safety incidents.

In an effort to better visualise the key differences between the original and the newly integrated HSE management plan, the original plan has been included in Appendix 15 as this will demonstrate the clear changes in the company safety management plan. Appendix 16 is a table demonstrating the differences between the original and the newly integrated HSE plan.

Prior to the implementation of the newly integrated plan very minimal use of HSE documentation was used. As the pre HSE management plan was quite basic in nature the main control measures included basic HSE inductions as well as toolbox meetings. However, the use of take 5s, risk assessment and hazard/near miss reporting were not implemented and considered high priority. Therefore, these gaps in the HSE management system were reflected as non-conformances by the client during the periodic audit.

5.1 Management Leadership and Commitment

The organisation must be committed to a robust management leadership that is integral to promoting an environment effective in reducing risks. The organisation's management team must consistently demonstrate transparent and proactive leadership and high standards of work practice to strive objectively towards zero harm and a safe work environment for all employees.

The management team should be committed to allowing sufficient resources to perform all HSE critical activities as well as to ensuring that responsibilities for health and safety issues are properly assigned and accepted by the team, and clearly understood. It must also ensure employees remain continuously committed to improving and developing all areas of the operations in order to remove or at the very least reduce workplace safety risk to ALARP. All accidents are preventable. The organisation can demonstrate its ongoing commitment and leadership to health and safety in the following ways:

- maintaining the culture to uphold health, safety and environmental philosophies
- ensuring the health and safety of people have first priority
- endorsing HSE policy
- measuring health, safety and environmental performance and setting strong expectations for continual improvement
- setting annual HSE KPIs
- ensuring incident investigation and analysis to prevent reoccurrence
- actively engaging in a direct manner to implement the health and safety plan
- leading by example on a day-to-day basis in relation to health and safety; safety should always be established from the top down

- placing health and safety matters high on the agenda of business meetings
- periodically communicating the significance of HSE considerations in business decisions
- facilitating and encouraging employees' suggestions to improve HSE performance
- conducting a site visit at least once per calendar year for each facility
- communicating with subcontractors on health and safety matters
- being open to safety innovation strategies and ideas
- rewarding the team for exhibiting best practice HSE compliance and exercising the company's safety values.

5.2 Health and Safety Policies

The organisation's health and safety policy is a written statement of the organisation's strategic objectives, which are designed to clearly outline the principles of action and what the organisation is committed to achieving in relation to health and safety. The direct result of an effective policy is the improvement of health and safety performance.

The safety policy is also an endorsed commitment, signed off by management, which renders it a legally binding document. The health and safety policy is required for the reasons outlined below:

- To clearly demonstrate management's full commitment to health and safety obligations.
- To demonstrate to employees that both safety and business performance are compatible.
- To declare transparently the organisation's safety objectives and specific strategies.
- To define clearly both employer and employee responsibilities and obligations for workplace health and safety.
- To understand and comply with all the fundamental aspects of the onshore *Occupational Health and Safety Act 1984* (WA) and *Offshore Petroleum and Greenhouse Gas Storage Act 2006 (AUST)*
- To outline a clear direction in relation to company internal safe work practices, procedures, risk assessments and guidelines to be followed to prevent injury. This will guide how safety will be administered in day-to-day operations.

Company policies make up a critical part of the way organisations handle health and safety. These specific policies are reviewed annually through a formalised HSE management-based review. All employees will need to comply with the following:

- QHSE policy
- drug and alcohol policy
- HR Policy
- equal opportunity policy
- code of conduct policy.

5.3 Breach of Drug and Alcohol Policy

In the event of an actionable positive drug and alcohol test result for the employee or subcontractor at the heliport, the person will not be permitted to go on site. This must be reported immediately to HR and HSE management, following an investigation.

Once management has been notified, it will perform the necessary arrangements for the employee or subcontractor, including accommodation and flight. The project coordinator will be in contact with the labour hire agency to arrange for replacement labour.

5.4 HSE Objectives

The organisation must ensure that health and safety objectives align with the company's general short- and long-term ambitions. The safety objectives also provide guidance for setting performance targets.

KPIs are developed to measure whether the objectives and performance criteria have been met. Examples of these KPIs are outlined in Appendix 11.

5.5 Responsibilities and Accountabilities Organisation Chart

It is very important to have a comprehensive organisational chart, and employees should be provided with an updated copy of this chart. The organisational chart should show the hierarchy arrangement of the organisation as well as each individual position and duty.

5.5.1 Responsibilities and Accountabilities

The organisation needs to ensure the participation and commitment of employees at all levels because this is necessary to maintain and improve HSE performance throughout the company. All employees have a duty of care to implement safe work practices and to follow policies and procedures.

During the pre-employment process, all new employees will be briefed on their specific accountabilities and responsibilities in relation to their role through an induction session. Adequate training must be provided to ensure staff understand their responsibilities. Full position descriptions are held and maintained by HR.

5.5.2 General Responsibilities

As per health and safety legislation duty of care obligations, all staff have a responsibility to maintain a safe work environment for themselves as well as not endanger other employees in the workplace.

All personnel should comply with the organisational procedures as well as the client company they are providing a service to. They must also ensure they abide by all statutory (legal) requirements that apply to them as they carry out their duties. All employees must always comply with relevant health and safety legislation and any specific supporting guidelines or standards outlined in the work they are engaged in. The company should always promote accountability at all levels of the organisation.

5.5.3 Client

As demonstrated in the health and safety duties of the regulations and *Occupational Health and Safety Act 1984* (WA), all organisations who have control of a workplace must ensure, so far as is practicable, that the work environment is in good condition and free from hazards.

The client company will advise the service provider company employees at all times of any specific health and safety requirements and regulations to be observed on site.

5.5.4 Organisation Management

Management of the organisation is ultimately accountable for the execution of work on a project. It is also responsible for the full implementation of the health and safety management plan, which provides a detailed guide on how the safety plan will be carried out.

Management should:

- lead by example
- ensure that all employees are competent with proven experience prior to the commencement of work
- ensure the highest possible risk prevention control measures are utilised and maintained
- ensure sufficient resources are available to meet health and safety responsibilities
- provide a safe workplace, safe plant, equipment and safe systems of work
- provide adequate information, instruction, supervision and training
- consult and cooperate with employees
- provide PPE
- ensure that all injuries or potentially unsafe occurrences are both quickly and carefully investigated and appropriate control measures are applied to minimise a recurrence
- ensure subcontractors provide adequate evidence that the health and safety of their workers comply with the client company's requirements
- conduct site visits

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- QHSE Policy.

5.5.5 HSE Team, and Training and Implementation

The HSE team consists of the health and safety representatives, safety coordinators, team leaders and management. The primary objective of the HSE team is to facilitate the SMS.

The HSE team will:

- lead by example
- as individuals, ensure their own fitness for work
- assist management in meeting commitments under the OHS legislation
- remain continually updated regarding health and safety legislation and ensure all staff in the organisation are aware of any relevant amendments to the law
- prepare health and safety reports and inspections required by regulations and relevant authorities
- make available to all staff all statistically based health and safety performance and records, and communicate this through various communication streams (e.g. induction, committee meetings, toolbox sessions)
- work closely with the management team and supervisor
- support management to meet its health and safety responsibilities by assisting in the identification and management of health and safety risks
- ensure that health and safety risks are controlled so far as is reasonably practicable and in accordance with the hierarchy of control
- coordinate incident investigations and ensure that appropriate measures are taken to prevent a recurrence
- conduct periodic site visits (paired with client HSE focal visits if possible).

5.5.6 Project Manager and Coordinator

The project manager and coordinator have the delegated responsibility for all operations of the project team and as such also assumes responsibility for the team's conformance with all relevant statutory-based health and safety requirements.

Project managers and coordinators will:

- lead by example
- ensure their own fitness for work
- assist in developing procedures and safety instructions
- in consultation, provide active support to the organisation personnel in all health and safety matters

- liaise with the organisation management or delegate to ensure statutory compliance and conformance to health and safety Acts, regulations, standards and specifications
- monitor progress towards project-related health and safety objectives and targets
- conduct site visits.

5.5.7 Supervisor

Supervisors are a critical branch of the work process because they are in regulator contact with workers and, being in a position of middle-level management, they have the opportunity to influence the work team significantly through their actions. They must also ensure that:

- all parties are aware of how to work safely, without potential risk to their health
- all employees abide by the rules of organisation.

“A supervisor can coach, help or guide workers to develop and remain competitive in HSE areas taken training courses to ensure they have all the necessary skills and attributes to lead their proposed teams in HSE effectively”(Health and Safety Executive, 2019). A list of mandatory offshore HSE-related training courses is outlined in training key competencies in Appendix 12.

All supervisors must possess a key number of attributes, qualities, and standards whom their respective employees must follow. The roles and responsibilities of supervisors include:

- leading by example
- ensuring their own fitness for work and monitoring fitness for work of employees
- providing sufficient supervision proportionate to the level of risk of the work being carried out and the level of expertise and ability (competency) of employees
- serving as an information resource for the area they are representing by providing advice and assistance on health and safety matters to employees
- ensuring that all employees are competent, with proven experience, prior to the commencement of work
- instructing all their employees in the safety standards and the safe work methods that are to be adhered to
- ensuring that all employees comply with the organisation and site requirements and taking immediate action against those who do not

- ensuring health and safety risk assessments are completed and regularly reviewed for all tasks and activities
- ensuring that HSE risks are adequately controlled as far as is reasonably practicable and in accordance with the implementation of relevant hierarchy of controls
- encouraging employees to report all hazards, unsafe work practices or dangerous occurrences being carried out, as well as injuries
- ensuring all hazards and incidents are reported and investigated by their relevant area of responsibility, and ensuring adequate corrective actions(s) are applied
- ensuring that a maximum of 10 employees report to the supervisor; additional employee numbers will require leading hands according to discipline
- conducting structured HSE inspections.

5.5.8 Employee (Installation Team, Tradesperson, Apprentices)

All staff have a duty of care towards themselves and to not endanger the lives of their fellow workers, to work safely and to ensure a safe work environment at all times. Furthermore, the organisation understands the key concept that those who create and are exposed daily to workplace hazards are the best individuals to control this risk, which is why a significant portion of task planning prior to commencement of a job involves proactive employee engagement in conducting risk assessments.

Employees are therefore required to:

- comply with statutory requirements and this management plan
- ensure their own fitness for work
- avoid adversely affecting the health and safety of themselves or any other person
- comply with instructions provided by the employer
- conduct an inspection of the work area before conducting the assigned work, to ensure a safe workplace environment
- use all protective equipment and clothing provided by the employer correctly
- report any incident, injury or situation that has the potential to cause a hazard
- actively participate in pre-start and toolbox safety talks
- enter one minor hazard, Safe card per person per day when on client company facilities.

5.5.9 Health and Safety Representatives

The principal role of a health and safety representative (HSR) is to speak for the employees in their designated work group (DWG) on matters of health and safety. An HSR plays a crucial role in not only gathering relevant information regarding health and safety issues for their workgroup but also providing guidance and assisting in safety incident investigations. HSRs can devise ways to help settle issues in consultation with managers and supervisors, as well as committees and other HSRs.

The organisation understands the importance of HSR collaboration and active engagement of offshore staff on relevant HSE matters and will ensure that the elected HSR attends the accredited safety representative course within 12 months of holding office to ensure he or she has the right tools to represent the relevant offshore site employees on matters of health and safety.

An HSR's main roles include:

- inspecting the site
- if required, accompanying an investigator during an HSE-related investigation
- representing employees in their DWG on health and safety issues and discussions
- investigating any health and safety complaints or issues
- attending safety committee meetings (attendance is quarterly)
- convening weekly meetings while offshore.

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- HSE Roles and Responsibilities

5.6 Training and Competency

The organisation will ensure that all employees are trained and competent with proven experience in their respective trades. Employment will include a review of all trade certificates, licences and tickets presented at the pre-employment stage. These certificates, licences and tickets will be confirmed as valid, and a copy retained by the organisation as a record. Verification of information will be required if deemed necessary, dependent on the specific role. Employees' competencies will be periodically reviewed to identify gaps.

As a minimum, all employees including subcontractors travelling to and working on the client production facilities must have the following valid competency and training records:

- Medical Fitness for work (FFW)—Remote Location Medical for Work and Travel
- Maritime Security Identification Card (MSIC)
- Offshore Petroleum Industry Training Organisation (OPITO) approved accreditation (Basic Offshore Safety Induction & Emergency Training (BOSIET), Further Offshore Emergency Training (FOET), Tropical Basic Offshore Safety Induction & Emergency Training (TBOSIET), Tropical Further Offshore Emergency Training (TFOET)
- Compressed Air Emergency Breathing System (CA-EBS)—FPSOs only.

The organisation will utilise an Excel-based training matrix to ensure that employees' and subcontractors' training and competency remain valid. The training matrix utilises the following colour coding, which changes colour automatically to identify the validity of the qualifications:

- Red—Qualifications that have already expired
- Yellow—Qualifications with less than six months' validity
- Green—Qualification with more than six months' validity.

The HR officer is responsible for monitoring this training matrix. Immediate actions will be taken to rectify those qualifications in red. Renewal training will be arranged for qualifications that are in yellow to allow sufficient time for renewal prior to the expiry date. All employees travelling to or working on the client production facilities must also have their skills and qualifications registered in the client system. This system will issue reminders with regards to expiring qualifications. As part of this study, a training matrix for various positions was developed, which can be referred to in Appendix 12.

5.7 Role-specific Training

Role-specific training is provided to the employee (including subcontractors) taking up a new role or existing employees who do not have the required training and competency. Training required for specific roles includes:

- Safe Supervisor Competence Program (SSCP), which is to be completed by all supervisors and leading hands. All supervisors and leading hands must complete the SSCP training within three months of commencement of their role, as per Appendix 10: HSE performance reporting

- HSR training for all newly elected HSRs. All existing HSRs must be formally trained.

5.8 Management of Subcontractors

The organisation uses subcontractors to perform selected work. All subcontractors' induction is managed in the same way as for its own employees, whereby the organisation ensures that all subcontractors are competent in their respective trades. Copies of certificates, tickets and licences for all subcontractors will be confirmed as valid and a copy retained by the organisation as a record. Subcontractors must also complete the medical assessment. Furthermore, subcontracting companies are also safety audited to ensure they comply with minimum safety requirements.

5.9 Workforce Involvement

The organisation management team acknowledges the advantages of employee input and participation and aims to:

- promote collaboration and teamwork between management and employees in managing and resolving workplace safety and health risks
- improve decision-making in relation to health and safety–related activities by gathering a wider source of ideas
- improve the health and safety culture throughout the organisation.

Communication and consultation enable the opportunity for cooperative problem solving and improved outcomes for health and safety. Consultation on health and safety issues at the company occurs via daily toolbox meetings. Communication regarding health and safety provides employees with a forum to actively engage in health and safety and embrace the following steps:

- **Information sharing**. Provide information in a sensible well-timed manner, which is clearly understandable to allow adequate time for people to voice their views, ask relevant questions, raise issues and provide ideas and recommendations. They must also take an active role in the problem-solving process.

- **Taking views into account**. Take into consideration the views of employees prior to making a final decision and encourage employees to help shape the decisions regarding HSE.
- **Feedback**. Once views are considered, ensure there is an adequate communication stream back to employees regarding the decisions made and the justifications for how they were made.

5.10 HSE Improvements

An HSE continuous improvement is a lead indicator, and the organisation should proactively identify areas where improvement can be achieved during the day-to-day operations of the offshore asset. Every organisation employee is encouraged to suggest HSE improvements that either improve HSE systems and processes or provide a specific reduction to risk.

The organisation's staff can submit their HSE improvement suggestions through the Survey Monkey system. Survey Monkey surveys are submitted daily by the supervisor. One HSE improvement is required per quarter per asset, as per Appendix 10: HSE Performance Reporting. Survey Monkey submissions are tracked by the QHSE coordinator.

5.11 Toolbox Meeting

Toolbox meetings are a primary communication and consultation forum that provide employees with the opportunity to ask questions about health and safety issues or concerns. The organisation should address these issues and get back to employees in a timely manner.

Toolbox meetings will:

- cover the work activities and procedure
- discuss previously reported hazards and injuries (reiterate key learnings)
- identify responsibilities
- engage the work party members in discussion of hazards, risks and controls with the task and location, and involve them in investigating suitable risk control measures
- ensure that everyone has participated in the discussion and has a full understanding
- provide relevant safety hazard bulletins.

5.12 HSE Inspections

Safety inspections are conducted to ensure that fundamental safety behaviours are being followed. Any safety non-conformance arising through safety inspections will be actioned. The safety inspection document covers key safety criteria such as permit to work, working at heights, isolation, heat stress, line-of-fire, chemical and process safety, and PPE compliance.

A structured offshore safety and health inspection or permit to work (PTW) audit will be conducted weekly by the supervisor. Health and safety workplace inspections are completed and submitted through Survey Monkey. Survey Monkey inspections are submitted daily by the supervisor. Any items arising from these inspections are actioned immediately into an action register for future reference, and the supervisors are encouraged to closely monitor these issues.

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- HSE Site Inspection Checklist.

5.13 Induction

5.13.1 Induction (Service Provider Organisation)

The organisation ensures all employees receive appropriate health and safety induction training and information to ensure competency in and awareness of the organisation’s health and safety requirements. All employees will be introduced to company rules, regulations, policies, and procedures at the time of employment. During the induction, they will also be briefed on all relevant health and safety requirements. This includes PPE procedures, emergency procedures, incident, and hazard reporting, first aid location and hazard and risk assessments related to their roles.

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- New Employee Induction Checklist.

5.13.2 Induction (Client)

Prior to commencing work with or visiting the client company's production operating facilities, the service provider organisation will ensure that all employees, including subcontractors, comply with the client's induction and facility orientation procedures. The items below highlight the inductions that are required prior to going offshore,

- common production induction—prior to site access (renewal required if no site access in the last 12 months)
- facility-specific orientation (renewal required if no specific facility site access in the last six months)
- common onshore facility orientation if travelling to an onshore production facility, or
- offshore facility orientation on a facility upon arrival at the helicopter admin office.

Associated client organisational documents developed by the researcher in collaboration with the HSE team:

- Common Production Induction and Facility Orientation Procedure

5.14 Awareness Training

5.14.1 Process Safety Management Fundamentals

All employees, including subcontractors, travelling to and from and working on client production facilities must complete the client HSE fundamental training courses.

Appendix 12, the Training Matrix and Key Competencies, identifies specific competency requirements for respective positions.

5.14.2 Human Factor Awareness

All employees, including subcontractors, travelling to and working on client production facilities must complete Human factor awareness training. Human factors refer to the human and individual characteristics that influence work behaviours in such a way that they have the potential to affect health and safety. "A simple way to view human factors is to think about three aspects: the job, the individual and the organisation and how they impact on people's health and safety-related behaviour" (Upstream, 2019).

5.15 Consequence Management

All non-conformances related to HSE rules, regulations and procedures will be managed according to the Non-conformance Management Procedure and the Corrective and Preventive Action Procedure. These procedures define the responsibility and authority for handling and investigating non-conformances, as well as the corrective actions to mitigate impacts (Upstream, 2019).

5.16 Risk Management

During the risk assessment process, all potential hazards should be identified by systematically examining the individual tasks and proposed work environment, evaluating risks, and identifying appropriate controls to either eliminate or reduce risk to ALARP. Risk assessment must be performed by personnel with the necessary skills, and all potential hazards must be identified, and all reasonable controls implemented. Risk assessment should also consider human and organisational factors (HOFs).

Prior to commencing work, all employees involved in the work must be engaged in a discussion of hazards and controls associated with the task. This is to ensure that any additional hazards are captured and that everyone participating in the discussion has a full understanding of the upcoming work.

During the risk assessment process, the following should be considered:

- specified tasks
- lessons learned from previous activities
- environment, including adjacent operations and equipment
- working party, including personal safety
- process safety
- occupational health hazards.

Associated client organisational documents:

- Health Risk Assessment Procedure
- Risk Management Procedure.

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- HIRARC.

5.17 Integrated Safe System of Work

When working on the client facilities, the organisation should comply with the client Integrated safe system of work (ISSOW) procedure. By complying with this system, it will ensure that work is planned, risk assessed, controlled, and safely executed.

The organisation should obtain all relevant permits and permissions from the client prior to undertaking any work. Work requests will be submitted well before the work is scheduled to be executed in order to ensure sufficient time for permit processing, review and approval.

Permits to work are formal documents that are filled out by the performing authority and approved by an issuing authority prior to commencement of the works. A permit to work should be placed on display at the location where the work is to be undertaken. Each permit should describe the scope of work to be undertaken and define:

- the work location
- the equipment to be used
- the equipment to be worked on
- the validity period of the permit and the precautions to be taken.

A risk assessment should be conducted as part of the permit to work and should consider the required controls to prevent or mitigate against:

- hazards specific to the task
- hazards associated with the task that may influence the site
- the potential for other activities on the site to impact upon the task

Work should not take place until all required certificates have been issued and all controls have been verified as being in place. Certificates must demonstrate all isolations, inspections or tests that have been undertaken by an authorised person. A certificate cannot be removed until all relevant permits have been signed off. Training for the ISSOW system can be conducted through the client company induction, and additional training will be conducted for the Permit Authority (PA).

Associated client organisational documents:

- Integrated safe system of work manual handbook
- Safe Work Control Procedure.

5.17.1 Permit to Work

The work permit should form an essential part of the safe systems of work for many maintenance activities. Multiple levels of review of the permit to work process will ensure that all HSE-related hazards, risks, and controls are sufficiently highlighted in the audit stage prior to campaign commencement. The HSE team should be involved in reviewing the perimetry of identified high-risk scopes at the work request stage.

5.18 Health and Safety Hazard Identification

A health and safety hazard identification (HAZID) should be conducted for jobs that are considered high risk. All hazards associated with the contract scope of work should be identified, and the risks reduced utilising the hierarchy of controls to a level that is considered both tolerable and ALARP in accordance with industry best practice. The scope of work should provide the details of the work and the environment in which hazards can be identified.

The HAZID should be attended by representatives with suitable knowledge of the work scope and risk management process. All hazards and risk mitigation measures will be recorded in the work pack. Work Packs detail the labour, equipment, and materials required to complete tasks according to timescales set out in the Control Schedule.

Associated client organisational documents:

- HAZID Procedure
- Integrated safe system of work manual.

5.19 Health and Safety in Design

Design concepts that are inherently safer are much more likely to reducing risk and are highly recommended as a first option in offshore process designs. Evidence of the concept of reliability and safety was first established in the aeronautical industry following the advancement of air transportation in the 1930s. During this era, aircraft engineers were tasked with conducting particular studies on the probability of aircraft components failing. The main objective of the statistical study was to improve the design of aircraft in an effort to reduce the risk of accidents.

It is most cost-effective to assess safety risk in the earliest phase of the work process life cycle. The most effective hierarchy of the control–risk measure is elimination of the hazard, which has been proven to be significantly cost-effective if conducted during the design or planning phase, rather than delaying this activity to a later interval of the lifecycle when the hazard could become a more tangible risk. Therefore, consideration of safety in design should commence early in the design process and continue throughout the lifecycle of the product (Safe Work Australia, 2018).

Designers are required to identify health and safety risks during the design phase of the project. If a legislative standard is deemed unsuitable to eliminate the risk, a systematic risk-based methodology should be implemented to find the right solution and thereby to adequately reduce the risk to ALARP, at the same time ensuring the client is aware of the residual risks.

As detailed by (Australian Safety and Compensation Council 2006, p. 5), the key elements that impact on achieving a safe design are:

1. Principle 1: Persons with Control – persons who make decisions affecting the design of products, facilities or processes are able to promote health and safety at the source.
2. Principle 2: Product Lifecycle – safe design applies to every stage in the lifecycle from conception through to disposal. It involves eliminating hazards or minimising risks as early in the lifecycle as possible.
3. Principle 3: Systematic Risk Management – the application of HIRARC processes to achieve safe design.
4. Principle 4: Safe Design Knowledge and Capability – should be either demonstrated or acquired by persons with control over design.
5. Principle 5: Information Transfer – effective communication and documentation of design and risk control information between all persons involved in the phases of the lifecycle is essential for the safe design approach. (Australian Safety and Compensation Council 2006, p. 5)

Human factor engineering should also be considered during the design stages because it will ensure that the capabilities and limitations of the user population are effectively considered. All design should comply with the client company's engineering standards:

- Engineering Standard Safety in Design
- Engineering Standard Occupational Health in Design
- Engineering Standard Human Factors Engineering.

5.20 Persons with Control

The main responsibility for ensuring safety in design rests with key stakeholders who are in control of design functions, such as engineers, as well as other key stakeholders who are in the position to influence the design outcome (such as clients, directors and managers). Safe design can be achieved more effectively when all the parties who control and influence the design outcome collaborate with each other on incorporating safety measures into the design (Australian Safety and Compensation Council 2006).

5.21 Product Lifecycle

> "The lifecycle of a product is a key concept of sustainable and safe design that provides a framework for eliminating the hazards at the design stage, and or controlling the risk as the product is constructed or manufactured, imported, supplied or installed, used or operated, maintained, repaired, cleaned, and or modified, de-commissioned, demolished and or dismantled, and disposed of or recycled." (Australian Safety and Compensation Council 2006, p. 10)

A safer product can be created if the hazards and risks that could potentially affect the downstream user in the product lifecycle are eliminated or adequately controlled during the design phase. During the early phases, there is greater scope to eliminate hazards during the design phase and integrate risk control measures that are well-suited to the original design concept and functional requirements of the product (Safe Work Australia, 2018).

5.22 Systematic Risk Management

Risk management is a systematic method of risk control through identification, assessment, and control of hazards. This process enables continuous improvement and aids in decision-making about health and safety performance.

5.23 Identify Hazards

Hazard identification is this first phase of the risk management process and this process needs to be implemented during development of the concept and design phases prior to the product being manufactured, constructed, and installed. Early identification of hazards is the most cost-effective and efficient method to achieve a design in which residual risk is tolerable and reduced to a level that is ALARP.

5.24 Assessing the Risks

Risk assessment is a highly effective tool that enables the organisation to calculate the level of risk of a hazard or risk (through the likelihood and consequence calculation). This process assists in risk evaluation, decisions on whether hazards need to be treated and the most appropriate risk treatment strategies.

Assessing risks utilises a number of qualitative and quantitative means to:

- identify and assess any existing controls
- determine the likelihood of a harmful occurrence occurring
- determining the potential consequences of such an event.

The purpose of a risk assessment is to provide input to decision-making when choices must be made between various alternatives, and the options involve different types and levels of risk.

5.25 Control the Risks

It is always more practical and cost-effective to achieve elimination or substitution of the hazard during the design phase. However, if the hazard cannot be adequately eliminated at this stage, then the designer of the project can reduce the risk to ALARP and provide information on the residual risk as well as the measures required to control the risk (Australian Safety and Compensation Council 2006). A designer should maintain a record of the risks identified throughout the design process and the steps taken by the team to practically eliminate or minimise those risks.

5.26 Monitor and Review

The designer should continually review applied control measures to ensure that specific risks have been adequately eliminated because, depending on the environment-specific controls applied in any one situation, these may become redundant over time if the work process changes. If control measures have not been reduced adequately then further control measures may need to be applied.

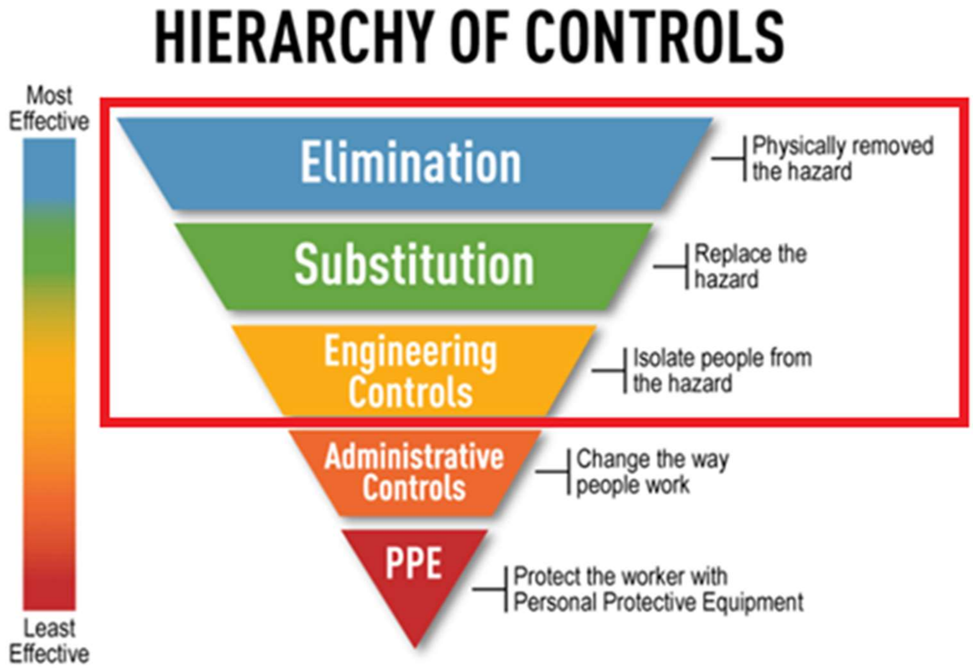
The risk management process and outputs should be monitored and reviewed on a regular basis to ensure that identified controls remain effective and efficient in both design and operation. It is also important to account for new or emerging risks.

5.27 Number of High-end Risk Controls

The hierarchy of hazard control is a system within the HIRARC process that is utilised by the organisation to eliminate or minimise exposure to hazards on site.

The organisation should understand the importance of controlling HSE risks through always considering "high-end risk controls". High-end risk controls are the most effective components of risk control. By initially considering higher-end controls, the risk will be reduced to ALARP. These higher-end risk controls consist of elimination, substitution and engineering controls. The remaining controls, such as "administrative" and "PPE", are considered "lower-end controls" and the least effective in controlling risk. The organisation should promote its staff to always control HSE hazards and risks (where practicable) by initially attempting to utilise these high-end risk controls to mitigate risk.

Figure 5.1 Hierarchy of Controls



Note. From *Hierarchy of hazard controls* (p. 1), 2019, webpage of Wikipedia (https://en.wikipedia.org/wiki/Hierarchy_of_hazard_controls). Copyright 2019 by Wikipedia.

5.28 Knowledge and Capability

As detailed by (Australian Safety and Compensation Council 2006, p. 21): The following skills and knowledge should be demonstrated or acquired by a designer or person with control over safe design:

- Knowledge of health and safety legislation, regulations, and other regulatory requirements
- Knowledge of the lifecycle
- Knowledge of hazard identification, risk assessment, and control methods
- Knowledge of technical design standards
- The ability to source and apply relevant data on human dimensions, capacities, and behaviour, and
- The ability to integrate knowledge from a range of sources and disciplines into a new solution. (Australian Safety and Compensation Council 2006, p. 21)

5.29 Information Transfer

Information transfer is the manner in which communications are made to those who will be working with the product regarding the risks involved, risk control measures and specific training requirements. Information pertaining to control of risks should be logged and transferred from the design phase to all other relevant users in following phases of the work lifecycle (Australian Safety and Compensation Council 2006).

5.30 Demonstration of "ALARP"

Risk should be lowered to the tolerable limit and subsequently be in accordance with the ALARP principle. The ALARP principle states that risks should be reduced "as low as reasonably practicable".

The risks to health and safety of people should be reduced to a level that is ALARP. Determining whether risks have been reduced to ALARP involves an evaluation of the risk to be avoided and an assessment of the sacrifice (in feasibility, cost, time and effort) involved in taking measures to avert that risk, and a comparison of the two. The organisation should refer to the client's ALARP demonstration procedure to demonstrate that risks are ALARP.

5.31 Identify Risk Reduction Measures

A comprehensive range of potential risk reduction measures should be identified during this stage. The identification of risk reduction measures should not be limited to what is considered feasible and practical during this stage.

5.31.1 Evaluate Risk Reduction Measures

Risk reduction measures should be evaluated and ranked based on the magnitude of the risk reduction delivered.

5.31.2 Determine ALARP Options

It is necessary to demonstrate that the risk reduction measures with the lowest residual have been implemented, or if not, why not. The ALARP demonstration should document that:

- there are no other practical measures that could reasonably be taken to reduce the risk further
- any further reduction in risk would be grossly disproportionate (in terms of cost, time and effort) to the benefit obtained.

For the rejected measures, the ALARP demonstration should document the reasons they are not practicable.

5.31.3 ALARP Demonstration

The assessment and documentation should be proportionate to the level of risk. Documentation should identify all risk control options considered and the reasons for adoption or rejection.

5.32 Management of Change

Change is an important and natural part of any organisation and management must be committed to handling this effectively in an open and transparent manner. While change is necessary for a business's success in the future, changes can also introduce new and unintended risks that affect people, safety, health, and the environment. Through the management of change process, changes should be properly identified, assessed, and controlled to avoid unplanned consequences. Effective management of change process also avoids inconsistent decision-making.

Example of changes are:

- addition of new equipment
- revision to standard operating procedures
- changes in organisational structure
- modification to process equipment and infrastructure
- changes in material and component specifications or sourcing.

The change process comprises four key steps to managing change in a proactive, transparent and constructive manner. Each step can be tailored to the nature and scale of the change.

Table 5.1 Four Step Change Process

Prepare	Planning	Implement	Evaluate
• Identify why change is required and outcomes to be achieved • Assess impacts, risk, opportunities and benefits	• Review the potential impacts of the change • Conduct risk and benefits assessment • Consider how employees and stakeholders will be involved • Consult with all affected personnel and stakeholders • Consider feedback and adjust plan (where relevant)	• Implement the change • Reassess and review • Communicate progress • Support employees to adapt	• Integrate into business • Close-out change

Note. From *Change Management Process* (p. 3), 2019, webpage of Prosci (https://www.prosci.com/resources/articles/change-management-process). Copyright 2019 by Prosci.

Where appropriate, all change or deviation should include the following information:

- the proposed change
- risk assessment of the change options
- the justification for change
- the proposed implementation actions and timeliness
- an organisational chart (if any)
- a human resource impact statement to detail the impact of change on staff, how services will be affected and how the change will affect the organisations work and positions
- a communication plan for all employees
- a consultation plan

Proposed internal changes should be reviewed by the company senior management and may also involve client representatives. Management will review the changes to be made and the impact of the change to health and safety in order to prevent hasty or ill-considered changes being implemented.

For changes that involve the client company, the organisation should notify the client company focal person of the proposed changes by providing sufficient details for assessment and decision-making. The change will only be implemented if the proposed change is approved by the client company.

Associated client organisational documents:

- Change Management Procedure.

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- Management of Change Procedure.

5.33 Health and Safety Planning, Performance and Management

5.33.1 Regulatory Requirements

The organisation is responsible for identifying, monitoring, and ensuring compliance with all health and safety legislation, codes of practice, guidance notes, Australian standards and any other requirements that are related to the scope of work.

All identified legislation and other requirements are documented in the legal and other requirements register. The organisation should ensure that legislative compliance reviews occur:

- biannually through compliance audit
- when new activities, operations and process are introduced into the workplace
- when any OHS-related compliance gap in process is recognised.

5.33.2 Performance Indicators and Targets

The service provider company should provide the client company with a monthly HSE performance report that includes the HSE-related statistics for the contract. Refer to Appendix

10—HSE Performance Reporting. The service provider company should also update the HSE KPI monthly. Refer to Appendix 11—HSE KPIs.

5.33.3 Reporting and Communications

An event is a collective term for either an incident or hazard. All employees, including subcontractors, must report an event they become aware of as soon as possible, and no later than by the end of the working day or shift, to their workplace supervisor. The event must be recorded in the client's event reporting database within 24 hours of the event occurring.

Associated client organisational documents:

- Health, Safety and Environment Event Reporting and Investigation Procedure.

5.33.4 HSE Discussions

The organisation should recognise and promote the dissemination of HSE-related information, particularly to its employees and contractors. Effective HSE communication and consultation between all key stakeholders helps to achieve a positive HSE culture. Effective HSE communication and consultation is also essential to the effective implementation of the HSE management system.

HSE discussions can include the following topics:

- general HSE-related moment, safety shares/discussions
- hazards and risks
- near misses
- safety incident or recent injury
- legislative changes
- HSE bulletins.

5.33.5 Reporting Minor Hazards (Safe Card)

Reporting and registering hazards is just as essential as reporting and registering the injuries because it indicates the proactive nature of the organisation and its intention to eliminate hazards at the source before they produce a detectable injury. Reporting a hazard indicates an "I see, I fix" attitude in a workplace: when you identify a risk, endeavour to eliminate the risk and to make it safe. As the next step, record the hazard and how you have addressed it. Minor hazard reporting is used to record hazards that are addressed promptly at the source, allowing a record to be kept for future analysis. This is also known as safe card reporting.

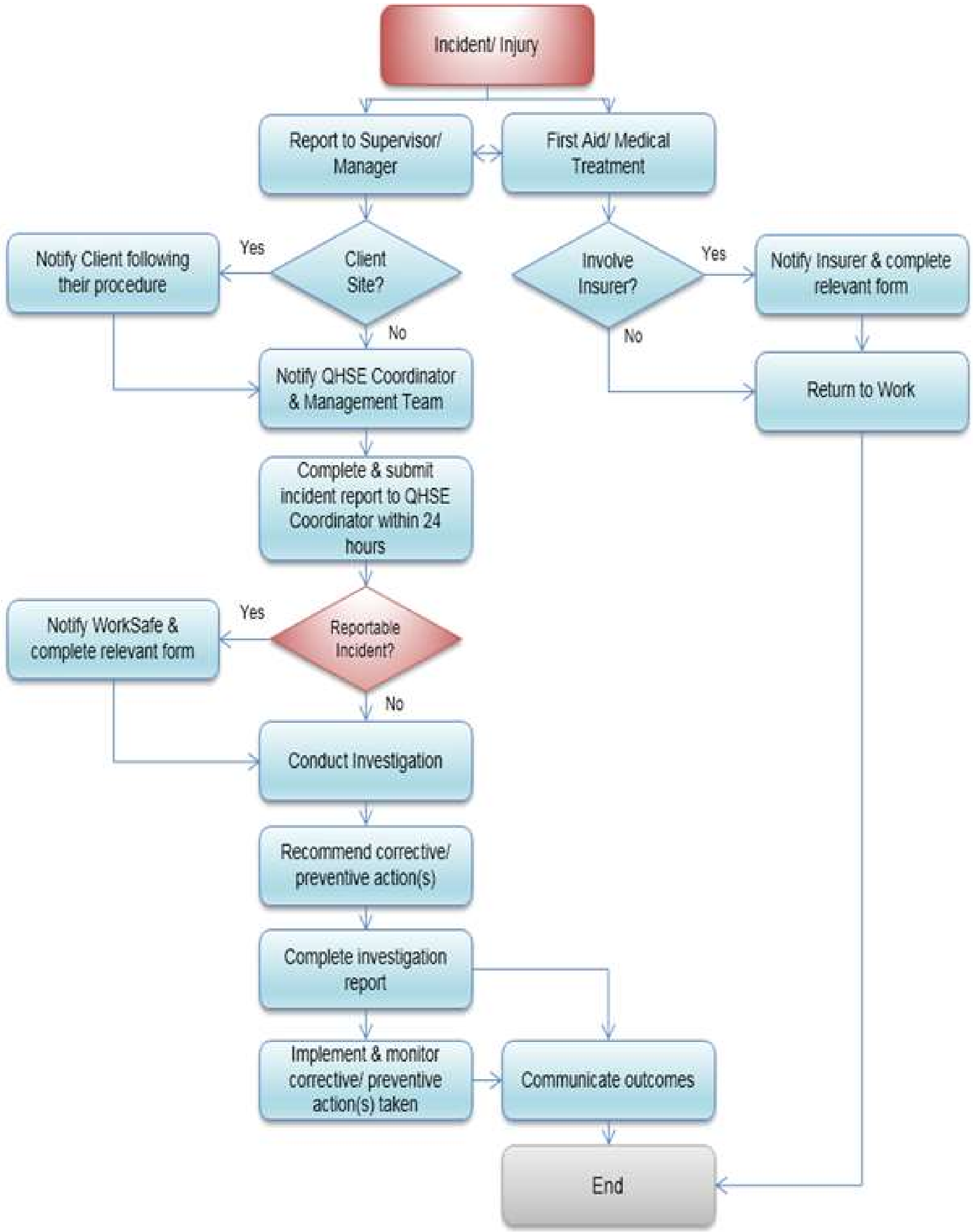
If the hazard cannot be rectified immediately or it potentially exceeds the definition of a minor hazard, it should be reported to the line manager as soon as possible, and no later than the end of the working day or shift. A target of 1 x safe card per day is required, as per Appendix 10—HSE Performance Reporting, Section 5.3.1.

5.33.6 Reporting Injury

The term injury is used for any physical injury or illness that has an impact on an employee's fitness for work. When an injury occurs, the injured employee must notify the immediate supervisor as soon as possible of the injury and seek medical attention from the site medical services or first aider where available.

The client facility's medical centre must immediately be notified of any injury that takes place on a client facility. First aid treatment for compensable injury must be documented in the event and incident reporting system (e.g. client's incident reporting database). If the injured employee seeks medical treatment after work hours, he or she must notify the supervisor as soon as possible.

Figure 5.2 Injury Reporting Flowchart



Note. Figure 5.2 was created by the author (Chegenizadeh, 2018a)

5.34 Incident Investigation and Analysis

Hazard and incident investigation and analysis is a systematic approach to the constant improvement of the HSE management system. Constructive accident investigations have a potential to yield useful information, which will aid in the following:

- identifying common injury trends
- allowing comparisons to be made, for example, among injury rates for various areas of the workplace, across different time frames and involving different types of injury
- complying with legal safety requirements
- identifying the root causes that contributed either directly or indirectly to each incident
- identifying flaws in the system that allowed the incident to occur
- recommending specific corrective action(s) and preventive action(s).

In the event that an incident occurs on the client facility that involves the service provider employees and subcontractors, the incident must be reported to the client focal person representative immediately. The client company will lead the incident investigation together with any relevant employees, subcontractors, and supervisors. A copy of the outcome of the incident investigation report form should be requested as a record. Any corrective action(s) and preventive action(s) assigned to the service provider organisation arising from the investigation report will be actioned accordingly and reported back to the client company for closure.

5.35 Medevac

If any of the employees require medical attention while on the client facilities this will be managed by the client medical service provider, including any medevac arrangement from the site to the relevant medical facility, at which time the care, custody and control of the injured person will be transferred to the service provider organisation (employer) control.

Upon arrangement of medevac, the client company is to notify the employer focal person of the injured person and the details of the event, including the nature of the injury and the details of the relevant medical facility. A table should be maintained with contact details in order of preference, per the organisation's focal person. Once notified, the organisation will perform the necessary arrangements for the injured employee, subcontractor including the accommodation and flight.

5.36 Injury Management and Return to Work

In the event that the employee or subcontractor sustains an injury on a client-operated site, the organisation's HSE team will work closely with the client company health and safety advisor to ensure that injury management obligations are met. The employer organisation will contact the injured employee as soon as practicable following the injury to offer practical and welfare support and maintain contact as agreed with the employee.

To facilitate this process, an effort must be made to:

- develop an injury management plan. Injury management commences when a medical certificate or First Certificate of Capacity indicates that an employee is:
    - fit for pre-injury duties, but requires further treatment
    - fit for restricted duties
    - unfit for work
- support the injured employee throughout the return to work process
- provide suitable duties (alternative or modified duties) to suit the stated medical capacity to an injured employee as soon as possible.

The organisation will provide evidence of medical clearance for return to work to the client prior to the injured employee, subcontractor returning to work on client facilities.

Associated client organisational documents:

- Injury Management Procedure.

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- Injury Management and Return to Work Programs.

5.37 Safe Work Procedures

The service provider organisation should refer to the client safe work control procedure when managing high-risk work activities.

5.38 Client Safety Rules

Safety rules refers to a summary of the operating standards that describe the compulsory requirements for safety in the workplace. This includes management characteristics of work such as planning, competency, documentation, and record requirements. Safety rules cover the following:

- foundations
- change management
- confined space entry
- electrical safety
- lifting operations
- permit to work
- process and mechanical isolations
- working at heights.

These rules help the service provider company to identify the critical controls that must be in place before undertaking work. Every employee must adhere to these safety rules at all times. For this purpose, the organisation should require all staff to complete a safety rules induction module prior to going offshore, as per the competency training matrix supplied in Appendix 12.

Associated client organisational documents:

- Safety Rules Booklet.

5.39 Working at Heights

All fall and drop-related risks must be minimised when conducting activities at any height. If there is a possibility for an individual or piece of equipment to drop from one level to another, successful risk control measures should be implemented.

Efficient measures include:

- the establishment of live edge protection (fixed guardrails)
- the use of a scaffold or elevated working platform (boom lift, cherry picker, scissor lift)
- the use of drop sheets, tool lanyards
- the use of tool belts to carry tools
- the use of fall protection and fall arrest systems
- the installation of catch platforms
- the designation of exclusion zones below the activity with a spotter

Work activities should be planned in line with the employees' level of skills and capabilities, the equipment available, the impact of certain environmental and climatic conditions and clearance and rescue requirements.

It is critical to eliminate any risk of dropping an object from one level to another during the work. Specific working-at-height–related risks need to be identified, for example, dropped equipment and tooling from a height.

Personnel working at heights should complete the working safely at heights course through an approved training provider. This will ensure the person is competent in using fall arrest equipment and devices prior to carrying out any inspection, fitment, or installation at heights. Refresher training should be conducted every two years for working-at-height activities.

Associated client organisational documents:

- Safe Work Control Procedure.

5.40 Confined Space Entry

The most effective risk control for confined space entry is to consider either eliminating the need for confined space entry or minimising the number of personnel involved in any planned entry. These specific scenarios must be considered prior to such working being carried out. All confined space entry activities must be supported by a documented detailed risk assessment and relevant permit to work process. The permit to work should be developed by a competent person and reviewed by all personnel involved in the confined space entry activity.

An ERP should be documented for all confined space entry activities. The ERP should be developed by a competent person, reviewed by all personnel involved in the confined space entry activity.

Before any employee is permitted to enter any confined space, every effort must be made to free the atmosphere of any contaminants prior to entry. The atmosphere within the space should be tested by an authorised gas tester, in accordance with the permit to work to determine the oxygen level and concentrations of flammable vapours, gases or toxic contaminants. A person is under no circumstances permitted to enter a confined space where an atmospheric contaminant is present at concentrations greater than the relevant exposure standard unless they are using suitable PPE, including respiratory protection. Testing should be completed prior to entry and at any subsequently required intervals.

A standby person should be made available for all confined space entry activities and should provide a communication link and initiate an emergency response. The standby person may not enter the confined space at any time. All personnel entering or exiting a confined space should be logged.

All employees who are required to enter a confined space should be trained in enter and work in confined spaces and instructed as to the nature of hazards involved and the necessary precautions to be taken and trained in the use of protective and emergency equipment required. Refresher training should be conducted every two years for confined space entry activities. The organisation is to comply with the client confined space entry training requirements.

Associated client organisational documents:

- Safe Work Control Procedure.

5.41 Lifting Operations

Management of lifting operations, procedures and maintenance of lifting equipment must comply with the client company obligations. Dedicated focal points for each facility will need to manage all the lifting operation job enquiries.

All proposed lifts should be planned, and a risk assessment must be completed by all relevant staff engaged in the lift. The risk assessment must specify all relevant hazards inherent to the task.

Dependent on the risk assessment category results, all relevant staff engaged and participating in the lift must specify all relevant inherent hazard to the tasks. The outcome of the risk assessment as well as the general complexity of the lifting operations will regulate the classification of the lifting process. All lifting operations should be conducted in accordance with the permit to work system. All lifting operations require a lift plan developed by a trained and competent person. The lift plan should consider the weather, sea state, visibility, terrain, stability, surrounding operations and installations, site access and egress, lifting equipment and personnel.

The lift plan should include appropriate drawings and sketches, and document:

- the person in charge and the competent person arranging the lift
- the equipment required
- the personnel required and their particular roles
- step-by-step directions
- communication
- contingency, emergency response and rescue plans (where appropriate)
- allowable environmental conditions
- barricades, if required.

Lifting team requirements must be clearly defined in the lift plan and be appropriate to the type of lifting operation being undertaken. All personnel involved in a lifting operation must read and confirm their understanding of the associated lift plan before the lift commences. Only competent personnel should operate lifting devices.

The recommendations below provide an overview of the safe operation of lifting activities:

- Obey all emergency stop signals at all times.
- Ensure that no process pipework or its associated hardware is used for the load suspension.
- Confirm the load to be lifted is within the working load limit (WLL) or rated capacity of the lifting equipment before commencing the lifting operation.
- Ensure that someone in control of the lifting device and equipment continues to be in attendance during the suspension of the load.
- Perform only one role at a time.
- Ensure that no one is situated under a load that is suspended or between a suspended load and fixed objects or structure.
- Never move a load directly over people where there is no suitable dropped object protection in place.
- Ensure that personnel have an escape route in case of unexpected movement of the load or equipment.
- Maintain clear communications at all times as per the lift plan.
- Minimise any direct contact with loads and lifted items during the lifting operations. Only approved and fit-for-purpose tools should be used for this purpose.

- Use bunting and signage to separate the lifting zones.
- Where appropriate, include emergency response and rescue operation in the planning process.

5.41.1 Lifting Gear

- All lifting equipment must be inspected before use by a competent person. This should include:
    - assessment of the condition of the lifting equipment and lifting points
    - suitability of the equipment for the environment and application
    - load stability, security, and rigging
    - appropriate equipment identification tag and WLL or rated capacity.
- Non-compliant lifting equipment should not be used.
- Lifting gear should be stored in a weatherproof area with adequate ventilation and fitted with appropriate hooks and racks for storage.
- Lifting equipment exposed to saltwater should be thoroughly cleaned with fresh water, inspected for damage, lubricated where appropriate and naturally dried before being stored.

Associated client organisational documents:

- Safe Work Control Procedure.

5.41.2 Rope Access

Rope access refers to any work-related activity that requires an employee to be either situated or suspended by rope to carry out a task. This activity is considered an expert activity and should always be done by an Industrial Rope Access Trade Association (IRATA)-certified employee.

5.42 Plant and Equipment

Plant and equipment relate to a comprehensive range of machinery, installation, equipment, and tooling. This inventory will need to be fit for purpose, maintained, inspected, and used in accordance with a safe system of work.

5.42.1 Electrical Equipment

A considerable amount of portable electrical equipment is operated by the organisation, and if is not utilised or maintained in the appropriate way, the outcomes can be fatal.

The following obligations have been developed to minimise this risk, and are mandatory:

- All employees and subcontractors carrying out work involving exposure to electricity—either by supply or by use of powered hand tools—should work safely as per legislative guidelines and directives.
- All electrical equipment should be tested and tagged on a quarterly basis in accordance with AS/NZS 3760-2010.
- The tag must be durable, legible, non-reusable and non-metallic. It is recommended according to best practice that the tag be colour coded to easily show the period in which the test was completed. This tag must include the below minimum information:
    1. the name of the person who completed the test
    2. the test or assessment date, re-test due date and reference to AS/NZS 3760.
- Only heavy-duty and industrial-rated extension cords are to be used on site.
- All workers should physically check leads on a regular basis and not wait for the quarterly tagging program to identify faults with a lead.
- Any damaged or compromised electrical equipment (i.e. insulation, faulty switch) must be tagged "Out of Service" and sent for repair. The description on the out-of-service tag must include the detail of the fault.

5.42.2 Tools and Equipment

The level of risk exposure to an employee operating tooling and equipment can vary depending on the specific selection of tooling, as well as the general competency and experience of the user. It is the duty of care of the user of the equipment to ensure it is fit for purpose and suited to the task.

The following measurements are intended to minimise the risks linked with using tools and equipment and should be referred to prior to commencement of works with any tool:

- Allocated PPE as per specific internal company procedure should be worn.

- Tooling should only be used on tasks for which the tooling was designed.
- All tools and equipment will need to be inspected prior to use and maintained and stored in a safe working condition.
- Damaged tools should be tagged “Out of Service”.
- Tools should be kept in good condition.
- Cutting tools must be continually kept sharp.
- Guards are installed on some tools and equipment to avoid injury as per manufacturers’ recommendation. A guard from a tool or piece of equipment must never be removed to operate it.
- Current colour-coded tags must be attached to all electrical tools and equipment.
- During working-at-height tasks, tools and equipment should be secured and contained to prevent them from falling to lower levels.

5.43 Chemical Management

Utilising hazardous substances and dangerous goods requires strict safety control measures to be put in place. The following general rules apply for chemicals:

- The client representative should be kept informed of any chemicals that may form part of the work on the client facilities through work packs. The organisation should also identify whether the chemical is an existing or new chemical.
- All chemicals must be accepted using the client-approved chemical selection, assessment and approval process prior to using them on the client facilities. The organisation can check whether the chemical has been approved by the client with a valid risk assessment and safety data sheet (SDS) through Chem-alert.
- Each hazardous substance must have an SDS that is less than five years old. The SDS relating to hazardous substances should be available at the place where the chemicals are used and stored.
- Maintaining a workplace register and inventory list of all chemical being used.
- Ensuring there is a full awareness of the safe handling procedure prior to handling any chemical or hazardous substance.
- Use of protective clothing and equipment according to the SDS.

- To follow the chemical respective SDS for using, storing, and disposing of that particular chemical.
- To store or handle containers for the chemicals must be correctly labelled to clearly identify the substance or chemical name.

Associated client organisational documents:

- Chemicals—Health, Safety and Environment Management Procedure.

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- Hazardous Substances Procedure.

5.44 Personal Protective Equipment

The use of PPE is mandatory in certain areas and operations. On client facilities, minimum standards exist for PPE, and these must be adhered to. PPE must be suitable for the tasks being carried out, as required by risk assessment. PPE should only be used where hazards cannot be eliminated, and personnel cannot be kept away from the hazard.

PPE as per the hierarchy of controls is considered the last line of defence. It is the user's responsibility to maintain PPE in decent and fit-for-purpose condition. A glove matrix is also in effect, which details specifically what type of glove should be used depending on the task being conducted. As per Fig 5.3 developed as part of this research for the contracting company the general PPE requirements are as follows:

Figure 5.3 PPE Level for Offshore Activities

PPE PROTECTION LEVEL FOR ONSHORE ACTIVITIES

PPE Risk Assessment	Activity/ Task	Types of Tools/ Machinaries	Ey…																Hand					Hearing		Foot		Head	
			Safety Glasses	Safety Glasses - Tinted - Shade 5	Mono Goggles	Face Shield	Welding Hood	Welding Helmet (with Correct Lens)	Respirator - Supplied Air	Respirator - Powered Air	Respirator - P2 Particulate Filter	Respirator - Organic Vapour Filter	Personal Gas Monitor	Impervious Clothing	Welding Jacket	Kevlar Body Suit	Confined Space Entry Harness	Fall Protection - Harness, Lanyard	Gloves - Welding	Gloves - Disposable Latex	Gloves - PVC / Chemical	Gloves - Rigging	Gloves - Impact / Anti-vibration	Hearing Protection (Single)	Hearing Protection (Double)	Steel Cap Boots	Enclosed Shoes	Bump Caps	Hard Hat
L	Bandsaw Cutting	Horizontal Bandsaw	√*		√*																	√		√		√			
		Vertical Bandsaw	√*		√*																	√		√		√			
	Bending of parts	Plate Roller	√*		√*														X	X	X	X	X	√		√			
		Pipe/ Tube Bender	√*		√*														X	X	X	X	X	√		√			
	Drilling	Hand drill	√*		√*														X	X	X	X	X	√		√			
		Drill Press	√*		√*														X	X	X	X	X	√		√			
	Low Speed Machines	Lathe	√*		√*														X	X	X	X	X	√		√			
		Mill	√*		√*														X	X	X	X	X	√		√			
	Pneumatic Tools	Rattle Gun	√*		√*																	√*	√*□	√		√			
		Air Ratcher	√*		√*																	√*	√*□	√		√			
	Needle Gunning	Needle Gun	√*		√*																	√*	√*□	√		√			
	Compressed Air Blow Down	NA	√*		√*																	◆		√		√			
	Laser Tools	Fixture Laser	√																			◆		√		√			
	Plasma Cutting	CNC Plasma Bed		√							√											√		√		√			
		Handheld Plasma Cutter		√							√											√		√		√			
	Gas Cutting	Oxy/ Acetylene Cutting		√		√					◆								√*			√*		√		√			
M	Grinding/ Cutting	Angle Grinder	√*		√*	√					◆											√		√		√			
		Die Grinder	√*		√*	√					◆											√		√		√			
		Bench Grinder	√*		√*	√													X	X	X	X	X	√		√			
		Linisher	√*		√*	√																√		√		√			
	Painting	Roller / Brush Application	√*		√*							√		√						√				√		√			
H	Paint Mixing / Solvent Handling	NA	√*		√*	√						√									√			√		√			
	Painting	Spray Painting	√*		√*	√						√		√						√*		√*		√		√			
	Working at Height	NA	√*		√*													√				√		√		√			
	Abrasive Blasting	Sand Blaster							√										√					√		√			
E	Welding	NA	√				◆	√		√*	√*				◆				√					√		√			

Legend:

- √* Denotes a choice between any one of the √'s
- √ Mandatory item of PPE (where double protection is required this item must be used in addition to the first piece)
- □ Denotes anti vibration gloves to be worn where possible
- ◆ Respective PPE to be worn where applicable - Based on Risk Assessment
- X No respective PPE should be worn

Special Instructions:

1. Consideration to either tinted or clear glasses for protection against UV Radiation in outdoor areas should be given
2. Gloves should not be worn when operating rotating machinaries/ tools.
3. Additional or task specific PPE is decided after a risk assessment (permit/HIRA)

Note. Figure 5.3 was created by the author.(Chegenizadeh, 2019k)

Minimum offshore PPE requirements:

- safety helmet (hard hat)
- protective footwear
- eye protection
- coveralls with high visibility reflective stripes
- gloves (unless deemed unsuitable for the task).

Additional PPE must be utilised when required and may consist of:

- hearing protection
- fall protection
- respiratory protection
- gloves with specific hand protection (cut, thermal or chemical)
- welding hood
- face protection.

Associated client organisational documents:

- Green Hat Procedure
- Personal Protective Equipment Procedure.

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- PPE Procedure.

5.45 Health Management

Health management and health management systems are the framework that organisations can implement to achieve and demonstrate due diligence for the health, safety and welfare of workers and others in the workplace. A well-designed health management plan increases the probability of improved employee health and enables employees to become healthier, happier and ultimately more productive.

5.45.1 Fitness for Work

Being fit for work refers to an individual's ability to adequately perform tasks both safely and competently and not be affected externally through physical or psychological means. Many factors can have adverse effects on an individual's fitness for work. These can include a specific medical condition, the individual's level of general fitness, mental health, stress, fatigue or the use of alcohol and other drugs.

As per health and safety legislation, employees have a duty of care to ensure they are fit for work at all times. This duty of care also requires:

- notifying the employer of any medical condition, (past or present) that may affect your fitness for work
- commencing work only in a fit condition
- abiding by the internal company drug and alcohol policy as well as the client's policy and testing procedure
- notifying the client facility medic and immediate supervisor of all prescription medication
- looking after yourself
- looking after your colleagues by providing information regarding fatigue management (education and peer management)
- continually monitoring employees' symptoms who may be at risk of being unfit for work.

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- Fitness for Work Procedure.

5.45.2 Fatigue Management

The organisation will ensure that processes are implemented to mitigate the risk of fatigue. The key principal is to plan work activities by factoring in the effects of fatigue and implement appropriate controls to mitigate known fatigue-related risks. The risk assessment process should be utilised to identify and manage the risks associated with fatigue. Identifying all reasonably foreseeable factors that could contribute to fatigue is the first step in the risk management process. The following employees are identified at risk of becoming fatigued:

- those who work consecutive extended hours (more than 12 hours) per day
- those who work on night shifts
- those who work on rotating shifts
- those who work on physically strenuous tasks.

All employees working on client facilities are to comply with the fatigue management procedures, including:

- allowing an opportunity for at least 10 hours rest in every 24 hours or between shifts.

In the event that work arrangements exceed the above-mentioned requirements, which will increase the risk of fatigue, the client focal person or offshore installation manager (OIM) will be informed of the situation by the supervisor and supported by a client fatigue risk assessment. Monitoring will be conducted to ensure that the risk of fatigue will not increase.

All employees are encouraged to report fatigue to their supervisor. Furthermore, the organisation will ensure that 100% of offshore staff will be checked for fatigue prior to mobilisation via the induction checklist. It is the duty of care of the individual to ensure that any form of fatigue is declared prior to mobilisation.

Associated client organisational documents:

- Fatigue Management Guideline
- Fatigue Management Work Instructions.

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- Fatigue Management Procedure
- Personal Fatigue and Fitness for Work Calculator.

5.45.3 Noise

In the workplace, proactive efforts must be made to reduce the noise of facilities, particularly when introducing new tooling or processes. Furthermore, noise testing must take place to monitor noise levels to ensure they do not surpass the regulatory national standard exposure for occupational noise (NOHSC: 1007[2000]; or equivalent local legislation), which is:

- an average daily noise level (LAeq, 8h) of 85 dB(A), and
- a peak noise level of 140 dB(C).

Personnel must wear properly fitted hearing protection where noise levels exceed exposure standards. Earmuffs, earplugs or other hearing protection supplied and used should comply with the requirements of AS/NZS 1270:2002 (Safe Work NSW, 2019). All employees that are likely to receive exposures above the standard eight-hour workday exposure standard should have access to audiometric testing. Base line testing on initial appointment and a follow-up test must be completed within 24 months after the initial appointment.

5.45.4 Health Monitoring

The client company is responsible for a health risk assessment (HRA). The HRA process should be followed to identify any specific job roles that might involve tasks or activities that may require health monitoring. Health monitoring must not be used as a replacement of the implementation of risk control measures. Health monitoring should be carried out where a risk assessment illustrates that the following criteria apply:

- There is a link between the work and an identifiable disease or adverse health condition.
- There are valid techniques to detect signs of the disease (e.g. spirometry, audiometry).
- There is a reasonable probability that the disease or condition may occur under specific work conditions.
- Where more effective control measures are not reasonably feasible and therefore lower effective control measures such as PPE are used, the correct implementation is subject to human error, and therefore the effectiveness of the controls in eliminating the risk cannot be guaranteed. Or,
- It is required by legislation.

For employees frequently working on the client facilities, the organisation should consult with the client HSE personnel advisor or refer to each client facility's HRA to identify any job roles that may require health monitoring and ensure that health-related risk control measures are followed. Associated client organisational documents:

- The client facility's HRA.

5.45.5 Medical Assessment

All personnel travelling to or working on the client facilities must undergo a pre-employment medical assessment that complies with all relevant industry standards prior to mobilisation and at intervals not greater than two years thereafter. More frequent medical and physical assessments may be essential for certain conditions and position requirements.

The medical assessment will include:

- musculoskeletal + fitness
- spirometry
- audiometry
- drug and alcohol screen
- AMSA (Australian Maritime Safety Authority)
- respiratory fit testing (for those potentially requiring respiratory protection).

All medical records should be kept confidential.

5.46.5.1 Remarks

A weight restriction of 135kg applies to people travelling to a client offshore production facility, this is excluding baggage. The organisation will ensure that all employees, including subcontractors, comply with this requirement, the reason being that the helicopter must calculate precisely how much fuel is required to travel from the onshore airport to the offshore facility, which is why a weight restriction applies.

5.45.6 Employee Assistance Program

All employees can attend our employee assistance program (EAP) wellbeing sessions in order to organise a confidential counselling session for work-related personal issues. The employee can access the service by simply calling Access Wellbeing Services (AWS) on 1300 66 77 00. The service is available 24 hours of the day. AWS is an independent counselling service that has been selected to deliver EAP to the employees.

5.46 Environmental Performance Management

The organisation should comply with the client environmental performance standards procedure to facilitate the achievement of environmental performance.

5.47 Information Management

All health and safety–related records should be identified, maintained, and disposed of in accordance with the organisational document titled Record Control Procedure. These records include training records and the result of audits and reviews. They should be instantly retrievable and protected against damage, deterioration, and loss. Record and document retention are also specified in this document.

Associated organisational documents developed by the researcher in collaboration with the HSE team:

- Record Control Procedure.

5.48 Management Review, Audit, and Improvement

5.48.1 Internal and External Audits

The organisation conducts planned periodic audits to ensure that the HSE management system has been appropriately applied and maintained, that operations are being performed in accordance with planned arrangements and that those plans are effective. The audits also make recommendations for further improvement. Third party external auditors will conduct an audit on a six-monthly basis to check compliance against standards and regulatory requirements.

Recommendations and corrective action that result from each audit should be tracked and monitored to ensure satisfactory implementation. The auditors will verify the effectiveness of corrective and preventive actions taken during subsequent audits or special follow-up audits.

The results of these audits will be reported to management and communicated to all personnel during toolbox meetings. Copies of these audit reports can be sent to the client upon request.

5.48.2 Management System Review

A management review of the HSE management system should be carried out at least annually to evaluate the continued suitability, adequacy, and effectiveness of the system, with a commitment to continuous improvement. The management review procedure should ensure that the necessary information is gathered to allow effective assessment.

The review will include the continued relevance of policies and objectives; health, safety, and environmental performance reports; incident reports; audit findings; corrective and preventive action reports; and any changes to regulatory requirements, safety standards and operations. Records of management review are documented through meeting minutes.

5.48.3 Performance Risk and Reward Key Performance Indicators

The performance risk and reward KPIs document the planned KPIs for the reporting period. During each report, the status for each activity is to be documented as per the following:

- on track
- not on track
- complete
- not complete.

Detailed descriptions and targets can be found in the relevant section of the performance reward table. See Appendix 11 for more details regarding the performance reward KPIs.

The next chapter analyses the service provider's offshore accidents and incident frequency rate as well as discuss various lead and lag indicators and customer satisfaction survey results. Furthermore, the service provider's HSE data are compared with the general oil and gas industry to identify similarities and trends. This data supports the need for an integrated HSE management plan specifically tailored for offshore purposes.

5.49 Chapter Summary

This chapter highlighted the key components of a safety management plan from a best practice perspective for a company that is a contractor for one of the largest oil and gas companies in Australia. The management plan set out the key components needed to be successful in managing HSE obligations and requirements offshore. The plan not only reiterated the importance of having the relevant documentation (e.g. policies, procedures, safety forms, etc) but also defined specific duties and responsibilities of stakeholders in the safety management system of the organisation and in particular management leading safety outcomes diligently and proactively.

Chapter 6: **PILOT STUDY INJURY DATA ANALYSIS**

6.1 Accident Injury Analysis and Benchmarking

As discussed in previous chapters, a safety management plan is critical to ensure that employees and contractors proactively work safely in the oil and gas industry and that relevant instruction, information, supervision, and training takes place. A successful safety management plan is not created by chance; it requires the buy-in and utmost commitment from upper management, and it should cover the many key fundamental ingredients of a structured working SMS. Successful integration of a safety management plan can lead to the creation of a high-performance workplace.

As discussed by (Health and Safety Authority, 2019), the framework for managing occupational health risks is based on the following key areas:

1. setting up a policy
2. organising your staff
3. planning and setting standards
4. measuring performance
5. learning from experience—audit and review.

This chapter will focus on the area of measuring HSE performance. It is critical in any industry to have the capacity to measure safety and health performance to determine the varying degrees of success as well as the areas needing improvement in the management system. An example of active monitoring can include activities such as conducting regular inspections of the site to ensure that specific standards are being implemented and management controls are working adequately. In contrast, reactive monitoring involves learning from past accidents and incidents. To be effective in risk mitigation both types of information must be gathered and analysed via active and reactive monitoring because both methods assist in identifying situations that create risks and provide an opportunity for the management team to plan and tackle the risks. Action items with high risk should be considered high priority. Time, labour and resources must be allocated to these items immediately. Information in terms of the risk item and action taken to mitigate that risk item must be passed onto the senior management and people with authority to make necessary changes, including organisational policy changes.

6.2 Offshore Industrial Accident and Injury Analysis: 2018 Snapshot

The latest HSE offshore headline statistics provide a snapshot of the general HSE performance of the Australian offshore industry in 2018. This also enables comparing of this data with the contracting company's HSE performance to determine any specific trends.

Following information has been collected from 2018 NOPSEMA report:

- 17.7 million total hours worked offshore (an increase from 12.8 million in 2017)
- 8 serious injuries offshore (an increase from 4 in 2017)
- 59 injuries (an increase from 52 in 2017)
- 14 accidents (an increase from 10 in 2017)
- 41 hydrocarbon releases (an increase from 29 in 2017)
- 155 inspections (an increase from 145 in 2017) (NOPSEMA, 2018c).

Data analysis of the injury frequency rate of a service provider oil and gas company is one strategy to highlight the effectiveness of a successful safety management plan over a specific period of operation. This chapter analyses both the lead and lag indicators of an oil and gas service provider company that has successfully implemented and applied this specific working safety management plan. Areas that have contributed to this success are also discussed, and a brief analysis provided of performance based HSE KPIs that were implemented. This will further assist in achieving not only safety compliance but also the positive influence of safety culture in the work environment.

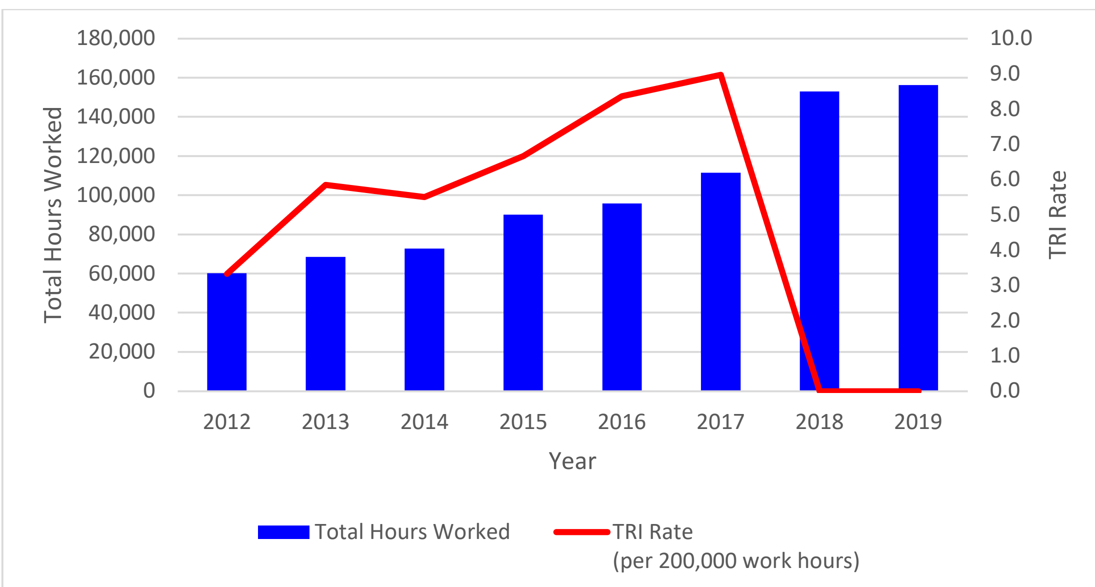
6.2.1 Total Recordable Injury Rate

Among many methods that are discussed, one widely adopted technique in the industry for determining the effectiveness of a safety management plan is through the analysis of the TRI (Intrafocus, 2019).

By multiplying the number of recordable cases by 200,000 and then dividing that amount by the number of labour hours at the company, one can calculate the OSHA recordable incident rate (or incident rate).

The oil and gas industry is classed as a high-risk work environment with mechanical tooling, hazardous chemicals and complicated processes. The service provider company in question conducted maintenance activities offshore and was engaged daily in high-risk work tasks. As detailed in figure 6.1, from the period of 2012 to 2017 there was a clear increased demand from the contracting company to work offshore, this led to higher amount of production hours being worked, and as this was pre-implementation of the HSE management there was also a direct increase in the TRI rate in this period of time. However, upon analysis of the contractor's specific incident and injury data, a downward turn was observed in injuries in 2018 and 2019 post implementation of the HSE plan. The sharp downward trend in injuries and positive safety performance in 2018 and 2019 can be attributed to its staff following the safety management plan and its key components (presented in earlier chapters). Figure 6.1 below demonstrates the service providers TRI rate performance over a period of seven work years offshore. It is interesting to note that the number worked hours significantly increased in 2018 and 2019, however due to successful implementation of the HSE management plan the number injuries significantly decreased.

Figure 6.1 Total Recordable Injury Rate



Note: Figure 6.1 was created by the author. (Chegenizadeh, 2019n)

6.2.2 Lead and Lag HSE Indicators

Lead and lag indicators are two styles of measurements used when evaluating performance in a business or organisation. However, it is important to keep in mind that there is no perfect measure in safety. The optimum objective is to measure both the bottom-line reactive results of safety as well as how the site is performing proactively at preventing accidents and incidents. To achieve the best result, we will require combination of both lead and lag indicators of safety performance.

A lead indicator is defined as a predictive measurement. A lead indicator is used as a measure to indicate a future event that can assist in identifying the drive and measure activities that should be carried out to prevent and control an injury. For example, the percentage of people wearing hard hats on an offshore site or the number of safety hazard reports filled out by staff is a lead safety indicator. In contrast, a lag indicator is classified as an output measurement, for example, the number of site-related injuries and accidents that occurred over a certain period of time on site.

The difference between the two is that a lead indicator can influence change and a lag indicator can only record what has happened previously (Intrafocus, 2019). One specific tool that the contracting company utilised was investing heavily in lead indicators to drive positive safety behaviours and culture. Historically throughout the oil and gas industry, the focus has always been on the reduction of lag indicators such as LTI rates, or TRI rates, by looking at the bottom-line injury rate, and neglecting the lead indicators. While these can be tracked and measured to show improvement (or not), as well as the impact on the company's bottom line, they are not the best way to measure safety performance (O'Neill, 2013).

Therefore, to accurately measure the true HSE performance of an organisation, the lead indicators must also be strongly considered. An analysis of the service provider company was taken of HSE inspections as well as safe card, OHSE observation and near miss reporting data. These data were critical in making further improvements in HSE performance and risk minimisation throughout the development of the SMS and the duration of the proposed contract (Intrafocus, 2019).

As part of the management plan initiative in 2018, the offshore contracting company was asked to provide monthly reports on both performance and risk and reward KPIs to the client, as explained below:

- Performance KPIs detail metrics that do not directly affect contract performance but are critical in the efficient and effective delivery of services to the client's offshore maintenance program.
- Risk and reward KPIs detail key metrics agreed between the main client and the service provider company.

Some of the main lead indicators and KPI's are outlined in table 6.1. As shown in table 6.1 and figures 6.2 and 6.3, further evidence of reporting both lead and lag indicators demonstrated a noticeable increased rate of HSE observations from 2018–2019. Observation reports were used by staff to conduct visual inspections of their work areas and to actively report unsafe activities and conditions.

Furthermore table 6.1 indicated, upon implementation of the HSE management plan and the KPIs in 2018 to 2019, there was a steady increase in lead indicators, which suggested a move towards a stronger management of safety hazards in the offshore environment. This can be specifically seen in a number of reported near misses and observations.

As part of the plan every supervisor had a KPI to submit an inspection report every week and every worker was required to submit a safe card every day to meet their KPI.

The safe card consists of the option of either reporting a safe, unsafe behaviour or a hazard. This was to encourage the staff to not only report unsafe behaviours but to also promote positive behaviours.

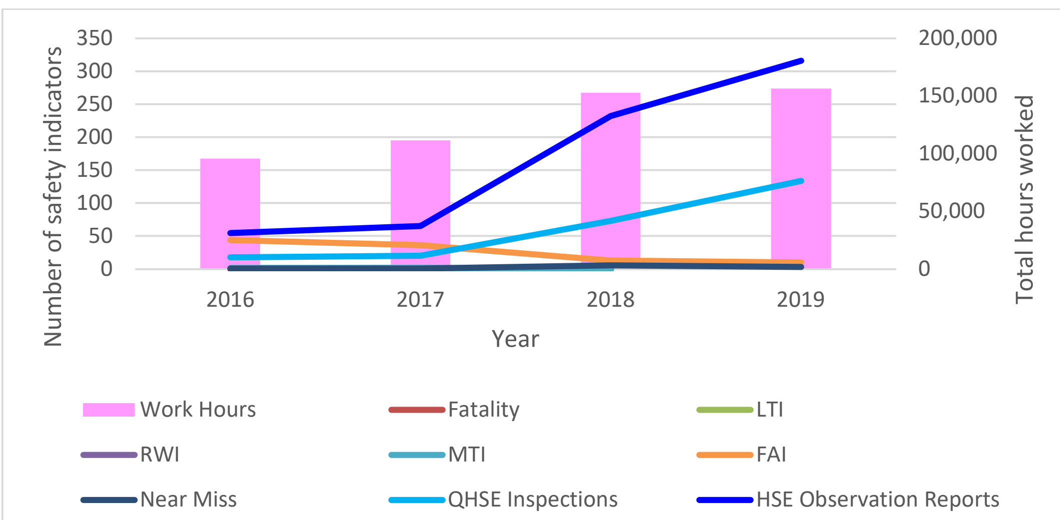
In summary, as a direct result of the implementation of the HSE management plan strategy including introducing KPIs which led to an increase in lead indicators there was a reduction in lag indicator related injuries in all areas of injury severity (e.g. FAI, RWI, MTI, LTI), irrespective of the increase in production work hours.

In conclusion, the table and both figures demonstrated that an increased participation in lead indicators can result in a reduction in lag indicators.

Table 6.1 Analysing Lag and Lead Indicators for the contracting company, 2016–2019

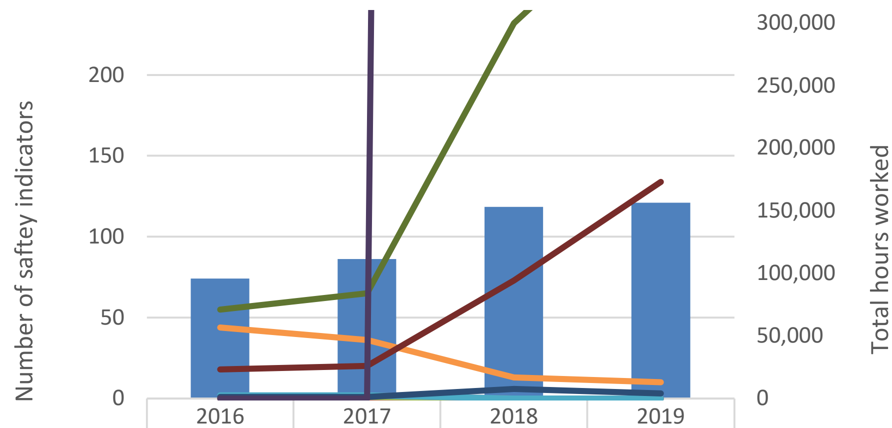
		Pre-Implementation of the HSE Plan		Post-Implementation of the HSE Plan	
	YEAR	**2016**	**2017**	**2018**	**2019**
Lag indicators	Work hours	95,700	111,407	152,865	156,213
	Fatality	0	0	0	0
	(Lost time injury) LTI	1	1	0	0
	(Restricted work injury) RWI	1	2	0	0
	(medical treated injury) MTI	2	2	0	0
	(First aid injury) FAI	44	36	13	10
Lead indicators	Near miss	1	1	6	3
	QHSE inspections	18	20	73	134
	HSE observation reports	55	65	232	316
	Client company Safe cards	0	0	8576	9,372

Figure 6.2 Lead and Lag Indicators for the contracting company



Note: Figure 6.2 was created by the author. (Chegenizadeh, 2019i)

Figure 6.3 Lead and Lag indicators Itemised Data for the contracting company

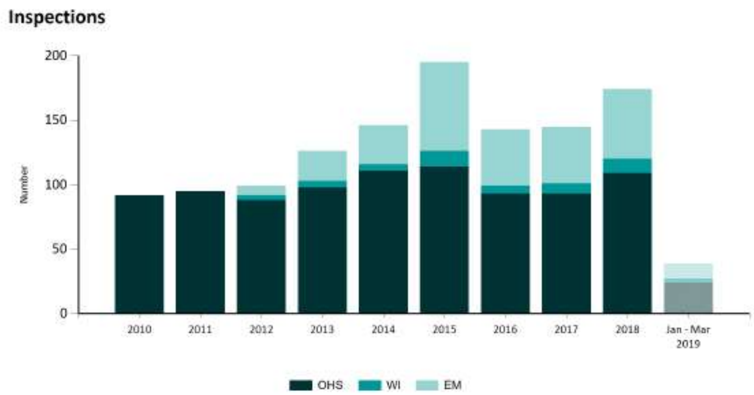


	2016	2017	2018	2019
Work Hours	95,700	111,407	152,865	156,213
Fatality	0	0	0	0
LTI	1	1	0	0
RWI	1	2	0	0
MTI	2	2	0	0
FAI	44	36	13	10
Near Miss	1	1	6	3
QHSE Inspections	18	20	73	134
HSE Observation Reports	55	65	232	316
Client Company SAFE Cards	0	0	8576	9,372

Note: Figure 6.3 was created by the author. (Chegenizadeh, 2019f)

A similar trend can be demonstrated by both the contracting company as well as the trends highlighted in NOPSEMA's inspection frequency in figure 6.4, from 2010 to March 2019. The higher number of inspection reports by both the contracting company as well as the general Australian offshore industry throughout the years indicated, both higher engagement and cooperation by employees in identifying, assessing, and controlling risk.

Figure 6.4 Inspection Records



Note: Includes 'rejected', 'refused to accept', 'not agreed', 'not acceptable', 'not satisfied', 'declined'.
Only includes OHS assessments with legislated timeframes (i.e. excludes scopes of validation).
OHS assessments include safety cases, diving project plans, diving safety management systems and pipeline safety management plans.
WI assessments only include well operations management plans.
EM assessments include environment plans and offshore project proposals.

Note. From *NOMPSEMA Charts: Last 10 Years* (p. 2), by NOPSEMA., 2019, webpage of the National Offshore Petroleum Safety and Environmental Management Authority (https://www.nopsema.gov.au/assets/Data-and-statistics/Charts-Annual-performance.pdf). Copyright 2019 by NOPSEMA.

6.2.3 Surveys and Customer Feedback

It was also determined that the general safety and wellbeing of staff was a critical factor in assessing the effectiveness of the SMS, which is why the service provider company conducted various HSE-related surveys throughout the year. Customer satisfaction was paramount to the company's success. The customer feedback and satisfaction survey assisted in understanding the client's requirements as well as identifying areas for continual improvement.

As shown in Figure 6.5, throughout the majority of the year the HSE feedback in all critical areas of the HSE survey was in the stretch region, indicating very positive feedback, and only momentarily in the second quarter of the year was some of the feedback in the base region. All constructive feedback in this area was discussed in management meetings to ensure that gaps or actions resulting from these surveys were promptly actioned. Furthermore, actions from the feedback survey were discussed openly in pre-start and toolbox meetings to ensure that all employees were provided with adequate consultation and communication of the results and the status of corrective actions.

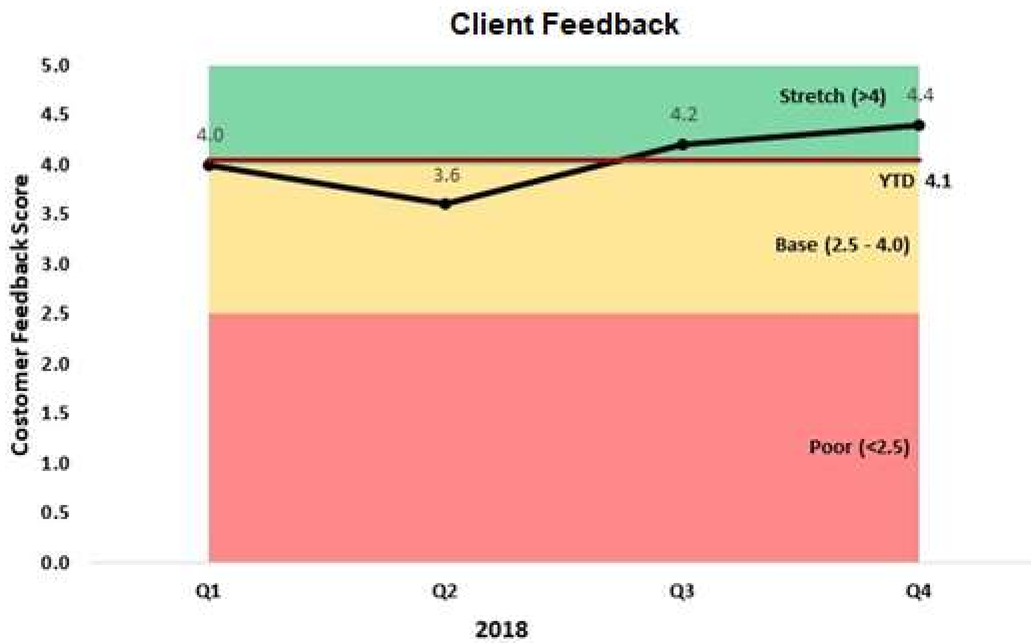
The objective of measuring performance through indicators is to gauge the organisation performance and identify ways to improve performance. To do this properly, both lead and lag indicators are required to assist in improving specific HSE objectives. It is important that management see value in both these indicators because they both contribute to improving safety performance. It is unlikely that leaders or employees will invest energy in the system if they are unable to see a clear link between the lead indicator and overall safety results.

Furthermore, an indicator such as client satisfaction directs the company towards looking to the future. Therefore, customer satisfaction is a lead indicator. The aggregated asset feedback KPI is based on the results of a customer questionnaire that is distributed on a quarterly basis with questions themed on:

- working safely
- technical competence
- people and culture
- communication and consultation
- safety innovation.

Figure 6.5 demonstrated that client feedback improved significantly over the course of the 2018 period, particularly from Quarter 2 onwards, suggesting considerable safety related improvements following the implementation of the HSE management plan.

Figure 6.5 Overall HSE Performance Contracting Customer Feedback Score



Note. Figure 6.5 was created by the author. (Chegenizadeh, 2019a)

The specific comments outlined below (as a result of the survey) help provide a snapshot of the client's' feedback and perception of the safety performance of the service provider throughout the 2018 and 2019 period.

- All team members deliver a constant high safety standard and so far, have never been found failing to comply with any safety rules or standards. They are generally well engaged in all safety aspects.
- The staff are continually looking for HSE innovation opportunities to make the job safer.
- Proactive and constantly engaged. These employees are appreciative of their job.
- All staff are conscious and diligent subject matter experts that strive to deliver campaigns as per the client company's readiness and maintenance models.

The HSE measuring criteria of the survey are shown below:

Table 6.2 Specific HSE Metrics: Client Feedback in 2018 and 2019—Average Scores

Metric	Score—2018	Score—2019
Working safely	4.5	4.8
Technical competence	4.6	4.7
People and culture	4.1	4.3
Communication and consultation	4.3	4.4
Safety innovation	4.5	4.6
Average	**4.4**	**4.56**

Note. Table 6.2 was created by the author. (Chegenizadeh, 2019a)

Table 6.3 Customer Feedback Measurement Key

Feedback score	Metric score
Very good	4.0–5.0
Good	2.5–4.0
Poor	0–2.5

Note. Table 6.3 was created by the author(Chegenizadeh, 2019a)

6.2.4 HSE Interview Feedback

As a result of the HSE interviews with offshore employees, some constructive feedback was provided, which subsequently led to a number of improvements to the HSE management plan. In relation to demographic data, owing to the primarily male-oriented nature of the offshore oil and gas industry, 80% of the respondents were male and 20% were female. Meanwhile, 20% of the respondents were in managerial roles.

Following the results of the safety survey, the answers were categorised into specific topics. The HSE topics discussed by respondents in the survey are identified below:

- active involvement of HSRs in internal HSE matters

- promotion of safety innovation in areas such as tooling, work process and procedures
- stronger safety communication of incidents
- greater management involvement and commitment to HSE.

Of the topics raised by offshore staff, the following initiatives were implemented to improve HSE processes:

- An internal and external HSR training program was implemented to empower HSRs to act on HSE issues.
- A KPI was introduced which measured attendance by HSR's to scheduled safety committee meetings.
- A safety audit was conducted of all tooling being used offshore. As a result, a standardised document was created indicating only approved tooling that should be used.
- Weekly HSE bulletins were distributed to all staff regarding relevant hazards offshore.
- All management personnel were sent on an HSE awareness course. In addition, all managers were assigned a KPI, for which they must chair the HSE committee meeting, attend at least one toolbox meeting per week and conduct one HSE inspection with a supervisor per month.

6.2.5 Analysis of Near Misses and Unsafe Act and Conditions

In 2018, the service provider company implemented the Heinrich triangle theory, while analysing and promoting internal lead indicators.

> The accident triangle, also known as Heinrich's triangle or Bird's triangle, is a theory of industrial accident prevention. It shows a relationship between serious accidents, minor accidents and near misses and proposes that if the number of minor accidents is reduced, then there will be a corresponding decline in the number of serious accidents. This theory has been described as the cornerstone of twentieth-century workplace health and safety philosophy. (Accident Triangle, 2019, p. 1)

The basic idea behind the triangle is that serious events such as fatalities, large environmental spills and serious financial losses occur only rarely. By contrast, near misses and low-consequence events are considerably more common and can be seen as being precursors to the more serious events (Sutton, 2012, p. 61).

Bird's Triangle was developed in the 1960s. Frank concluded that one thing could lead to another and ultimately cause a catastrophic incident. His theory determined that if underlying workplace at-risk behaviours were left untreated this could eventually lead to near misses and ultimately to events causing injury or harm to workers. Furthermore, other research studies described another theory knows as the domino effect or the lining up of factors leading to an event.

The service provider company embraced the key purpose of Heinrichs triangle theory. To reduce the risk of serious injury or a fatality at the top of the pyramid, the management team analysed the occurrence of near misses and unsafe behaviours at the base of the pyramid. According to (USSA Global, 2015), the base of the Heinrich pyramid primarily concerns lead indicators, such as analysis of previous near misses and unsafe acts, which enables management and staff to learn from past HSE near miss incidents and failures proactively, as detailed in Figure 6.6. This concept was important in ensuring that further opportunities could be made to improve HSE performance and highlight unsafe areas of the site. The Heinrich triangle theory was also implemented in the service provider company's HSE safety induction program to ensure that all new employees were educated on its importance and methodology (SHP, 2016).

Figure 6.6 Heinrich's Triangle Theory

Note. From *Heinrich's Accident Triangle Explained* (p. 1), 2016, webpage of Safety and Health Practitioner (https://www.shponline.co.uk/common-workplace-hazards/heinrichs-triangle-health-and-safety-cpd/). Copyright 2016 by Safety and Health Practitioner.

In the 1970s, it was particularly unethical to talk about safety in any relation to monetary value. A book titled *Safety is Good Business* provided a key message that contained an analogy with Heinrichs's accident pyramid: "The top events are very costly but are few. Smaller-size accidents are numerous, their costs are quickly forgotten, but because of their sheer number, their total loss is high. Therefore, it pays to invest in safety" (Pasman, 2015, p. 388).

6.2.6 Reactive HSE Lag indicators

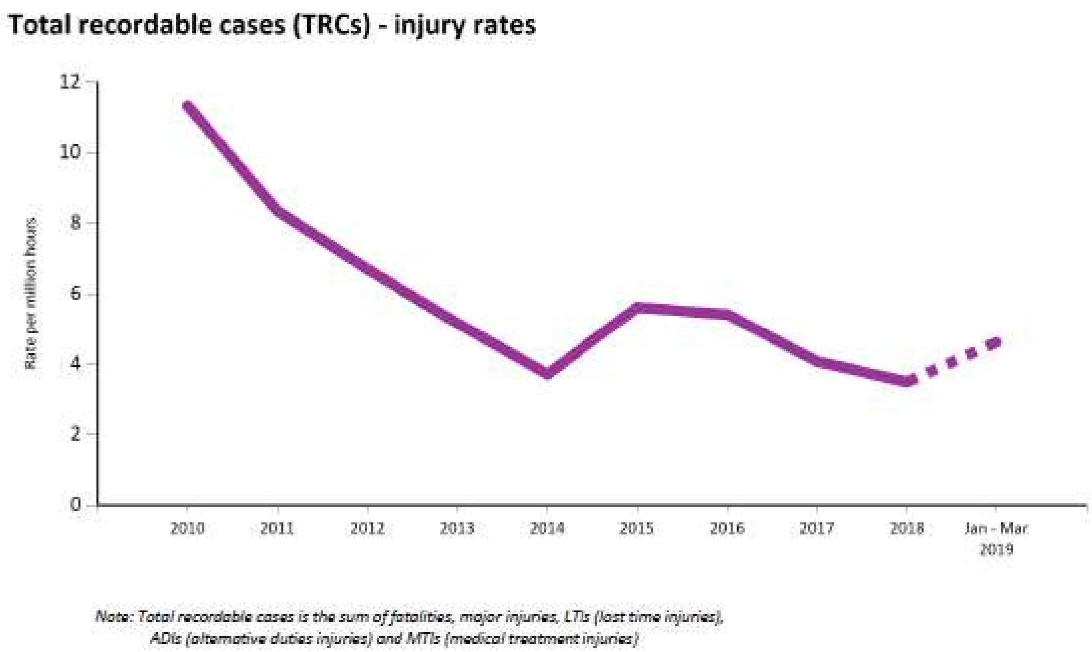
Lag indicators are measurements that consist of data from the past, such as incidents and accident statistics. These figures represent the bottom-line number that evaluates the overall effectiveness and success of the safety systems within a company. They inform companies of how many employees were injured and how serious the injuries were. However, these statistics are classed as reactive. Lag indicators describe, after the fact, the number of people injured in a way that impaired their ability to return to work for at least one shift. "Many businesses rely on lag data for reporting as it is familiar and easy to measure but this only provides one piece of the puzzle. When used in isolation, it doesn't provide a clear picture of safety performance or improvement" (Farrell, 2003, p. 2). If we are truly striving for safety excellence and a culture where risks are managed, and injuries and incidents are prevented, we need to turn our focus to proactive lead indicators.

As shown in Figure 6.7, the Australian offshore industry has seen an apparent downward trend in both total recordable cases and injury rates throughout the nine-year period of analysis. These results are promising with regard to a number of key safety indicators, since for the fifth consecutive year (2010–2014) there were no fatalities. The recording of 52 injuries from January 2017 to December 2017 was identified to be the lowest number of injuries since 2005, which was the establishment year for NOPSEMA. This positive injury performance was reflected in the total injury rate of 4.07 per million hours worked, which was the second-lowest total injury rate since 2005 (NOPSEMA, 2018b).

A total of 59 employees had been injured by the end of 2018. There were also six LTIs that resulted in workers having to take three or more days off work (NOPSEMA, 2018c). Nevertheless, the accident rate was only slightly higher in 2018 in comparison with the previous year. In conclusion, to ensure the continual improvement in HSE performance, the industry must continue to be vigilant and concentrate on key lessons from these events to prevent occurrences in the future.

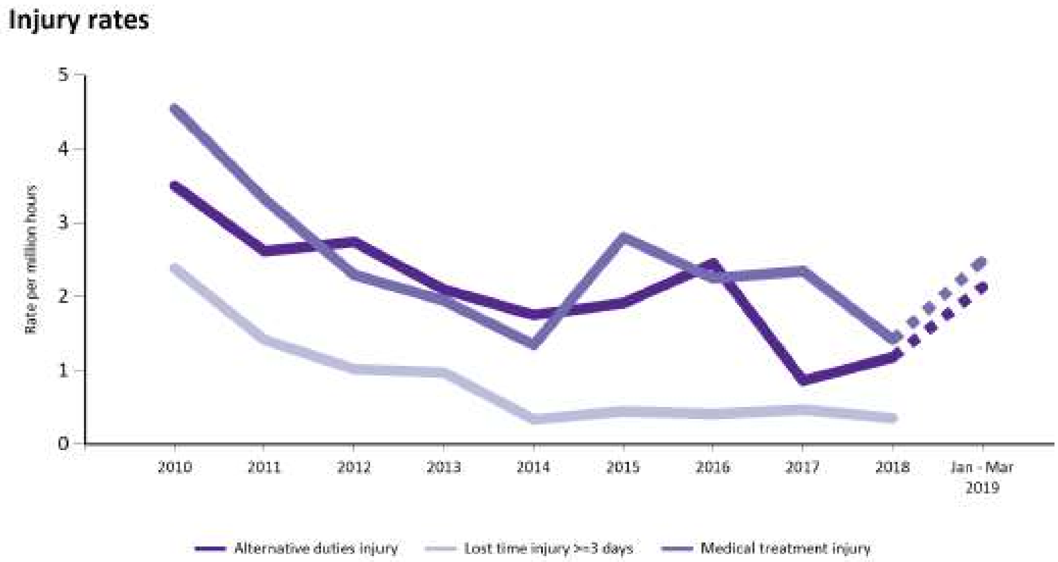
As demonstrated in figure 6.7 and 6.8 the offshore industry has seen a general downward trend in injury rates over the past nine years (from Jan 2010 to March 2019). The reduction in total recordable cases between 2010 and 2014 was due decreased work demands in the industry which resulted in less employees being mobilised offshore. The second factor can be attributed to the greater consultation processes, risk management, compliance monitoring and enforcement measures, following the notable catastrophic incidents in the offshore industry (e.g. Deepwater Horizon). However, this has not been without specific challenges, with a spike in incidents in 2014–2015 and also 2018 to the present. The 2018 increase has been attributed to gaps in management practices for contracting companies. Due to various financial reasons the industry started to outsource projects and maintenance contracts to contracting companies. Due to this decision there was an increase in the number of contracting companies working in the industry. This resulted in an increase in recordable cases and injury rates throughout this period, which was due to inadequate HSE management plans.

Figure 6.7 Total Recordable Cases—Injury Rates Based on Injuries Reported to NOPSEMA



Note. From *NOPSEMA Charts: Last 10 Years* (p. 5), by NOPSEMA., 2019, webpage of the National Offshore Petroleum Safety and Environmental Management Authority (https://www.nopsema.gov.au/assets/Data-and-statistics/Charts-Annual-performance.pdf). Copyright 2019 by NOPSEMA.

Figure 6.8 Injury Rates Based on Injuries Reported to NOPSEMA



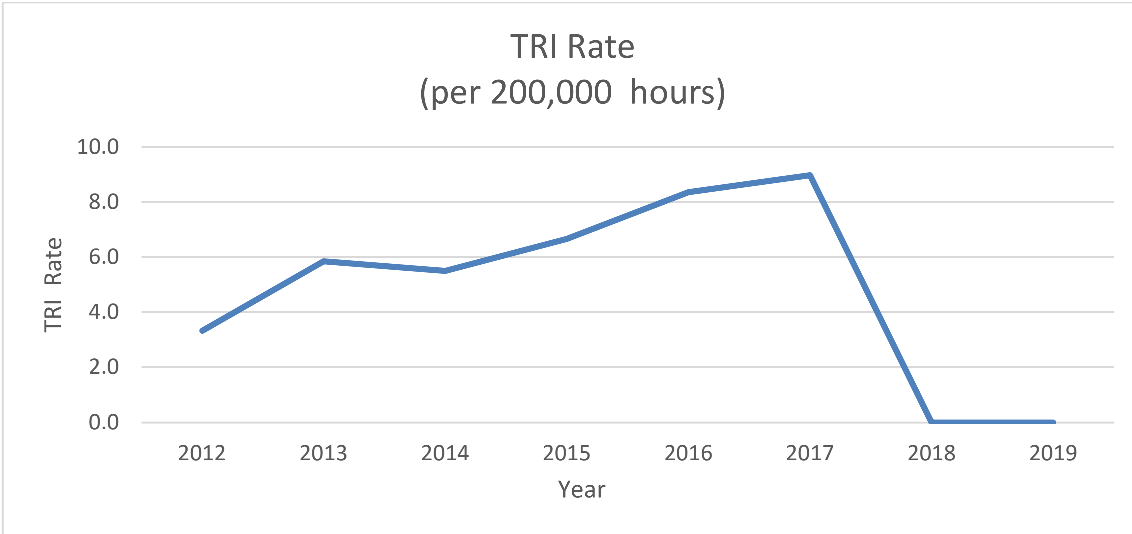
Note. From *NOPSEMA Charts: Last 10 Years* (p. 5), by NOPSEMA., 2019, webpage of the National Offshore Petroleum Safety and Environmental Management Authority (https://www.nopsema.gov.au/assets/Data-and-statistics/Charts-Annual-performance.pdf). Copyright 2019 by NOPSEMA.

* *NOPSEMA recording their injuries as per million hours worked*

The total recordable injury rate was measured differently between the contractor and NOPSEMA. The contracting company recorded its injuries as the number of TRI's per 200,000 hours whilst NOPSEMA recorded its injuries as the number of TRI's per 1,000,000 hours worked. Although the TRI's measurement calculations are different, trends can still be observed between the two sets of data.

Similarly, as shown in Figure 6.9 the offshore service provider company illustrated a downward trend in its TRI rate from 2017 to 2019 following implementation of the HSE management plan. In general, there was a consistent increase in the TRI rate for the contracting company over 2012 to 2017; however, it is apparent that through the various safety initiatives implemented (including the full implementation of the integrated safety management plan) significant improvement was made between 2017 and 2019.

Figure 6.9 TRI Rate for Contracting Company (per 200,000 Work Hours)



Note. Figure 6.9 was created by the author. (Chegenizadeh, 2019n)

In conclusion, figure 6.8 and the pre-implementation of the HSE management plan period in figure 6.9 demonstrated that there are still improvements to be made for contracting companies, in terms of HSE management plans. The post implementation of the plan period in figure 6.9, can provide evidence that a best practice HSE management can reduce injury and improve safety indicators.

It must also be noted that figure 6.7 NOPSEMA: Total Recordable Case trends are measured in 1,000,000 hours in comparison to the contracting companies TRI rate in Figure 6.9 which is based on 200,000 hours.

6.2.7 Proactive HSE Lead Indicators

For many years it was assumed by numerous organisations that analysing personal injury statistics was an effective way of measuring a facility's major hazard risk classification. However, several incidents have shown this assumption to be blatantly false, for example, the explosion at a Shell chemical plant in Deer Park, Texas, in 1997 and the BP Texas City refinery disaster in 2005. Relying only on injury rates as an indicator of safety performance significantly hindered BP's perception of process risk. As discussed by (Leo W. Gerard 2010), a group of BP executives had boarded Deepwater Horizon in the Gulf of Mexico when it exploded. They had ventured out to the oil rig to celebrate with the team the achievement of a recent safety accomplishment. It has been reported that workers on the rig had worked for seven years without experiencing an LTI—

or rather, seven years without one being recorded. It was common knowledge that organisations regularly discouraged workers from reporting workplace injuries.

As discussed by (Skogdalen, Utne, & Vinnem, 2011), traditionally, the main focus of safety performance was reflected through analysis of mostly lag indicators. However, it had been proven that merely looking at lag indicators did not provide a clear indication of true HSE performance. Therefore, more focus was required on the development of indicators that provided feedback prior to an accident occurrence (lead indicators).

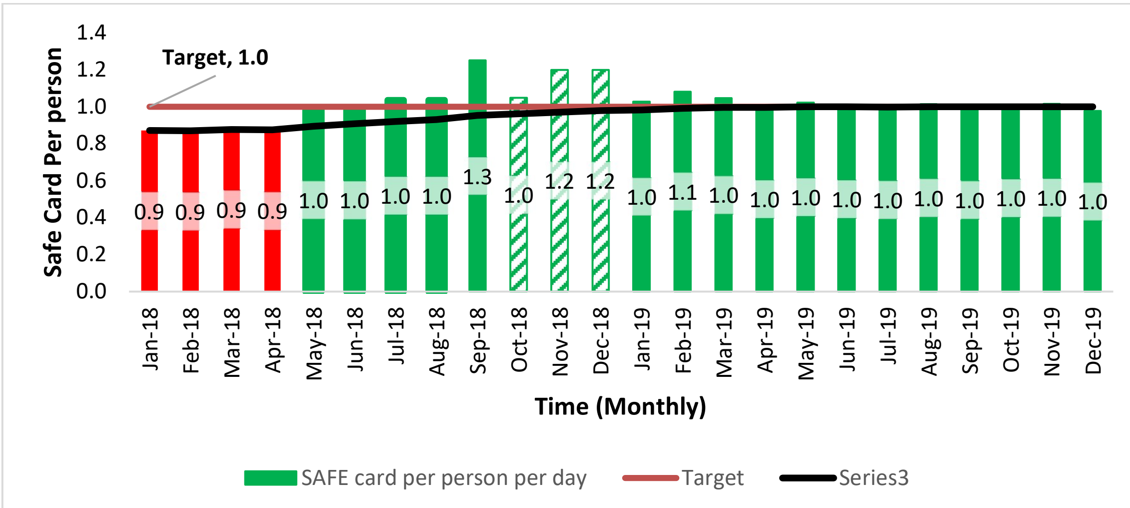
To achieve continuous improvement by the service provider company, a number of key proactive lead indicators were identified that would contribute further to risk and accident prevention. Daily submission of the following proactive HSE documentation was organised:

- safety training
- HSE audits
- safety observations and interactions
- reporting of safe behaviours as well as unsafe behaviours
- key stakeholder engagement in safety initiatives
- open reporting of near misses
- total number of hazards that have been eliminated
- housekeeping standards.

The safe card campaign was another initiative instigated in this study that further promoted proactive safety lead indicators. Safe cards which are categorised as either an unsafe act, condition, hazard or near miss fell into the base category of the Heinrich pyramid found in Figure 6.6. The safe card campaign participation rate is detailed in Figure 6.10. A Safe card is a brief reporting document that is completed by an employee prior to commencing their task to identify hazards and safe or unsafe behaviours. The Safe card was a successful tool for enabling staff to become proactive in health and safety and to actively assess risk and explore effective ways of eliminating hazards.

A HSE KPI of submitting one safe card daily was required per employee. For more information regarding the service provider's KPIs, refer to Appendix 11. The contractor's specific Safe card participation chart provided in Figure 6.10 illustrates the positive tracking of safe cards throughout the 2018 and 2019 work years. This indicates that employees were committed to consistent reporting using Safe cards while conducting their daily tasks offshore.

Figure 6.10 Safe Card Participation in 2018 and 2019



Note. Figure 6.10 was created by the author. (Chegenizadeh, 2019l)

Hazard reporting (another lead indicator) was also considered a critical component of risk reduction and accident prevention. This indicator was particularly effective in determining specific trends, such as:

- type of injuries occurring
- location and environment
- tooling
- procedural
- human factor related.

As indicated in Figure 6.11 below, a relatively consistent number of hazard observations were reported in 2018 and 2019 by offshore staff which indicated the improvement in the safety culture in a workplace and that people felt more comfortable to report any HSE concerns. Hazard reporting (a subcategory of safe cards) was seen by the organisation as a critical strategy for identifying potential opportunities to eliminate risk.

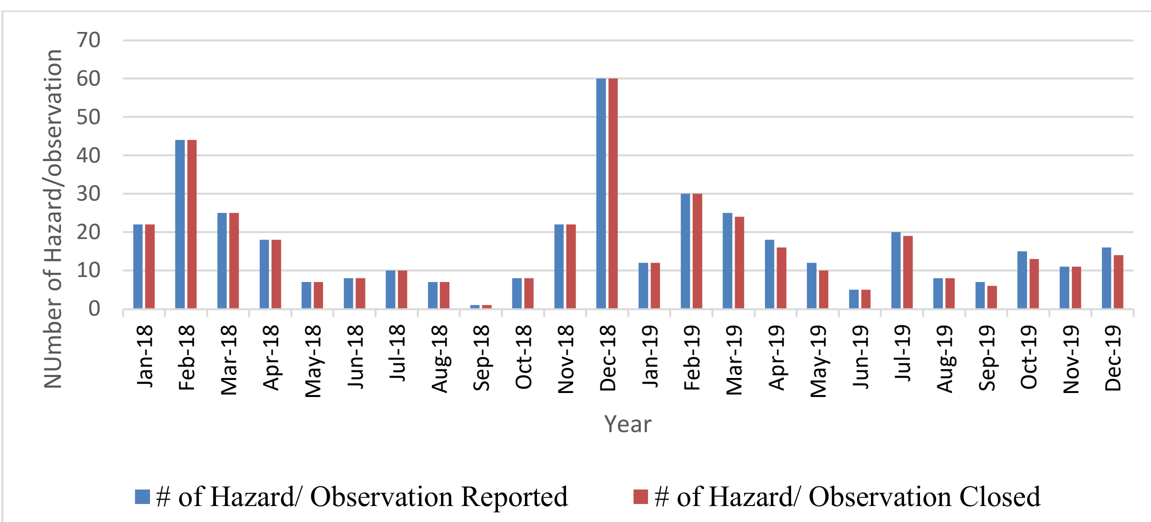
Furthermore, another proactive lead indicator related to supervisor HSE workplace inspections was introduced to the service provider company. Inspections were required to be completed by a supervisor once a week, and they identified key areas such as:

- permit to work
- housekeeping
- chemical management
- PPE.

The inspections were also classified as proactive and lead indicators; any findings from these inspections were actioned immediately by the responsible person.

All the hazards reported via safe card submissions, inspection reports and hazard observations were recorded and tracked throughout 2018 and 2019. As can be seen in figure 6.11 all the hazard items reported in 2018 had been actioned and closed out, however some of the items remained open for 2019 as either they required more funding or were planned to be completed in stages.

Figure 6.11 Number of Hazard Observations Reported in 2018 and 2019



Note. Figure 6.11 was created by the author. (Chegenizadeh, 2018b)

These hazards were also divided into specific areas to determine further trends. This indicated high-risk areas of work and the specific areas that management was required to put time and resources into to prevent further potential accidents. The statistics outlined in this research back up Heinrich's triangle and were evident because of the relatively strong reporting culture of the service provider company.

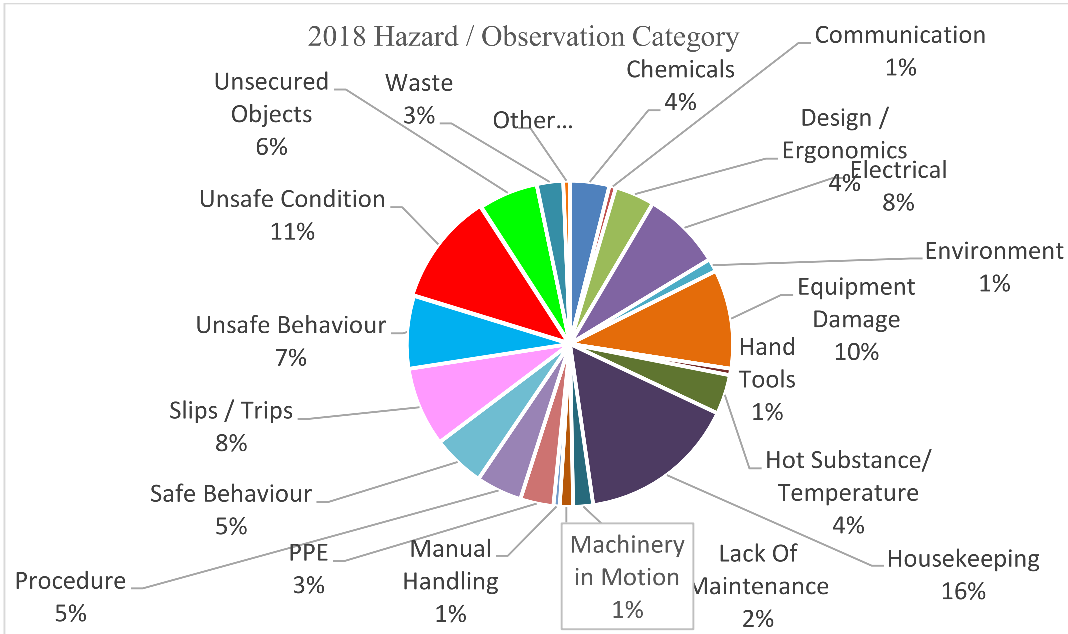
Figure 6.12 and 6.13 both highlighted the type of hazards which were reported offshore by the contracting company. This data was particularly useful, as it was used to identify high risk areas of the facility, and provided a good indicator where resources were needed to be allocated towards controlling these areas of risk in the future. As part of the developed HSE management plan, specific producers and processes were developed to immediately address and control the risk in the top four identified hazard categories areas which were housekeeping, unsafe condition, equipment damage and unsecured objects.

Some examples of these include inspection schedules to target housekeeping of specific work areas of the facility, providing tethers and lanyards for staff who are working at heights to ensure objects and restrained and secure at all times and are not at any risk of dropping from heights.

(USSA Global, 2015) outlined further analysis of the data from offshore industry around the world having showed similar trends and identified the top four hazard categories which consisted of:

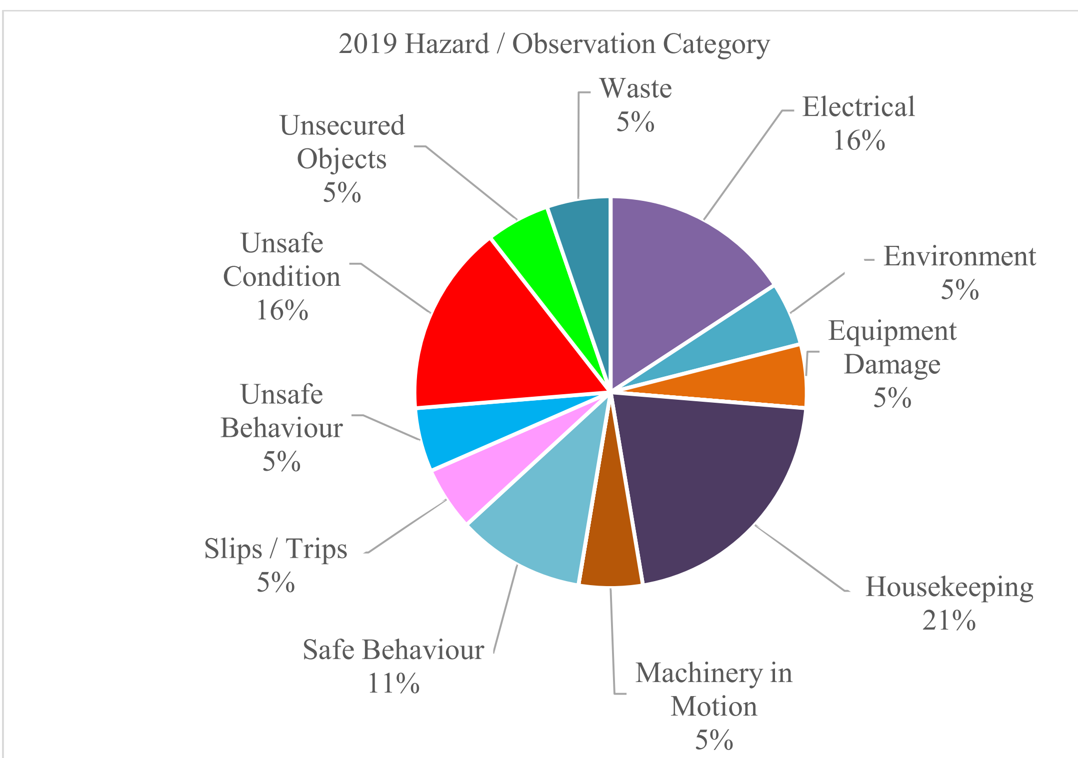
1. housekeeping
2. unsafe conditions
3. equipment damage
4. electrical

Figure 6.12 Hazard Observation Categories, 2018



Note. Figure 6.12 was created by the author(Chegenizadeh, 2019c)

Figure 6.13 Hazard Observation Categories, 2019



Note. Figure 6.13 was created by the author(Chegenizadeh, 2019c)

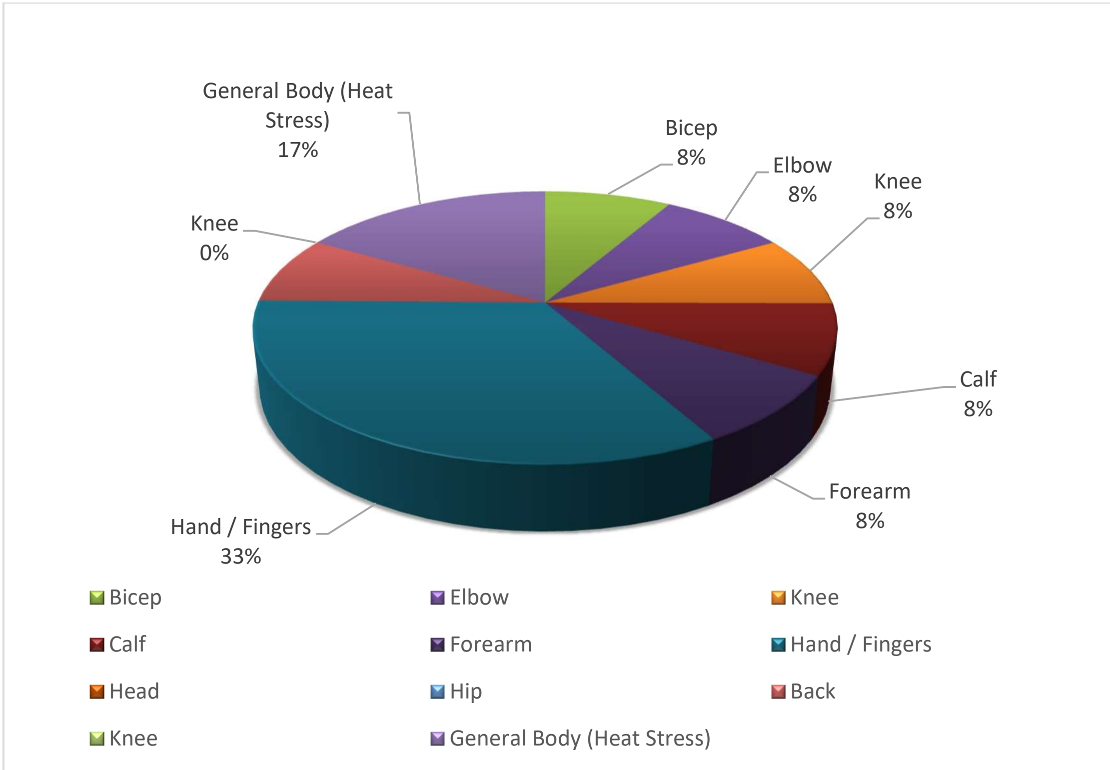
6.2.8 Bodily Locations of Injury Data

The service provider company supplied incident data in relation to the bodily location of injuries, as outlined in Figure 6.14 and 6.15 below. These data were useful for identifying the types of injuries that had occurred offshore. For example, it was determined that the top two HSE-related injuries occurring throughout 2018 were hand injuries and heat stress. In response to this data, the following safety initiatives and innovation campaigns were strategically implemented to reduce risks throughout 2019:

- introduction of a "towards zero harm" campaign to reduce hand injuries
- assessment of specific tooling used offshore and PPE to determine if there were more user-friendly and safer products available that would better suit the user (e.g. introduction of chisel grips to eliminate line-of-fire injury when using hand tools such as a hammer and chisel)
- Creation of a PPE matrix which outlines the correct PPE for a specific task and tool
- implementation of hydration testing and heat awareness training seminars, and the introduction of the use of hydration packs (e.g. camelbacks) to reduce the risk of heat stress, exhaustion, and dehydration during strenuous tasks.
- Creation of a training matrix which outlines what training modules, qualifications, and certifications are required for specific job role

All these safety strategies were in line with the safety management plan's directive and objective of ensuring that all HSE-related hazards and risks in the work environment were appropriately identified, risk assessed, controlled and reviewed by the work party.

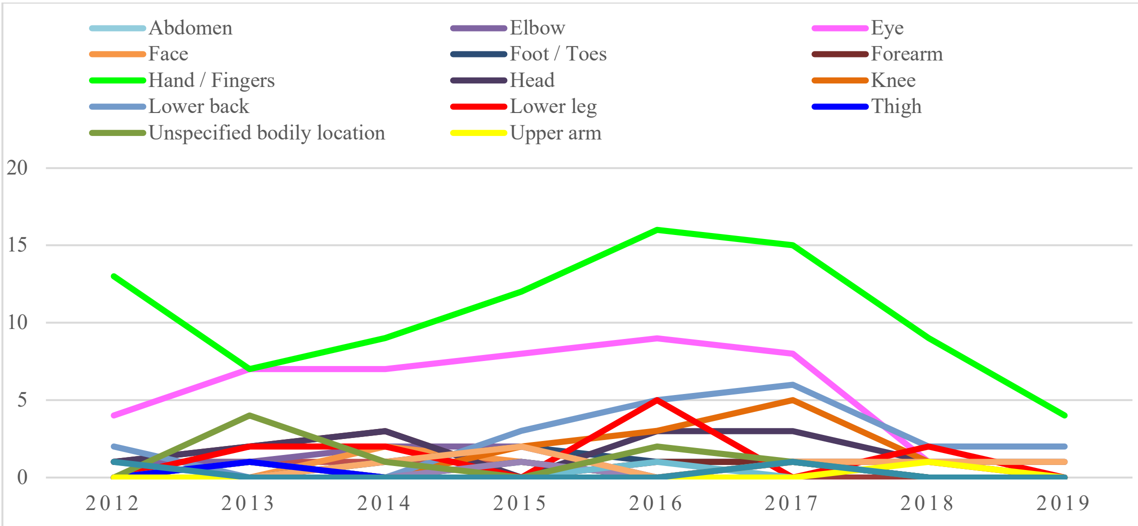
Figure 6.14 Percentage of Injuries by Bodily Location, 18 January–18 December



Note. Figure 6.14 was created by the author. (Chegenizadeh, 2019j)

Analysis of bodily location injury data pre and post implementation of the plan in figure 6.15 provides evidence that the control measures and tools created as part of the HSE management if implemented correctly can reduce the rate of injury. This figure demonstrated that several hand injury, eye injury and other injuries decreased significantly post implementation of the plan in 2018 and 2019.

Figure 6.15 Percentage of Injuries by Bodily Location, 12 January – 19 December



6.2.9 Mechanisms of Injury

A method by which damage (trauma) to skin, muscles, organs, and bones occurs is referred to as a mechanism of injury (MOI). The employer utilised MOI data to help determine how a particular serious injury had occurred. Table 6.4 below classifies the specific MOIs occurring from 2016 to 2019. This data also assisted the company and management to allocate specific resources to safety initiative campaigns to reduce further injury in the future. The data shown in Table 6.4 indicates that the majority of MOIs incidents were due to hitting objects; body stressing; and falls, trips and slips.

Table 6.4 Contracting Company Offshore Mechanisms of Injury, January 2016 – December 2019

Mechanism of injury	Frequency	Percent
Hitting object (cut, crush, abrasion, laceration)	48	33%
Body Stressing (Manual handling, Fatigue, repetitive and strenuous work)	25	16%
Hit by moving objects	23	15%
Falls, trips, Slips	18	14%
Chemical and other substances	9	7%
Heat, electricity, environmental	8	7%
Unspecified	7	5%
NA	2	1%
Total	148	100%

Note. Table 6.4 was created by the author.(Chegenizadeh, 2019h)

Figure 6.16 below highlighted the contracting companies' nature of injuries from 2012 to 2019, with a high number of sprain/strain injuries over 2015 to 2017 which is pre implementation of the HSE management plan. Analysing the nature of injuries helped in determining what the most common injury occurrences were in the work environment and hence necessary resources allocated and work procedures were developed to ensure prevention. This specific injury data helped to determine relevant safety initiatives to prevent these incidents. For example, the implementation of a manual handling educational session for employees. This session could be directly customised for offshore employees to reduce the high number of sprain/strain injuries occurrences.

Post-implementation period in figure 6.16 provided evidence that the HSE management was successful in significantly reducing some of the higher common injuries and even eliminating some specific injuries such as burn, bruise and crushing injuries.

Figure 6.16 Contracting company nature of injuries 2012–2019

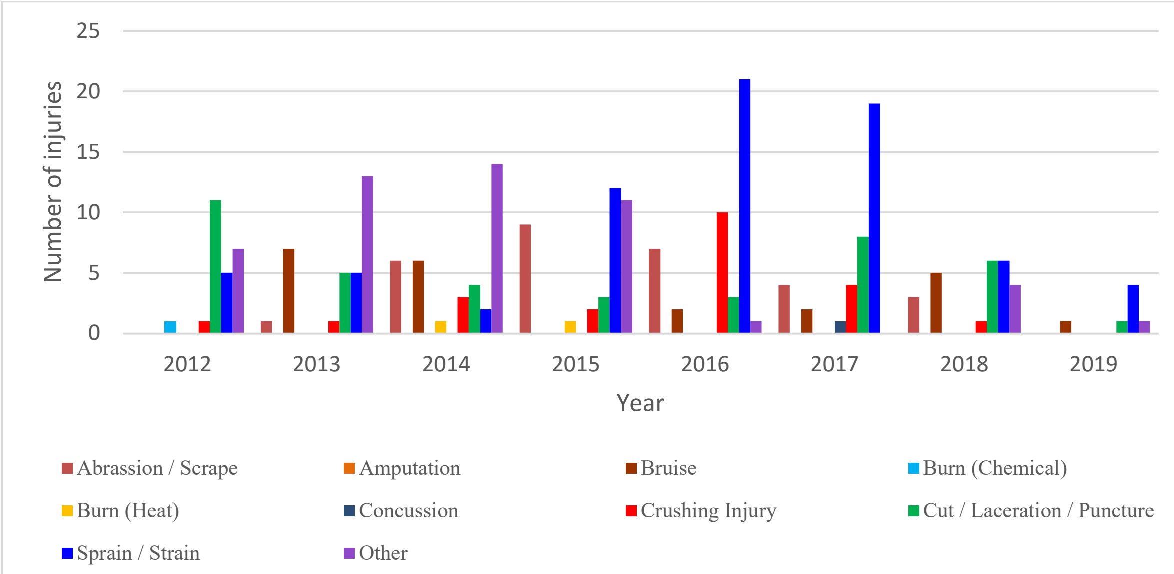
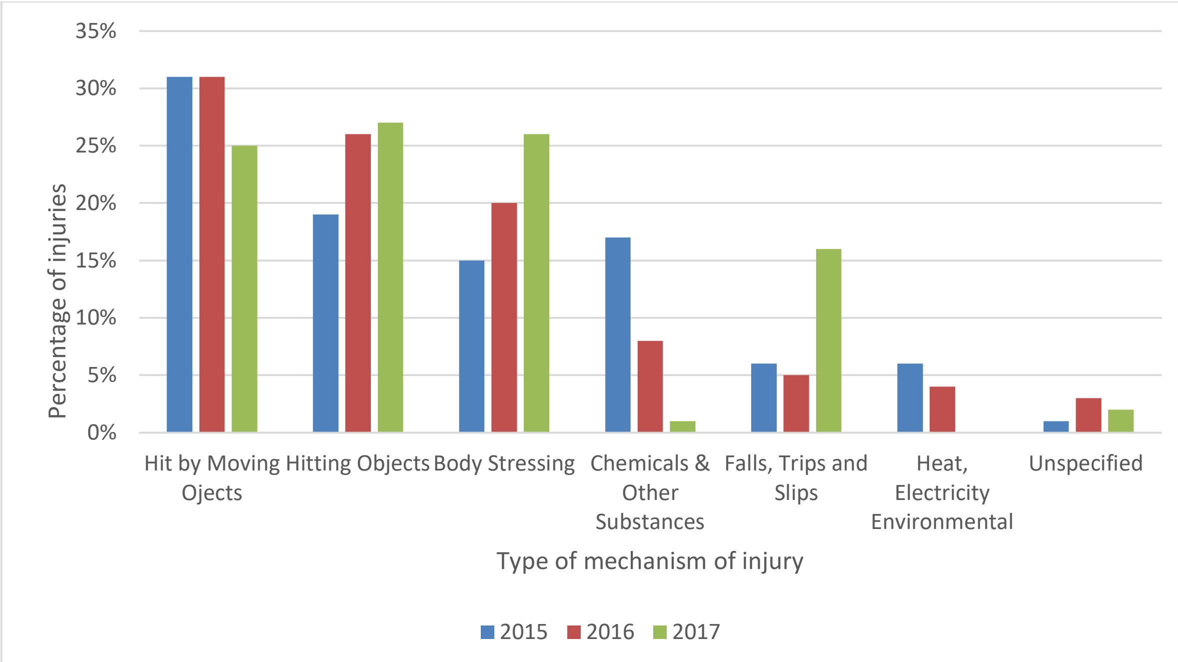


Figure 6.17 highlights the frequency of mechanism of injuries over a period of three years by NOPSEMA. Interestingly, in comparison, the NOPSEMA report identified that in 2016, 2017 and 2018 the most frequently reported MOIs were also being hit by a moving object, hitting an object and body stress. This indicated that the specific offshore company in question followed a relatively similar MOI trend to the rest of the offshore industry (NOPSEMA, 2018b).

Figure 6.17 Mechanism of Injury: Total Offshore Incidents from 2015 to 2017



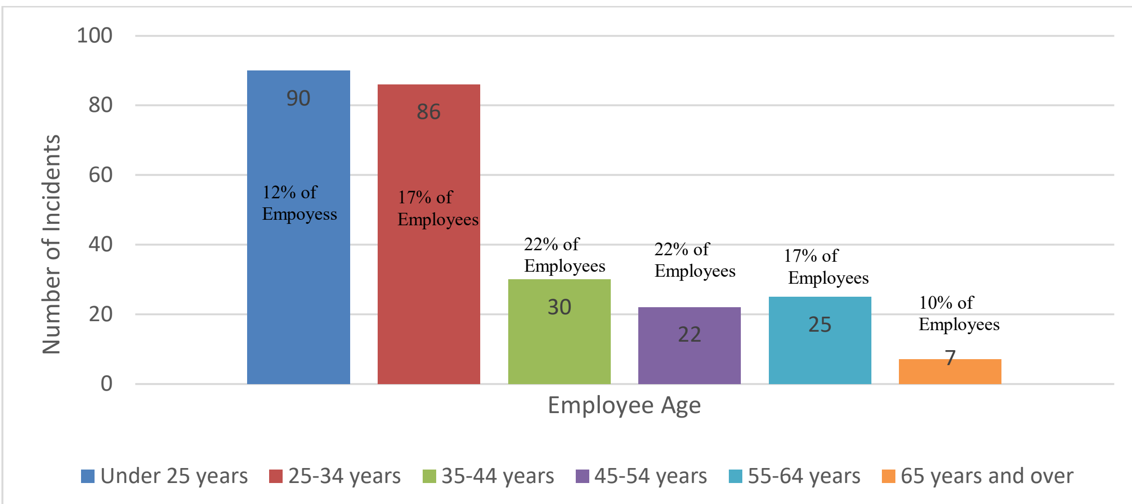
Note. From *NOPSEMA: Annual Offshore Performance Report to 31st December 2017* (p. 32), by NOPSEMA, 2018, webpage of the National Offshore Petroleum Safety and Environmental Management Authority (https://www.nopsema.gov.au/assets/Publications/AA624610.pdf). Copyright 2018 by NOPSEMA.

Another external factor determined during the data analysis study was identifying the specific age of staff who became injured in this period on site. As detailed in Figure 6.18, the majority of HSE incidents occurred for employees between the ages of under 25 years and between 25 and 34 years. This indicates a younger demographic of less experienced staff who were more prone to injury. In addition, the workers between 25-34 may have some experience however are prone to take more risk. The more mature workers because they have seen more accidents throughout their career, they are keener to follow the safety rules and procedures. The main reason why there was a higher number of 55-64 age group was due to these employees coming from other industrial sectors such as mining and construction. To reduce risk, a study took an initiative for the contracting company new starter using green hat. All new starters (green hat staff) were paired with more experienced staff and supervised to ensure they received as high a degree of on-the-job support as possible. In addition, throughout every toolbox and safety committee meeting, safety issues were openly discussed, and green hat attendees were encouraged to share health and safety issues and concerns with the rest of the team.

Within the North Sea region and most other European waters green hats are also considered "high-risk" staff, and an offshore worker is required to wear a green hard hat on his or her first three trips to an asset, regardless of that person's years of experience within the offshore industry.

Furthermore, the Australian offshore industry experienced similar challenges, which were due to the high level of commissioning of new liquefied natural gas (LNG) facilities. During 2017, four LNG facilities had been simultaneously commissioned. This level of commissioning was unheard of in Australia; therefore, the strain on the capacity of the industry to resource this activity with skilled and experienced staff was significant (NOPSEMA, 2018b).

Figure 6.18 Injured Employee Profile by Age, 2012–2019



Note. Figure 6.18 was created by the author. (Chegenizadeh, 2019e)

6.2.10 Training Requirements

Training was highlighted as a key factor particularly for new starters prior to being mobilised to the site. The service provider company implemented a document called the "site mobilisation checklist", which ensured that no employee would be mobilised without completing all the relevant checks. All staff were interviewed prior to mobilisation offshore and closely assessed to ensure that they were suitable for the allocated position they had applied for; less experienced staff were allocated lower risk tasks and grouped with more experienced staff.

The site mobilisation checklist included the following:

- completion of a site-specific HSE induction
- relevant HSE industry training (e.g. BOSIET, TBOSIET, CSTP), licences, certifications and competency-based safety training was completed as per Appendix 12: training matrix
- HR checks were conducted to ensure that the right employee was hired for the job in line with their previous work experience.

6.2.11 HSE Key Performance Indicators

As outlined in Table 6.5, a list of key performance HSE lead indicators were followed throughout the service provider's maintenance campaign. Specific targets were set for each KPI to ensure that staff consistently met safety milestones every year. These HSE lead indicators were tracked yearly. It was important that these HSE KPIs followed the SMART methodology, which consists of being specific, measurable, achievable, realistic, timely, and were agreed upon by all key stakeholders (not just upper management). These HSE KPIs followed critical HSE areas that the service provider company wished to track and ensure were compliant. The areas covered included:

1. **Supervision training.** As per the duty of care, supervisors must be deemed competent prior to conducting supervisory duties. The SSCP is an entry-level program, which was developed to provide a benchmark for universal safety leadership skills across the Australian oil and gas industry.
2. **Safe cards.** A Safe card is a short proactive tool that assists employees on the job to record minor hazards, safe or unsafe observations and safe or unsafe behaviours. Safe cards can also be logged digitally through the incident reporting system, and their content can be used to discuss various safety issues further in future pre-start and morning toolbox meetings.
3. **HSE workplace inspection.** This comprises a document checklist to be filled out by a supervisor inspecting critical safety items of the work process (e.g. work permits, housekeeping, chemical management, PPE).
4. **Management HSE visits.** Management is required to visit the offshore site. This provides an opportunity to brief offshore staff on any HSE news, updates, and upcoming safety initiatives. This effectively eliminates any barriers between management (middle management) and employees and creates a more open relationship.

5. **HSE improvements.** In a similar way to Safe cards, the HSE improvement form is used specifically to identify "a safer better way to conduct a task". This improvement form is filled out if a safety improvement is being made related to such things as tooling, processes or procedural issues. HSE improvements can also be measured by effectiveness and tied into the rewards campaign. HSE improvements are also critical in providing an avenue for employees to contribute further to a working safety culture.
6. **Process safety competency.** This ensures that all staff in the contracting company (including management) complete an online e-module that covers the fundamentals of process safety.
7. **Certification and qualifications.** All staff are required to complete the relevant training, competency and qualifications to complete their task safely. The contracting company must have a training matrix that clearly shows what level of minimum HSE training is required for each role.
8. **Shift compliance.** Shift compliance ensures that fatigue management risk assessment is conducted if staff exceed 12.5 hours of work on a shift.
9. **Roster compliance.** This ensures that fatigue management risk assessment is conducted if staff exceed 12.5 hours of work on a shift.
10. **Supervisor to staff ratio.** The ratio ensures that supervisors do not supervise too big a group, which may become difficult to control or manage. Prior to commencing a campaign, the supervisor must ensure that a certain number of staff is not exceeded. Every supervisor can effectively manage a certain number of people and should not be given more employees to manage. Allocating the incorrect number of employees to a supervisor can create organisational issues and even lead to catastrophe. To avoid these issues within the company, senior management must work to identify the optimal supervisor to staff ratio to achieve the most effective management of employees.

Table 6.5 HSE Lead Indicators

HSE Lead Indicators	Description	Target
Safe Supervisor Competency Program (SSCP)	Percentage of supervisors who have completed the SSCP	100%
Safe cards	The number of Safe cards recorded per person per day (minor hazard, safe or unsafe observations, safe or unsafe behaviours)	1 (per person per day)
HSE workplace inspections	The number of structured HSE workplace inspections using a checklist and conducted by the supervisor. E.g. GSR inspection checklist, PTW audit.	1 (per supervisor per week)
Management HSE visits	The number of management visits to the site that include a structured HSE activity (HSE assurance, workplace inspection and crew engagement session)	2 (per asset per year)
HSE improvements	The number of HSE continuous improvement initiatives that either improve HSE systems and processes and provide a specific reduction to risk	1 (per quarter per asset)
Process safety competency	Conformance to process safety competency requirements (including PSM fundamentals e-learning).	100%
Certifications and qualifications	All required certification and qualification documents are valid and recorded in contractor's verification system	100%
Shift compliance (shift exceeding 12.5 hrs)	All cases of overtime exceeding 12.5 hours reported to the senior manager of the offshore platform (Offshore	0

	Installations Manager, OIM) and supported by a fatigue risk assessment. Daily tasks scheduled to ensure all tasks can be executed within a 12-hour shift	
Roster compliance	The number of roster exceedances. All cases of roster exceedances reported to the OIM and supported by fatigue risk assessment. Roster tasks scheduling to ensure all tasks can be executed within a scheduled roster	0
Supervisor to staff ratio	The ratio of supervisors or lead hands to reporting staff	1:10

Note. Table 6.5 was created by the author. (Chegenizadeh 2019)

6.2.12 Human Factors

Analysis of human factors is another area that was widely analysed. According to a definition shared by the World Health Organization, human factors refers to organisational, job, environmental, individual and human characteristics that influence behaviour at work in such a way as to affect health and safety (Health and Safety Executive 2019). To minimise risk, it is critical to identify and manage human factors.

As detailed by (Burrage, 1995, p. 235), "many of the failures that arise within systems and lead ultimately to disaster have their origins in decisions or actions taken by individual managers at some level within the system. Thus, managers and decision makers are just as susceptible to error or misjudgement as operators, and the potential effects of their errors are often far greater. Complacency is the enemy of safety. The absence of a major incident within an organisation over a long period can lead to corporate complacency. For example, prior to the Challenger disaster, a general attitude of increasing confidence had built up within NASA that as previous launches had proceeded without incident, future launches would also proceed smoothly."

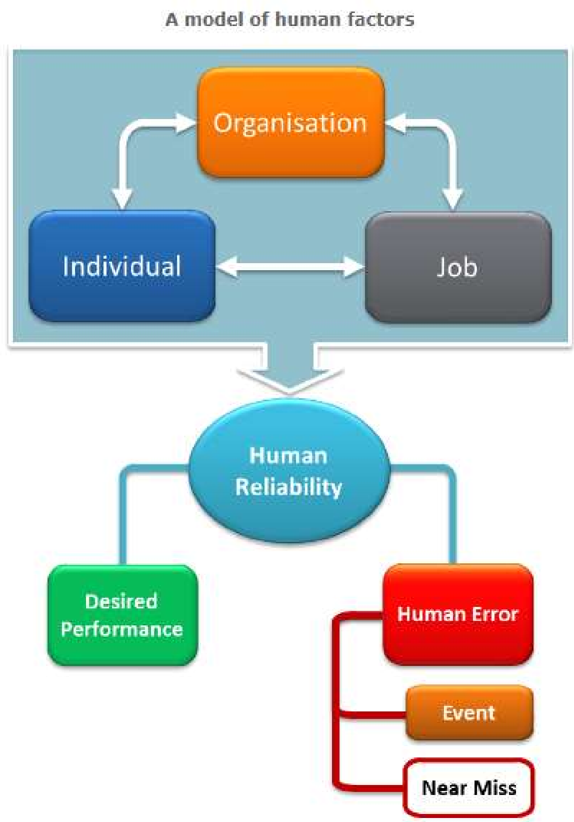
For the majority of industrial accidents there has been a causative chain of human errors and organisational conditions, with (Reason, 1990) suggesting that human factor causes can be responsible for 70–80% of accidents in hazardous industries. One effective way of minimising accidents is to ensure that workers have a clear understanding of their workplace. This refers to the employee being situationally aware of their environmental conditions and tasks and making the necessary judgement regarding how changes can affect the work environment in the future.

By understanding those human factors that influence employees, organisations can apply specific integrated solutions to improve human reliability, reduce error and mitigate its consequences. There are various strategies that can be utilised to design, identify, and optimise human factors, which can contribute to the reduction of workplace risk to an ALARP level. Such approaches will assist responsible parties in meeting many of their obligations under the onshore *Occupational Health and Safety Act 1984* (WA) and *Offshore Petroleum and Greenhouse Gas Storage Act 2006 (AUST)* as well as associated regulations. Over the decades, human error has been labelled a contributing factor in many incident causation investigations. Countless cited statistics claim that human error has been responsible for between 70% and 100% of incidents (Upstream, 2019).

Extensive research has been conducted in this field, and it has been found that the greatest threat to complex and potentially hazardous systems are human rather than technical failures. Therefore, when discussing safety, and specifically safety culture, it is important to underline the fundamental factors of human error. Unfortunately, the high-risk nature of the offshore industry means that the consequences of a minor error can result in catastrophic or life-threatening events. Human factors can be moderated, although they can never be eliminated and managing human risks cannot become 100% effective.

NOPSEMA (2018) describes human factors as "the ways in which the organisation, the job and the individual interact to influence human reliability in hazardous event causation". This interaction is outlined in Figure 6.19 below (NOPSEMA, 2018d).

Figure 6.19 Human Factors



Note. From *NOPSEMA: Human Factors* (p. 1), *by* NOPSEMA, 2018 webpage of the National Offshore Petroleum Safety and Environmental Management Authority (https://www.nopsema.gov.au/resources/human-factors/). Copyright 2018 by NOPSEMA.

To mitigate human factor risks, the following actions were implemented:

- All employees (including management) must complete a comprehensive human factor training module during their induction.
- Risk assessments on typical offshore tasks must be conducted by relevant staff completing the assigned work to determine if any high-risk human factor–related tasks (e.g. highly repetitive) can be automated through substitution with machinery.
- Employees must complete a Human factor assessment together with the HSE coordinator onsite prior to commencing tasks to ensure staff are aware of potential human factor errors that could occur during the task.

For example, upon analysis of NOPSEMA's Australian offshore HSE trends (Figure 6.20), it was interesting to find that one of the main causes of accidents in 2015, 2016 and 2017 was attributed to a lack of supervision and human error (human engineering).

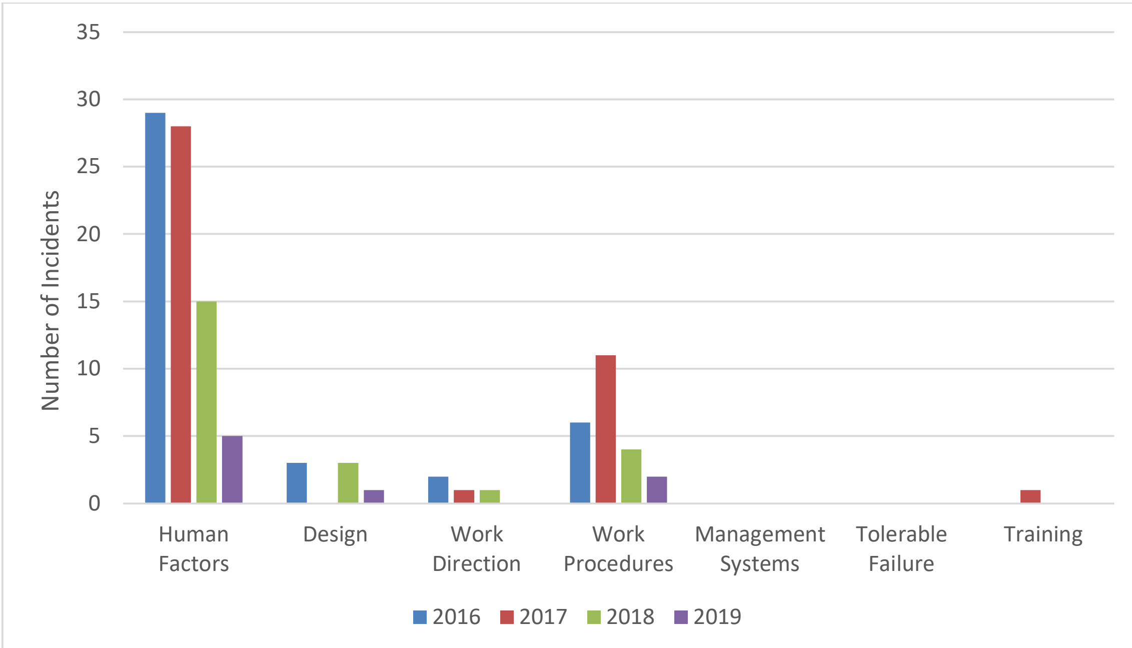
Figure 6.20 Basic Causes of Accidents

Key: blue = human performance difficulties; orange = equipment difficulties

Note. From *NOPSEMA: Annual Offshore Performance Report to 31st of December 2017* (p. 23), by NOPSEMA, 2018, webpage of the National Offshore Petroleum Safety and Environmental Management Authority (https://www.nopsema.gov.au/assets/Publications/AA624610.pdf). Copyright 2018 by NOPSEMA.

Reviewing incident reports revealed a long history of human factor–related incidents in the offshore service provider company. As shown in Figure 6.21, there was a clear indication that human factor–related incidents was a lot higher in 2016 and 2017 pre implementation of the HSE plan in comparison with 2018 and 2019 post implementation of the plan. This indicated that as the safety management plan became more established, the type of safety incidents moved away from training management systems and work procedures to more human factor–related incidents. Figure 6.21 indicated a high degree of complacency, since many of the safety incidents were related to such acts as removing PPE (e.g. gloves, safety glasses) during work tasks and a lack of concentration or being distracted whilst on the job. Therefore, as a result, a section was added to the safety management plan's HSE KPI performance section to ensure that all staff were trained in the fundamental components of human factors.

Figure 6.21 Human Factors, 2016–2019



Note. Figure 6.21 was created by the author. (Chegenizadeh, 2019d)

"Much less attention has been focused on both Risk influencing factors (RIFs) as well as human and organisational factors (HOFs). The steps described in the well planning and the Deepwater Horizon includes HOFs to a large extent. Revealing and understanding the HOFs are of great importance when conducting drilling operations." (Skogdalen & Vinnem, 2012, p. 60)

During the past decade, much research effort has been aimed at revealing, isolating and measuring or predicting HOFs and their influence on risk. For example, the cement job in the Deepwater Horizon incident involved a number of RIFs related to environment, facility and operations which include:

- Narrow pore pressure and fracture gradient,
- Use of nitrogen foamed cement,
- Use of long string casing design,
- Short shoe track,
- Limited number of centralisers,
- Uncertainty regarding float conversion,

- Limited pre-cementing mud circulation,
- Decision not to spot heavy mud in rathole,
- Low cement volume,
- Low cement flow rate.

The BP engineers did recognise some of these factors however unfortunately, many of these risk factors were not followed through which subsequently led to the catastrophic incident. (Skogdalen & Vinnem, 2012, p. 2)

Table 6.6 HOFs that Influence Major Hazard Risks

Work practice	The complexity of the given task, how easy it is to make mistakes, best practice, normal practice, checklists and procedures, silent deviation and control activities
Competence	Training, education, both general and specific courses, system knowledge
Communication	Communication between stakeholders in the (PDCA) cycle of process of plan, do, check and act
Management	Labour management, supervision, dedication to safety, clear and precise delegation of responsibilities and roles, change management
Documentation	Data-based support systems, accessibility and quality of technical information, work permits system, safety job analysis, procedures (quality and accessibility)
Work schedule	Time pressure, workload, stress, working environment, exhaustion (shift work), tools and spare parts, complexity of processes, human–machine interface, ergonomics

Note. From *Quantitative Risk Analysis of Oil and Gas Drilling Using Deepwater Horizon as Case Study* (p. 61), by Skogadalen & Vinnem., 2012, Journal of Reliability Engineering and System Safety, 100(58-66) (https://www.sciencedirect.com/science/article/abs/pii/S0951832011002651). Copyright 2012 by Elsevier.

6.2.13 Chapter Summary

This chapter highlighted the importance of continually measuring HSE performance indicators, through various key performance indicators such as lead and lag indicators, to determine the effectiveness of the safety management plan over time. In review the chapter came to a conclusion that lead indicators are a proactive measure which has a promising role in improving HSE behaviour and work practices in the work environment and that lag indicators were used more as a monitoring mechanism to simply gauge HSE performance, however had limited effectiveness in actually improving future HSE performance. The chapter also analysed both the lead and the lag indicators performance (e.g. total recordable injury rate) of the contracting company to determine the effectiveness of the best practice HSE plan over time. Determining a number of significant statistical improvements in HSE performance following the implementation of the new HSE plan from 2018 onwards.

Chapter 7: **KEY STRATEGIC ELEMENTS IN THE IMPLEMENTATION OF A SUCCESSFUL SAFETY MANAGEMENT PLAN**

As discussed in the previous chapters, this research has highlighted the importance of the development of a world-class, best practice safety management plan. However, to be truly successful, having the right paperwork, processes and procedures is only one critical aspect of success. The other equally critical component is the implementation of the safety management plan, which is discussed further below.

The integrated best practice HSE management plan must clearly demonstrate the following key strategic components. All these components must be achieved prior to contractor employees being mobilised to the offshore client site:

- Demonstrating clear management commitment and leadership regarding the HSE message; reinforcing team mottos such as towards zero harm and looking after yourself and your mates. Ensuring all the management team conduct a basic health and safety training course so they understand the importance of safety in the workplace.
- Clearly defining key HSE responsibilities for all stakeholders in the work process. Ensuring position descriptions are created for all relevant roles and signed off and understood by everyone.
- Clearly identifying training competencies that are to be completed prior to mobilisation. No staff are to be mobilised until all relevant training has been completed and licensing verified.
- Employing and embedding HSE experts into the SMS to help enforce the critical aspects of the safety management plan.
- Engaging HSR representatives in day-to-day operations (through conducting HSE inspections, and HSE communication of hazard and incidents).
- Highlighting the principles of "duty of care" for both employers and employees.
- Abiding by the HSE subcontractor management principles.
- Actively involving the contracting company in HSE-related associations to improve HSE standards (e.g. stand together for safety).

- Risk management process: Identifying, assessing, and controlling all specific hazards and risks (emphasis on higher-end risk control of hazards, e.g. elimination, substitution or engineering controls rather than reliance on administration or PPE). Ensuring the involvement of employees in this process.
- Conducting regular HSE inspections, audits and HSE surveys to gauge any gaps in the SMS. Ensuring that any actions from these inspections are actioned to relevant persons and closed out in a timely manner; furthermore, communicating to employees once an action has been closed out.
- Recording HSE lead and lag indicators (major emphasis placed on HSE lead indicators); also ensuring that all key staff from employees to supervisors, HSR representatives and management are involved in the development of these KPIs.
- Striving to improve continuously in the creation of an environment that enables constructive feedback. HSE must be consistently ingrained in day-to-day operations; employees should be trained to spot hazards proactively and communicate these openly for rectification.
- Scheduling regular safety toolbox committee meetings (to aid in HSE consultation and communication; management to also be involved in these meetings).
- Providing a strong HSE induction that reinforces expectations of staff prior to commencing work (enforcing expectations and standards on day one).
- Analysing and targeting hazards, near misses and unsafe behaviours. These types of lead indicators must be viewed as opportunities for improvement and investigated thoroughly by the work team.

The fundamental HSE key strategies in enabling best practice are discussed below:

7.1 Leadership

HSE leadership is critical in the development of an effective safety management plan. Evidence must be demonstrated that leaders are personally committed to safety through their transparent actions in the workplace, the boardroom, and every other relevant section of the organisation.

Failure to involve health and safety as a vital business risk in panel decisions can lead to devastating outcomes. As discussed in earlier chapters, this could be a major contributing factor in offshore incidents. The issues of many high-profile safety cases over the years have been rooted in failures of leadership (HSE, 2019b). Furthermore, historically HSE based legislation, clearly highlights the key responsibilities of stakeholders such as employers, directors, and executives, who can be personally liable when a duty of care has been breached, leading to large fines as well as reputational damage.

Members of the board have both collective and individual responsibility for health and safety. As discussed by (Hughes & Ferrett, 2011), health and safety is integral to success. Board members who do not show leadership in this area are failing in their duty as directors and in their moral duty, and they are damaging their organisation.

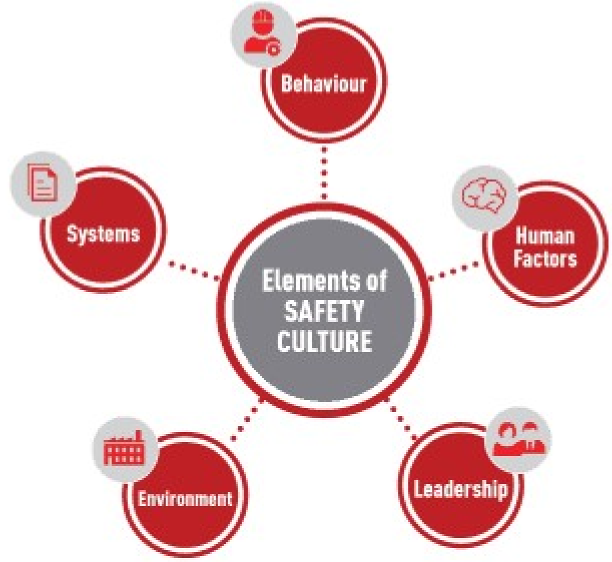
7.2 Safety Culture and HSE Innovation

Both safety culture and HSE innovation are interlinked as they both are effective tools used in organisations to improve HSE beliefs, perceptions, and values that employees share in relation to risk within an organisation. Safety culture and HSE innovation benefit organisation through:

- enabling a positive and proactive safety culture (rewarding good safety practices by staff and promoting best practice when a safety innovation has been realised)
- committing to HSE innovation opportunities (exploring ways of making the job easier and safer: is there a better tool for the job, or a more efficient way of conducting a task?).

Just as Tillerson, the CEO of ExxonMobil, said, "companies must develop a culture in which the value of safety is embedded in every level of the workforce, reinforced at every turn and upheld above all other considerations" (Darren, 2015, p. 3). A basic commitment to safety begins with the board of directors and should be present at every level of management down to the frontline supervisors with direct charge of ground-level operations (Olive, O'Connor, & Mannan, 2008, p. 133). If an organisation needs to improve and maintain a strong safety culture, leadership of that organisation is critical, as indicated in the diagram below:

Figure 7.1 Elements of Safety Culture



Note. From *How Can Leaders Influence a Safety Culture* (p. 1), by GLC., 2017, webpage of GLC Europe (https://glceurope.com/how-can-leaders-influence-a-safety-culture/). Copyright 2017 by GLC Europe.

According to (GLC, 2017), upper management should be engaged in and informed of site-specific HSE issues; they must diligently attend HSE committee and toolbox meetings and contribute to and advance the HSE message (GLC, 2017). Furthermore, it is important that employees see the management staff are committed to the HSE system. Quite often, it is this executive leadership that offers the most noticeable face of the organisation to both internal and external audiences.

7.2.1 Safety is Always the First Priority

Safety should be respected as highly as any other essential corporate function (NSC, 1999). This means giving safety achievements the same consideration as other business accomplishments and treating safety matters with the same magnitude and dedication as other business challenges (NSC, 1999). Many best-in-class organisations in the offshore industry develop HIRARC measures and consider reducing site-specific risks to be ALARP. This methodology is implemented to staff during their initial HSE induction, and there is an expectation that it is always followed.

The key to best-in-class safety is to reward good HSE behaviour and to promote this activity further. Staff must complete safety documents prior to commencing a task, such as a step back 5 x 5, this work-related document will enable the employee to plan the task, even if it has been categorised as a routine, mundane task. Alternatively, if an employee is involved in an incident that could have been a near miss or an actual injury, they must be able to report it immediately and not be in fear of consequences for doing so.

Employees must speak up if they encounter a hazard or risk, and not walk away, because the “duty of care” states that they must look after themselves and not put others in danger (Barling, Loughlin, & Kelloway, 2002). World-class safety leaders should establish a working environment in which standing up for safety is welcomed by the organisation, including frontline workers, as positive and strong (Barling et al., 2002). Empowering employees to raise HSE issues is one step towards creating a healthy safety culture. Building this kind of culture of safety may require overcoming traditional mind sets such as just “getting the job done” and “toughing it out”.

7.2.2 Employee Engagement and Behaviours

(Krause & Henshaw, 2005). Workers and contractors who are proactive in safety and take pride in the safety of their own and their colleagues’ actions are an organisation’s first line of safety defence (Krause & Henshaw, 2005). By involving employees in the HSE process, they will be less likely to view safety goals and policies as someone else’s rules and will be more inclined to participate because they have played a significant role in the development of the procedures in the first place. Employees who are proactively engaged in this process will bring a far greater contribution and enthusiasm to the work than will workers who are given externally enforced rules with which they are obligated to comply.

7.3 Organisation and Structure

To strive for best in class, resources such as safety experts, coordinators, and managers) must be allocated by the organisation and these must be embedded into the safety operations. The core responsibility of the safety professionals is the prevention of incidents that cause harm to people, property or the environment. The key components of the SMS should be facilitated and adhered to. However, having a safety professional working actively in the business does not mean other staff can relax from their duty-of-care requirements. Safety is everyone’s obligation and responsibility. Having a dedicated safety personnel or team is not enough and everyone must still be accountable and responsible for safety in everything they do.

7.4 Resource Allocation

Safety costs are expenses related to improving workplace safety. A best-in-class safety organisation will understand that the initial cost of providing such things as resourcing certain safety programs, employing safety professionals, resourcing PPE and conducting safety-related training in the long term will be a sound investment. (Duke, 2013) stated a company committed to safety without suitable resources and tools is no better placed for safety excellence than a company with no regard for safety. A company that is considering cutting safety expenditure should consider both the direct and indirect cost consequences, as outlined below:

- **Medical treatment and workers' compensation**. When employees are injured at work, they require treatment. Depending on the severity of the injury, this process could take up to a few months until the employee is back to normal work duties. Medical costs can play a significant factor in the organisation's expenses. The financial loss because of medical treatment for injuries generates an easily measurable impact on the company's bottom line.
- **Regulatory fines.** Fines can have a significant influence on whether the safety and health standards are being managed correctly. This not only affects the reputation of the company but also influences the success of tenders for future jobs, as well as creates a financial burden on the company's bottom line. Regulatory fines have the most evident impact on whether hazards are corrected in a timely manner.
- **Downtime and loss of production.** Injuries can create major interruptions in companies' operations, which result in expensive loss of work and profits. In any profitable organisation time is considered money, and the company must ensure continued production as much as possible with minimal downtime.
- **Wages paid to first responders.** When a major incident occurs, usually the first respondents are the emergency response professionals, which can later lead to high costs, particularly if this is a recurring cycle.
- **Heightened absenteeism.** When employees feel unsafe and observe their fellow workmates becoming involved in frequent safety incidents, this generally leads to an increased level of absenteeism. Furthermore, this affects existing workers who are at work and are exposed to a greater risk of injury because of the resulting lack of staff.

- **Damage to reputation.** Organisations spend a large amount of money yearly on marketing and advertising campaigns, only to have their reputation tarnished by a tragic safety incident.

7.5 HSE Metric and Reporting

Another strategy to enable a high-performing safety organisation is to analyse historical HSE data (from both lead and lag indicators) such as LTI frequency rates; medically treated injury rates; and first aid, near miss and hazard reporting. Senior management must be able to receive reliable and accurate data to set future organisational safety performance goals, know which areas of the HSE sector require improvement, and allocate the necessary extra resources to enable continuous improvement. One potential flaw in the approach of gathering relevant HSE metrics is a poor reporting culture; this must be resolved through management not apportioning blame when an incident occurs but being proactive in learning from these mistakes.

7.6 Verification and Audit

The results from periodic audits should be communicated back to management as well as to the CEO. Every organisation striving for best practice should perform frequent audits to evaluate safety performance and pinpoint areas that need to be reviewed and improved. Audits gauge safety management systems for compliance with company policy and government regulations and assess safety processes and performance. Internal and external auditing reports are one of the most significant sources of information that can be used by organisational leaders to review their safety practices at their operating facilities.

7.7 Chapter Summary:

This chapter summarised the research study and emphasised that just having a best practice management plan is not the only component needed to be successful in HSE performance, there are a number of overall strategic elements that also need to be implemented to ensure a successful HSE management plan. These included leadership by management, as well as having a strong commitment to delivering all key criteria of the HSE plan and allocating necessary resources to ensure that HSE is delivered adequately to all key stakeholders as well as promoting a strong safety culture through education of critical safety ideologies (e.g. human factors, process safety) to employees to reinforce HSE behaviours.

Chapter 8: **CONCLUSIONS AND RECOMMENDATIONS**

For a long time the oil and gas industry has neglected safety, as evidenced by the many catastrophic incidents that have occurred in the past. This may be because the majority of petroleum organisations are characterised as large businesses. Hence, most of their budgets and resources are invested in exploration and production in search of maximising profits and returns rather than also being invested implementing proactive safety and health initiatives and a sound safety management plan. These inefficiencies have resulted in unsatisfactory safety performance outcomes and a significant number of fatalities and incidents (through catastrophic disaster), including minor and major injuries or financial losses. However, recently there has been a major shift in the industry, which has highlighted the importance of safety and health through an evolution in safety culture. However, to achieve further progress, more improvements are necessary.

Most of these HSE based initiatives discussed in this research have been mainly focused on the oil and gas companies in an attempt to protect their direct employees and assets. However, as has been highlighted contractors and subcontractors in many instances have been excluded from this process and been overlooked as external factors.

Findings from the current study identify significant failings in the petroleum industry regarding safety performance. These include the oil and gas industry's environment, lack of management commitment, lack of safety management systems, shortage of skilled labour, inadequate implementation of occupational safety and health legislation, poor safety performance of subcontractors, and non-existent uptake of safety programs and safety culture. Other factors that have had an impact on fatalities are the characteristics of the workers (e.g. age, education, ethnicity, work experience), time-related factors (year, season, time of day), union involvement, legislation, regulations and inspections. All these components are labelled contributing factors that have had ill effects on the industry in the past, through to the present day. The high number of fatalities and incidents in the oil and gas industry indicates the demand for major development in OHS measures. Petroleum engineers, being viewed as a member of "top tier" management in the projects, are likely to have knowledge of OHS procedures and regulations. However, OHS training is not always incorporated comprehensively into their engineering education. The Western Australian oil and gas industry has the capability to become a useful tool for benchmarking and can be labelled a world-class performer in occupational safety and health in relation to other industries such as the mining and construction industry.

With reference to the literature review and current status of oil and gas industries, the lack of a health and safety management plan was observed. A huge gap has been identified in the oil and gas industry, particularly in relation to contractor and subcontractor management. Upon a historical review of the majority of catastrophic incidents and major workplace accidents, it was evident that many of these occurred as a direct result of contractor involvement.

Through the research and historical analysis of past safety incidents it has been highlighted that Contractors and subcontractors are more accident prone because they spend less time in the workplace environment. This lack of familiarity with the workplace environment, as well as the time pressures to meet strict deadlines or else risk facing potential fines by the client, can have significant adverse effects on the reputation of a company. A combination of these issues can inevitably cause these workers to fall into a higher category of risk and increase the risk of making mistakes on the job (human error) or be tempted to take certain shortcuts to save time.

An offshore maintenance contracting company was therefore selected for this study; this was a medium-sized organisation that had carried out a number of projects offshore and that offered a broad range of services to some of the largest and leading oil and gas companies onshore and offshore. Through a comprehensive review of policies, procedures and accident and incident data in the general offshore industry, it became apparent that these incidents could have been prevented, thereby highlighting the need for a centralised best practice safety management plan (which could be used by all relevant companies) that is both proactive and led by upper management. There is also a direct need for standardisation in the industry when it comes to safety and health rules.

Therefore, as part of this study, a comprehensive integrated best practice safety management plan was developed, and recommendations have been made for future improvement. Following full implementation of this management plan in a real workplace, an analysis of incidents, near misses and non-conformance took place, ultimately to prove the importance of having a practicable safety management plan in use.

Supporting documents, tables, graphs and forms, which assisted with being able to understand the study results, can be found in the appendices. Although this study has mainly targeted the oil and gas industry, this management plan could be expanded to other relevant high-risk industries such as mining and construction if the work environment changes are accounted for while developing the plan.

8.1 Conclusions Related to the Research Aim

The aim of this study was to create an integrated best practice safety management plan for contracting companies in the oil and gas industry and aid in further reduction in the occurrence of both low- and high-level incidents and work-related injuries.

To assist with achieving the research aim, the following three questions were asked:

1. What health and safety management plans do other industries such as construction, health services and asset management use to enable them to work effectively towards a zero-harm goal?
2. Which strategies were used in the workplace by oil and gas contractors and subcontractors to maintain the highest level of workplace safety and health according to lead and lag indicators?
3. Could a standardised health and safety management plan be developed for contractors working in the oil and gas industry to harmonise health and safety expectations across the industry to achieve high standards of health and safety in contractors' workplace and strive towards a zero-harm goal?

8.1.1 Research Question 1 Conclusions

Prior to conducting the research study, a number of safety management plans were reviewed from various industry sectors to determine which specific safety areas had proven to be successful in achieving the zero-harm goal. Critical analysis of other workplace organisational HSE management plans was completed. These HSE management plan reviews were conducted on industrial sectors other than the oil and gas industry. Upon analysis of these plans, a number of key areas were highlighted that had proven to be successful in achieving the towards zero-harm goal. This was reflected by the businesses' improved HSE performance throughout the year upon rollout of the HSE plan. The key areas identified included:

- management commitment through HSE policy, attendance of safety committee meetings and engagement in onsite inspections

- a robust safety training program for both employers and employees including safety culture awareness. Induction of new starters (green hats) with an extensive safety training program
- engagement in an HSE innovation program related to the daily safety risks to which employees are exposed
- specific high-performance KPIs targeting business HSE targets
- safety responsibilities of all parties in the organisation clearly defined and understood. All employees sign off on their position description clearly stating their safety responsibilities in the organisation
- higher engagement and empowerment of HSRs in the safety management plan, ensuring adequate safety participation in all safety-related work activities
- creation of targeted safety programs to combat relevant site injuries, for example, prevention programs related to hand safety, manual handling, and eye safety
- engagement by management in a compulsory safety leadership training program, which provides employers with the necessary tools and skills to lead safety by example, empower their employees to be best in class and ensure that they own their safety management processes
- critical workplace documentation such as risk assessments, policies, and procedures, which are produced and revised internally by the management team as well as by site personnel.

These successful components all assisted in creating the standardised health and safety plan for the oil and gas industry. The reviewed plans came from health services, asset services and mining and construction, which provided a comprehensive examination of plans from different work sectors.

8.1.2 Research Question 2 Conclusions

Strategies used in the workplace by oil and gas contractors and subcontractors to maintain the highest level of workplace safety and health according to lead and lag indicators were evaluated when reviewing the effectiveness of the safety management plans. Successful management plans reviewed placed greater emphasis on employer and employee engagement with lead indicators. Having this integrated plan in place demonstrated that examining lag indicators reduced the rate of low-level and high-level incidents and injuries. It also proved that lead indicators can influence change and drive positive safety behaviour and culture. Therefore, greater emphasis was placed on KPIs such as HSE inspection, Safe cards, OHSE observation and near misses reporting. Other strategies implemented in successful safety and health management plans in industries such as construction, health services and asset management included conducting safety surveys and interviews to gauge accurately the safety performance of employee feedback and conducting analysis of near misses and unsafe conditions through implementation of the Heinrich triangle theory.

Overall, the HSE management plans reviewed from various organisations highlighted several key initiatives and trends that enabled best practice in health and safety. All the organisations analysed indicated the importance of ensuring that health and safety needed to be led by top management, as well as demonstrating an active involvement and commitment to this process. Other key strategies found by in workplaces was the importance of empowering HSRs to promote health and safety, to lead by example through their actions and to act as mediators between management and site employees. HSR's were viewed as a driving force for change who assisted in the further development and evolution of a higher level of safety culture. Furthermore, many of the organisations encouraged their teams to think of new and innovative ways to conduct their tasks in a safer manner and to improve continuously. It was also observed that successful safety innovations were rewarded by management; this form of positive recognition prompted further safety innovations by the team.

Finally, it was also found that the majority of the organisations actively analysed their HSE statistics in order to identify gap areas and then invest enough resources into targeting these problem areas through various safety targeted or prevention programs. All these various initiatives employed by these organisations assisted significantly in creating a successful safety management plan.

8.1.3 Research Question 3 Conclusions

The third research question to be answered was, could a standardised health and safety management plan be developed for contractors working in the oil and gas industry to harmonise the health and safety expectations across the industry to achieve high standards of health and safety in contactors' workplace and strive towards a zero-harm goal? The conclusions related to this research question were in the affirmative. This was evidenced through this research study's findings from which a standardised HSE management plan was developed in the form of a generic framework for the oil and gas industry, and the outcome—reported in Chapter 4—demonstrated the plan's effectiveness. Moreover, the second plan, documented in Chapter 5, was a comprehensive contracting company HSE management plan integrated specifically for an oil and gas company in Australia. This particular safety management plan acts as a standardised model for contractors to make use of and details what safety and health obligations contractors must adhere to for workers to stay safe in the oil and gas industry.

One external initiative currently in place is the organisation, Safer Together. This industry safety, member-led organisation further supports the needs for standardisation of safety standards. However, this member-led body is still in its early stages of development. Apart from this research study and bodies such as Safer Together, the industry has struggled to achieve standardisation to cater for contracting companies who work in this industry.

8.1.4 Research Aim Conclusions

The aim of this study was to create an integrated best practice safety management plan for contracting companies in the oil and gas industry and aid in further reduction in the occurrence of both low- and high-level incident and work-related injuries. Conclusions related to this aim are that the research clearly demonstrated a successful integration of the HSE management plan by the contracting company involved in the study. This plan is presented in Chapters 4 and 5. Evidence of this integration is further demonstrated in Chapter 6 through improvements in both lead and lag indicators throughout the duration of the research study. The next phase of the research would be for this integrated plan to be implemented for other contracting companies in this industry as well as other related industries, so further benefits can be realised.

The contracting company involved in the research study applied for accreditation to both health, safety, and environmental standards, following the successful integration of the health and safety management program in 2019. Through a number of external audits conducted in Quarter 3 and Quarter 4 of 2019, the organisation succeeded in achieving accreditation. This further reinforced the organisation's commitment and performance to achieving best practice in health and safety performance.

Chapter 6 of the research study demonstrated a clear reduction in both low- and high-level incidents and work-related injuries over the period of the two-year research study from January 2018 to December 2019. During the two-year period following the implementation of the new safety management plan, there was an elimination of both low and high-level injuries throughout the duration of the study. The TRI rate, which was traditionally a common way of measuring HSE performance in the industry, saw a sharp decline towards zero from 2017 to 2018, which then remained consistently at zero in 2019. Prior to this, the rate had peaked at 9.0 in 2017. Furthermore, it was observed that during the commencement of the project in 2018 there had been a clear engagement in lead indicators such as HSE inspections, observation reports and Safe cards, which also clearly had a positive impact on the incident rate.

8.2 Conclusions Related to the Research Objectives

8.2.1 Feasibility Study and Scope Development (Objective 1)

Objective 1 was to conduct a feasibility study, develop the scope and structure of the research, identify the gaps and limitations related to standardisation and implement an HSE management plan in the oil and gas industry. Conclusions related to research objective 1 are that this objective has been achieved, as documented in Chapter 1.

This research was the first study to explore standardised health and safety management plans for the oil and gas industry by contracting companies, and to evaluate the possibilities of creating a standardised health and safety management plan for promoting a high standard of workplace safety at work relating to injury prevention. This approach will promote safety standardisation and ensure all contracting companies understand clearly what the requirements are and how HSE standards and operations should be run to be truly successful and strive towards zero harm and lower accident and incident rates.

This study will also benefit contracting companies by providing clear HSE rules and regulations that enable standardisation in the industry and will result in a reduction in the occurrence of both low- and high-level incident and injuries. This will have far-reaching positive impacts on the industry as a whole and further move the industry towards a "proactive-generative" safety culture.

8.2.2 Analysis of Catastrophic Incidents (Objective 2)

Research objective 2 was to conduct an analysis of catastrophic HSE incidents in the oil and gas industry through use of root cause analysis. Conclusions related to research objective 2 are that this research objective was achieved, as described in Chapter 2.

The papers reviewed in this section primarily researched the topic of safety management systems as well as safety culture, which was a foundation for this PhD research. Research publications were reviewed and explored to identify the key components necessary to be best in class in health and safety in the oil and gas industry. Catastrophic HSE incidents in the oil and gas industry that were reviewed and analysed detailed not only that specific documentation, such as training records, standards and procedures, is important in enabling a successful safety management plan, but also that management commitment must be present and led from the top down in order to deliver any positive HSE outcomes.

8.2.3 HSE Management Plan from a Legislative Perspective (Objective 3)

Research objective 3 concerned studying the importance of an HSE management plan from the legalisation point of view and the status of current industry movements towards achieving a standardised HSE management plan. Conclusions are that this research objective has been achieved, as described in Chapter 2.

Throughout the study various organisations and industry bodies were researched to determine the status of safety standardisation from a legislative perspective. The regulatory body NOPSEMA was prominent during this investigation. One example of legislation studied was the development of the Offshore Petroleum Safety Regulations 2009, which demonstrate clearly how a facility will be operated safely. In addition, recent programs such as Step Change in the UK and Safer Together in Australia highlight the drive towards the overarching goal of standardising HSE across the board, through recruitment of relevant member companies in the oil and gas industry.

8.2.4 Methodology (Objective 4)

Research objective 4 was to identify the best research methods to analyse the historical incident data obtained from the offshore contracting company that have the highest validity and reliability rating. Conclusions are that this research objective has been achieved, as described in Chapter 3.

The mixed methods approach was utilised for this study and consisted of qualitative and quantitative research tools. This research method was determined to be the best technique to conduct this research because the study explored the various experiences and levels of safety participation and awareness that personnel have when working in the oil and gas industry and determined a commonality in experience within the target group. The review of published HSE-related literature, analysis of various safety management plans and the completion of the pilot study by participants all assisted in developing and refining the interview questions asked of the research participants.

8.2.5 Integrated Management Plan (Objective 5)

Research objective 5 was to identify the key factors (high-performing aspects) of each management plan that have been proven to be successful. Conclusions are that this research objective was achieved, as described in Chapter 4.

Following the review of various safety management plans from various industries, such as asset services, healthcare and construction, a number of high-performing HSE aspects were extracted from these plans in order to develop a best practice document. As a result, a model health and safety management plan were produced. To validate the effectiveness of the integrated HSE management plan, the model health and safety management plan was implemented by one contracting company in relation to maintenance operations in the Western Australian offshore oil and gas industry as a case l study organisation. This model was implemented throughout this organisation. A detailed comprehensive case study was undertaken. Following the implementation, the accident and injury incident rate was reviewed after 24 months and it was determined that there had been a noticeable improvement in HSE performance.

8.2.6 Pilot Study (Objective 6)

Objective 6 was to conduct a pilot study by implementing an HSE management plan that can be utilised by any contracting company in the oil and gas industry in an offshore contracting company organisation and observe the outcome. Conclusions are that this research objective was achieved, as described in Chapter 5.

As part of this study further development of a best practice HSE management plan was integrated for a company that worked as a subcontractor for one of the largest oil and gas companies in Australia and performed a significant number of projects offshore. The management plan outlined in Chapter 5 details an extensive list of specific instructions on how to maintain a safe work environment in the offshore industry free of risk of injury or harm to employees.

8.2.7 Key Strategic Elements in Implementation of a Successful Safety Management Plan (Objective 7)

Research objective 7 highlighted the importance of the development of a world-class, best practice safety management plan. However, the research demonstrated that to be truly successful, having the correct paperwork, processes and procedures is only one critical component of being a successful contractor in the oil and gas industry. The other equally critical component is the actual implementation of the safety management plan. Conclusions related to the achievement of this research objective are that the integrated best practice HSE management plan must also clearly demonstrate such areas as leadership, safety culture and innovation, engaging employees, having an organisational structure, allocating sufficient resources, having an adequate HSE metric and reporting as well as verification of audits. The research summarised that all these points must be achieved prior to contractor employees being mobilised to the offshore client site.

8.2.8 Incident Data Analysis (Objective 8)

Research objective 8 was to conduct an analysis of both contracting company and Australian oil and gas HSE incident statistics. Conclusions are that this research objective was achieved, as described in Chapter 6. In this chapter, it is demonstrated that following the implementation of the HSE management plan by the offshore contracting company the incident and accident rate for that company significantly reduced.

The research benchmarked the contracting company's HSE performance against the general Australian oil and gas industry to determine the trend over the 2017–2018 period. It was determined that there was a steep downward trend in injuries in this period (including the TRI rate performance) following the official rollout of the safety management plan and its key components by the contacting company. This can be attributed mainly to the correct implementation of the integrated HSE management plan by the contactor management team.

8.2.9 Safety Standardisation (Objective 9)

The last research objective, objective 9, was to create safety standardisation throughout the oil and gas industry. Conclusions are that this research objective was achieved by creating an HSE management plan. The standardised HSE management plan is presented in Chapter 5. This management plan outlines specific instructions on how to maintain a safe work environment in the offshore industry.

Furthermore, a checklist was also developed in the research study; this checklist is provided in Appendix 13. For auditing purposes, this checklist can be used to ensure that the contracting company has all relevant policies and procedural documentation in place.

An HSE management plan toolkit checklist was developed to clearly identify the safety standards required to achieve best practice in health and safety in the oil and gas industry. A total of 10 tools were developed, each contributing to the overarching health and safety management plan.

This checklist fulfils the requirements of the oil and gas industry by meeting both national and international safety standards as well as best practice organisations. This checklist was mainly developed for contracting companies wanting to determine their health and safety obligations and requirements.

8.3 Recommendations

Contractor safety management is continually improving in the oil and gas industry, and continued work is still required to ensure that incremental progress can be made to ensure the offshore environment is as safe as possible for contracting companies. For this reason, in an effort to create more opportunities for improvements in the future, the following recommendations are presented for further research:

- Examine and monitor any workplace safety–related changes to legislation concerning the offshore oil and gas.
- Actively monitor all future safety initiatives from Safer Together and ensure all these are adequately implemented in the contractor's organisation.
- Safer Together Organisation provide your safety management plan to their Members for use.
- Conduct an industry-wide safety culture survey to adequately gauge the overall level of safety perception across the whole oil and gas industry as well as similarly related work sectors.
- Conduct a more thorough analysis into the aim, objectives and impacts of the new ISO 45001 safety certification standard in relation to the offshore contractor offshore environment.
- To ensure greater validity of this research study and to assist in the continued successful integration of the plan, it is recommended that as many contracting companies as possible from both onshore and offshore contracting companies engage in the trial and complete implementation of this HSE management plan. This would test the value and effectiveness

of the plan. The companies engaged in the trial would be responsible for objectively critiquing the plan and providing improvements and constructive feedback.

8.4 Future Research Directions

Following the successful implementation of the HSE management plan in the chosen contracting company, there was a marked improvement and proven reduction of accidents and incidents. An important recommendation of this study is to roll out and implement the integrated health and safety management plan to other contracting companies in the oil and gas industry. The HSE management plan can act as a standardised benchmark document for all contractors to follow one clear standard. If the contracting companies follow an adequate implementation of the plan, as discussed in chapters four and five, then the oil and gas industry will see a reduction of safety incidents as per the "towards zero-harm goal". This will also create less confusion between organisations in relation to which specific safety requirements to follow and what their responsibilities are as contractors.

The future direction of this research is ultimately to be able to standardise the key elements used in the existing HSE management plan and tailor these to suit onshore operations throughout the entire oil and gas industry. The primary goal is that safety standards should remain the same, irrespective of any specific geographical location.

8.5 Summary

The researcher has conducted a comprehensive literature analysis of publications related to the oil and gas industry, concluding that this industry was deemed high risk, with complicated processes and high-risk equipment. In particular, the research identified that contractor management failures lead to many offshore catastrophic disasters of the 21st century, with a large loss of life. Throughout the history of the offshore oil and gas industry, there has been a separation between employees, contractors and subcontractors concerning HSE. The research study determined that an integrated best practice HSE management plan is the key to contractors reducing accident and incidents through standardisation of safety standards. An HSE management plan was developed as a result of analysis of other multiple HSE management plans from various industry sectors. The plan developed was successfully implemented by a chosen contracting company over a two-year period, and the company's accident and incident rates declined significantly as a result.

In summary, the main intention of this research was for the integrated HSE management plan to provide clarity to relevant stakeholders by enabling an organisation to conduct their operations safely and eliminate the risk of injury or harm that could potentially be caused to their most important assets, their employees. This standardised HSE management plan for contracting companies in the oil and gas industry is now available for use in industry. To accompany the plan, the researcher has developed the following documents. An integrated best practice HSE management plan checklist (see Appendix 13) helps companies ensure that they have included all the necessary elements in this management plan. Interview questions guide companies to determine their company safety management maturity level (see Appendix 6) and a biannual offshore safety survey report tool which covers all the key HSE areas of an organisation (see Appendix 8). An annual safety culture survey and a customer service feedback form (see Appendix 9) assess the success of the company safety management activities (see Appendix 7). As a result of this research, an organisational and client organisation document matrix (see Appendix 10) has been developed for companies to use to check that each organisation has the correct policies, procedures and documents essential for successful workplace HSE management. A list of recommended lead and lag indicators and how to calculate each one has been included as Appendix 11, and key HSE indicators (see Appendix 12) have been written so that the companies using the plan can monitor the effectiveness of their safety management activities on a regular basis to be able to take action to make improvements if opportunities for improvements are identified. An HSE policy template has been developed (see Appendix 15) and included for offshore oil and gas contracting companies to use. This policy template covers what the company, its employees, visitors and contractors need to do for successful workplace safety, health and environment management. Another tool developed as a result of the research findings is a comprehensive training matrix, which contains the training requirements for different levels of employment positions (see Appendix 13) for successful workplace safety knowledge and actions.

The research has also highlighted the importance of management taking control of their processes and procedures and always being committed to the goal of “towards zero harm”.

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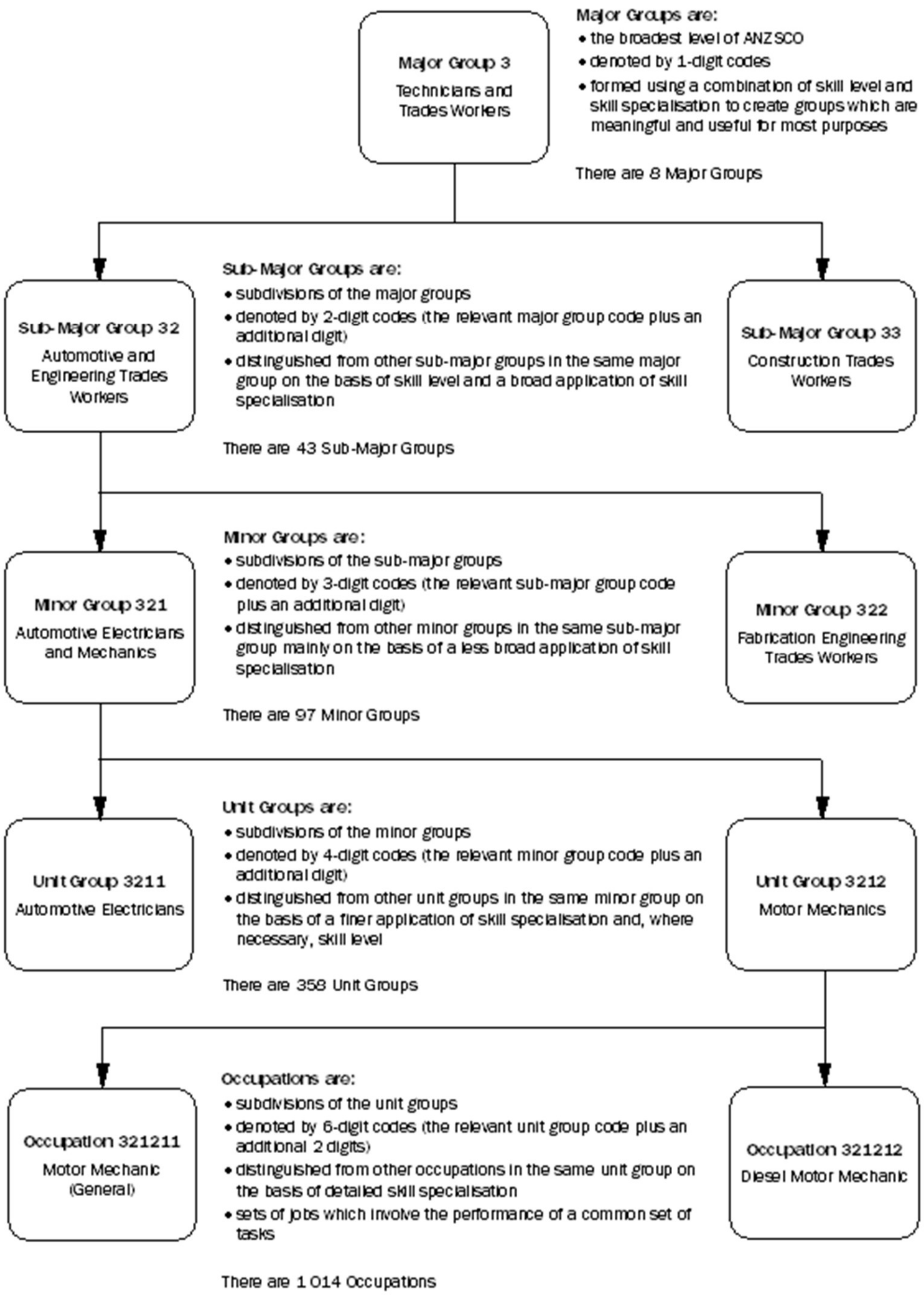
APPENDICES

Appendices 1: Industries Classification as per ANZSCO

There is a total of five levels in the structure of the ANZSCO, these consist of —major group, sub-major group, minor group, unit group and occupation. The categories which lie at the most detailed level of the classification are labelled as ‘occupations.’ The ANZSCO follows the same hierarchy structure as the Australian Standard Classification of Occupations (ASCO) Second Edition and NZSCO 2006. The following in figure A1.1. is an outline of the ANZSCO structure.

Figure A1.1 Industries Classification as per ANZSCO



Note. From *ANZSCO*, 2006, Webpage of Australian Bureau of Statistics, https://www.abs.gov.au/anzsco). Copyright 2006 by Australian Bureau of Statistics.

The Australian and New Zealand Standard Industrial Classification (ANZSIC) have been exclusively developed for use in both Australia and New Zealand, for the purposes of production and analysis of industry-based statistics. It replaces the Australian Standard Industrial Classification (ASIC) and the New Zealand Standard Industrial Classification (NZSIC) which had been used for a number of years. Both of these classifications had been well regarded by industry, both together as well as separately.

During the development phase of the ANZSIC, a considerable degree of prominence was placed on configuring this classification with the international based standards. "The International Standard Industrial Classification of All Economic Activities (ISIC), Revision 3, has been used as the international standard for reference purposes. This will lead to significant improvements in the comparability of industry statistics internationally" (Australian Bureau of Statistics, 2006), (Australian Bureau of Statistics, 1993).

In the past both Australia and New Zealand have had a number of economic agreements, for over 100 years. The most current example of this relationship was the (the Australia - New Zealand Closer Economic Relations Trade Agreement [CER]) became operative from 1 January 1983.

The prospect of the two countries developing and implementing a communal industrial classification was raised in the early 1990's. The statistical agencies both used similar principles to create their national industrial classifications and were, therefore, able to reach an agreement on the strategy and principles for the development of one classification that would meet both countries requirements.

The ANZSIC has a 4-level structure and 17 divisions within each level, which includes Divisions (the broadest level), Subdivisions, Groups and Classes (the finest level). The main aim of the division level is to indicate the quantity of the classifications that supplies the economy bigger picture.

Figure A1.2 ANZSIC Division Titles and Codes

A	Agriculture, Forestry, and Fishing
B	Mining
C	Manufacturing
D	Electricity, Gas and Water Supply
E	Construction
F	Wholesale Trade
G	Retail Trade
H	Accommodation, Cafes and Restaurants
I	Transport and Storage
J	Communication Services
K	Finance and Insurance
L	Property and Business Services
M	Professional, Scientific, Technical
N	Administrative and support
O	Public administration and safety
P	Education and Training
Q	Health care and social assistance
R	Arts and Recreation
S	Other services
X	Not started/Unknown

Note. From *ANZSIC*, 2006, Webpage of Australian Bureau of Statistics, (https://www.abs.gov.au/anzsco). Copyright 2006 by Australian Bureau of Statistics.

Appendix 2: Contracting Company Approval

[redacted]

Private and Confidential

Negin Chegenizadeh

Principle Researcher
Curtin University

GPO Box U1987

PERTH WA 6845

18/06/2019

Dear Negin,

RESEARCH PROPOSAL FOR NEGIN CHEGENIZADEH

[redacted] would like to offer our support to Mrs Chegenizadeh's research project on HSE performance of contracting companies in the oil and gas industry by:

1. Providing de-identified health and safety incident & injury data between the periods of 2016 to 2019
2. Access to company HSE policies, procedures, and risk assessments

These actions will allow the projects learnings to be shared with industry and the promotion of good practices.

Please note: The [redacted] company name will not be used in any form in the research project and will instead be referred to as 'anonomyous contracting company'. Data analysed during the subject research will be de-identified to preserve research participants' privacy.

Regards,

[redacted]

Appendix 3: Participant Information Statement

PARTICIPANT INFORMATION STATEMENT

Research Title: Development of an Integrated HSE Management Plan for Contracting Companies in the Oil and Gas Industry

Name of Investigator: Negin Chegenizadeh.

Research Aim: The aim of this research is to develop an integrated best practice health and safety management model for contracting oil and gas companies.

Your Role: To answer specific health and safety–related questions regarding specific conditions in your current workplace environment, truthfully and to the best of your knowledge.

Resources: For the safety-related survey a printed or electronically emailed questionnaire will be utilised and provided by the researcher.

Consent to Participate: Your involvement in this research is entirely voluntary. You have the right to withdraw at any stage without it affecting your rights or responsibilities. You will be asked to complete a Consent Form confirming your consent to participate. The consent form will be provided 3 months prior to the roll out of the survey and interviews. Should a participant wish to inspect their own personal information that is collected as part of this research, the researcher, Negin Chegenizadeh, can be contacted on phone number 0423854804 to provide you with access to the documentation. Any clarification regarding the privacy of information or further information related to this research can be obtained from Negin Chegenizadeh.

Confidentiality: Names of research participants will not be recorded to maintain participants' confidentiality. Information obtained and collected from you in relation to this research will be stored and maintained confidentially, with the principal investigator and research supervisor only having access to the information. At no time will any of the details obtained, be provided or disclosed to a third party. All electronic data will be stored on a password protected computer with access by the principal investigator only. All electronic data will be stored on the Curtin University R-Drive, which is a secured password protected site.

Further Information: This research is conducted as part of my doctoral study through Curtin University. If you would like further information about the study, please feel free to contact me on the phone number 0423854804 or by email negin.chegenizadeh@postgrad.curtin.edu.au. Alternatively, you can contact my Supervisor Dr Ali Saeedi on phone number (61 8) 9266 4988 or research co-supervisor, Dr Janis Jansz, on phone number (61 8) 9266 3006 or by email j.jansz@curtin.edu.au. Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number XX/XXXX). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au.

Appendix 4: Consent Form

Consent Form

HREC Project Number:	HREC Number XX/XXXX
Project Title:	
Principle Investigator:	
Version Number:	
Version Date:	

- I have read the information statement and I understand its contents.
- I believe I understand the purpose, extent and possible risks of my involvement in this project.
- I voluntarily consent to take part in this project.
- I have had an opportunity to ask questions and I am satisfied with the answers I have received.
- I understand I will receive a copy of this Information Statement and Consent Form.

Participants Name:	
Participant Signature:	
Date:	

Declaration by Researcher: I have supplied an Information Letter and Consent Form to the participant who has signed above, and believe that they understand the purpose, extent and possible risks of their involvement in this project.

Researcher Name:	
Researcher Signature:	
Date:	

Note: All parties signing the consent form must date their own signature

Appendix 5: HSE Interview Questions

HSE QUESTIONS

Demographic information.

Gender: Male [ ] Female [ ]

Age: [ ] 18–28 [ ] 29–38 [ ] 39–48 [ ] 49–58 [ ] > 58

How many years have you worked as a Safety and Health Representative in the Western Australian Oil and Gas/Resource industry?

[ ] < 1 [ ] 2–4 [ ] 5–6 [ ] 7–8 [ ] > 8 years. Please specify ____________

How many years have you worked in the Oil and Gas/Resource? ______________

Your employment position is? ____

What size Oil and Gas/Resource company do you work for? [ ] < 100 employees. [ ] 100–999 [ ] > 1,000

Interviewer (investigator):	Negin Chegenizadeh				
Employee:					
Date:	/ /				
Location:					
SAFETY CATEGORY	**Not at All**	**Rarely**	**At Times**	**Yes Always**	**Additional Comments/Evidences**
1.0 OVERALL SAFETY					
1.1 Do you and your team have a strong positive safety culture?					
1.2 Do you know who you need to go to if you encounter a safety issue?					
1.3 Do you believe that all accidents can be prevented?					
1.4 Does your company follow strategic HSE objectives?					
1.5 Does your company conduct periodic audits?					
1.6 Does your company have systems in place to ensure you are fit for work?					
2.0 LEADERSHIP					

1.1 Do you believe that management leads safety by example?					
1.2 Do managers at all levels receive formal HSE training?					
3.0 POLICY/PROCEDURES					
3.1 Are you aware of specific HSE policies and procedures					
4.0 HSE AWARENESS					
4.1 Are accident and incidents communicated to the team?					
4.2 Do you receive hazard/safety bulletins?					
5.0 HSE PARTICIPATION					
5.1 Do you Attend HSE toolbox meetings?					
5.2 Do you contribute to HSE toolbox meetings?					
6.0 HSE MANAGEMENT PLAN					
6.1 Have you seen a direct improvement in health and safety?					
6.2 What specific improvement have you seen?					
6.3 Are you happy with the way the HSE plan has been implemented?					
6.4 How can we reinforce HSE goals further in the future?					
6.5 Does the HSE management plan provide clear guidelines?					
6.6 Is the HSE management plan easy to understand and follow?					
6.7 Can you describe the main reasons why we have seen an improvement in HSE incident performance?					
6.8 if there is anything else that should be considered					

Appendix 6: Annual Survey—Safety Culture Survey

Safety Culture Survey

Annual Survey

Safety Overall
Do you believe the company is committed to the health and safety of employees?
Do you see health and safety as an everyday factor in your work area/team/department?
Are you able to provide feedback and contribute to health and safety at work?
Leadership
Do you believe your health and safety is a priority for your manager?
Do you believe your managers demonstrates his commitment to health and safety by leading by example?
Workplace Policies and Procedures
There is clear communication around the company's QHSE policy?
There is clear communication around company's objectives & Targets for 2019?
Everyone receives the necessary training when starting a job or using new techniques/equipment?
There is regular communication between employees and management about safety issues?
Systems are in place to identify, prevent and deal with hazards at work?
Workplace health and safety is considered to be as important as production and quality?
There is an active and effective health and safety committee and/or health and safety rep/coordinator?
Incidents and accidents are investigated quickly in order to improve workplace health and safety?
Communication about workplace health and safety procedures is done in a way that you can understand?"
Do you know how to access relevant information about the health & safety management system?
Health and Safety Awareness
Are you transparent about my rights and responsibilities in regard to workplace health and safety?

Are you clear about the company’s rights and responsibilities in regard to workplace health and safety?
Do you know how to complete your work in a safe manner?
If you become aware of a health or safety hazard at my workplace, you know to report it to?
Do you have the knowledge to support in responding to any health and safety concerns at your workplace?
Do you know the necessary safety measures that should be taken while undertaking your work?
Participation in Health and Safety
Do you feel open to voice specific concerns or make suggestions regarding workplace health and safety matters related to your tasks?
If you notice a workplace hazard, would you feel comfortable pointing this out to management?
Do you know that you can stop work if you believe something is unsafe and management will not scrutinise your comments?
Are you provided with sufficient time to complete your daily assigned tasks safely?
General Questionnaire
What do you feel we should be measuring, monitoring and evaluating?
Any additional statements you would like to see on our QHSE Policy?
Do you have a clear understanding of your job role and responsibilities?
Do you feel there are any communication barriers? (e.g. language, literacy)
What additional training do you feel is required for your job role?
Do you think we could manage our suppliers, subcontractors & purchasing better?
What areas do you think should be audited more frequently?
Additional Comments/Areas for improvement/feedback

Appendix 7: Biannual Survey—Offshore Safety Survey Report

Curtin University

Offshore Safety Survey Report

Safety Performance
Was today an HSE perfect day? *HSE perfect day is defined as day without injuries, accidents or harm to the environment.
Safe Card Reporting
Have you and your crew submitted Safe cards for the day? KPI Target: 1 per person per day
Fatigue Management
Did anyone in your team work more than 12.5 hours today?
Has anyone in the team exceeded their shift?
Was a fatigue risk assessment completed?
Safety Communication
Was a health and safety–related topic discussed by an employee in any meeting forum?
Safety & Health Representatives
Do you have an HSR rep in your team?
Was a safety and health representative meeting held this quarter?
Safety Inspection
Was an offshore safety inspection completed today?
Continuous Improvement
Continuous Improvements (CI) submissions. Please list any potential suggestions that can improve the way we work.
Were there any issues/concerns, please list any issues raised?

Appendix 8: Customer Service Feedback Form

Curtin University

CUSTOMER SERVICE FEEDBACK FORM

No #	Questions	Scores
1	The contractor drives behaviour and attitudes consistent with the main providers safety culture.	
2	The contractor provides the right personnel (technical competency and skills) for the work assigned.	
3	The contractor provides the right equipment and materials for the work assigned.	
4	The contractor arrives prepared and well organised for the work assigned.	
5	Work delivered by the contractor is to the quality expected.	
6	Work delivered by the contractor is on time and in budget.	
7	The contractor drives teamwork and effective communication.	
8	The contractor communicates safety information adequately amongst the team.	

Appendix 9: Organisation and Client Organisation Documents Matrix

Descriptions	Client Company Document	Service Provider Document
Policy	Health, Safety and Environment Policy	QHSE Policy
HSE Expectations	Health Safety and Environment Management Expectations	Nil
HSE Management	Health Safety and Environment Management Procedure	Nil
Fatigue Management	Fatigue Management Guideline, Fatigue Management Work Instruction	Fatigue Management Procedure
Drug and Alcohol	Alcohol and Other Drugs Procedure, Australian Operating Unit Alcohol and Other Drug Work Instruction	Drug and Alcohol Policy
Temperature Extreme Management	Temperature Extreme Management Guideline	Nil
Chemical Hazardous Substances	Chemicals- Health, Safety and Environment Management Procedure	Hazardous Substance Procedure
Injury Management	Injury Management Procedure	Injury Management and Return to Work Program
Facility Induction	Common Production Induction and Facility Orientation Procedure	Competency, Training and Awareness Procedure
General Safety Rules	General Safety Rules	Nil
Fitness for Work	Fitness for Work Procedure	Fitness for Work Procedure
Descriptions	**Client Company Document**	**Service Provider Document**
Risk Management	Risk Management Procedure	Risk and Opportunity Management Procedure
Hazard Identification, Risk Assessment and Risk Control	Hazard identification- HAZID Procedure, Health Safety and Environment Risk Assessment Guideline, Formal Safety Assessment Guideline	Hazard Identification Risk Assessment and Risk Control Procedure
Incident Reporting	Health Safety and Environment Event Reporting and Investigation Procedure	Hazard and Incident Reporting Investigation
Roles and Responsibilities	Nil	HSE Roles and Responsibilities
PPE	Personal Protective Equipment Procedure	Personal Protective Equipment
As Low as Reasonably Practicable (ALARP)	ALARP Demonstration Procedure	Nil
Emergency Management	Emergency and Crisis Management Procedure	Emergency Management Plan

Appendix 10: HSE Performance Reporting

Health and Safety performance reporting indicators are designed to provide information to assist businesses in making informed decisions that can influence ongoing organisational performance. On the other hand, poorly designed safety outcomes can have a harmful impact on both individuals and their families, on the financial, interpersonal and reputational health of a business as well as the wider community. The table below explores both critical lead and lag KPI indicators developed by management which lays the foundation for improved HSE performance.

Exposure Hours	Month	YTD Total	Description and Calculation
Total Exposure Hours Worked			Total exposure hours worked for the scope of work performed for the client.

Sect Lead Indicators	Target	Actual	YTD Total	Description and Calculation
3.2.1 Percentage of Safe Supervisor Competency Program (SSCP)	100%			Percentage of Supervisors who have completed SSCP.
5.3.1 No. of safe Cards	1 per person per day			The number of Safe cards recorded per person (minor hazard, safe or unsafe observations, safe or unsafe behaviours).
3.1.7 No. of HSE Workplace Inspections	1 per Supervisor per week			The number of structured HSE Workplace Inspections using a checklist and conducted by the Supervisor. E.g., GSR Inspection Checklist, PTW Audit.
2.1 No. of management/Coordinator HSE Visits	1 per asset per year			The number of management or coordinator visits to the site that include a structured HSE activity (HSE Assurance, Workplace Inspection and Crew Engagement Session).
3.5 No. of HSE Improvements	1 per quarter per asset			The number of HSE Continuous Improvement initiatives that either improve HSE systems and processes and/or provide a specific reduction to risk.
3.2.8 No of HSR's Engagement	100%			Number of HSR's attending committee meeting per quarter divided by number total number of HSR's
3.2.8 No of HSR's Engagement	100%			Total number of HSR's in weekly catch up meeting attendances

				divided by the total number of HSR's
3.2.8 No of HSR training	100%			The number of trained HSR reps divided by the total number of HSR's
4.1 No of Permit Audits	1 per quarter per asset			The number of Permits reviewed divided by the total number of campaign work orders
4.1 Review of Refurb Campaigns	100%			To review 100% HIRA section of permits for all campaign work orders.
4.3 No of Safety in Design Improvements	1 per quarter per asset			Number of safety in design improvements per quarter divided by the number of assets
Review of Refurb Campaign	100%			The number of work orders reviewed divided by the total number of campaign work orders
Review of Refurb Campaign	100%			The number of HSE Work Packs reviewed divided by the total number of work packs
5.3 No. of HSE-related discussions/shares	1 per quarter per asset			Number of HSE-related discussions in any offshore meeting forum divided by the number of assets
4.3.3.5 No. of high-end risk controls	1 per quarter per asset			Number of high-end risk control/s utilised to reduce the risk of a hazard or HSE issue divided by the number of assets
5.11.2 Fatigue Management	100%			100% of offshore staff checked for fatigue prior to mobilisation

Lag Indicators	**Monthly Target**	**Monthly Actual**	**YTD Total**	**Description and Calculation**
Total Recordable Injury Rate (12 Mth Rolling)				TRIR = [# of LTC, RWC, MTC incidents] X [1,000,000] ÷ [# hours worked by all employees on client contract]
No. of Fatalities				The number of fatalities for the scope of work performed for the client.
No. Recordable Injuries (LTC, RWC, MTC)				The Number of recordable injuries (Lost Time Case + Restricted Workday Case + Medical Treatment Case) for the scope of work performed for the client.
No. of First Aid Cases				The number of First Aid Cases for the scope of work performed for the client.

No. of Near Misses				The Number of Near Miss events for the scope of work performed for the client.
No. of High Potential Incidents				The Number of High Potential Incidents for the scope of work performed for client (including Process safety and Personal Safety).
No. of Environmental Incidents				The Number of Environmental Incidents for the scope of work performed for the client.
No. of Occupational Illnesses				The number of Occupational Illnesses for the scope of work performed for the client.

Appendix 11: HSE KPIs

Lead Indicators	Description	Target	Calculation	EOY Measurement
HSE Consultation & Engagement	Greater participation by Contracting staff in HSE-related topics. HSE-related discussion to be led by a Contracting crew in any meeting forum (e.g., toolbox, committee meeting)	1 per Week	Total number of discussions by contracting crew in the month divided by the number of weeks per month with staff offshore	Monthly - Current month score [Complete or not complete] EOY - Final result average [Complete or not complete]
Hazard Management & Risk Control	To control HSE risk by utilising the top three hierarchy of controls (Elimination, Substitution Engineering Controls) High-end risk control implemented to control an HSE hazard/Safe card (reported by staff)	1 per Quarter	Number of high-end risks controls to control an HSE hazard each quarter	Monthly - Current month score [On track/Not on track] Quarterly - Quarterly score [Complete or not complete] EOY - Final result % [Complete or not complete]
HSR Involvement Quarterly	To ensure HSR's are actively engaged and in attendance of quarterly safety committee meetings. All elected HSR Reps to attend quarterly HSE committee meeting.	100%	Number of HSRs attending committee meeting per quarter divided by the number of HSRs	Monthly - Current month score [On track/Not on track] Quarterly - Quarterly score [Complete or not complete] EOY - Final result % [Complete or not complete]
HSR Involvement Weekly	To ensure HSR's are actively engaged and in attendance of weekly HSR meetings. All elected HSR Reps to attend meeting.	100%	Number of HSRs attending HSR meeting per month divided by number of HSRs offshore during the month	Monthly - Current month score [Complete or not complete] EOY - Final result average [Complete or not complete]
Health & Safety Representative Training	To ensure that HSR's are adequately trained and competent to conduct their HSR duties. All HSR reps to complete the HSE course within the first 12 months of holding office	100%	Number of HSRs trained within 12 months of office divided by number of HSRs	Monthly - Current month score [Complete or not complete] EOY - Final result average [Complete or not complete]

Maintenance Campaign Permit Reviews	Ensure that HSE-related hazard and risks have been highlighted prior to campaign commencement. Review all sections of 1 selected high-risk activity permit per campaign at work request stage	1 per campaign	The number of high-risk activity permits divided by the number of campaigns per month	Monthly - Current month score [Complete or not complete] EOY - Final result average [Complete or not complete]
Fatigue Management	To ensure all offshore staff are fit for work. All offshore staff checked for fatigue prior to mobilisation	100%	Number of offshore staff checked for fatigue divided by the total number of offshore staff	Monthly - Current month score [Complete or not complete] EOY - Final result average [Complete or not complete]
Review HSE Content of Work packs	Work packs to be reviewed to assess HSE risks during installation activities	100%	The number of HSE Work Packs reviewed divided by the total number of Work Packs	Monthly - Current month score [Complete or not complete] EOY - Final result average [Complete or not complete]
Review HSE Content of Work Scopes	Assess the HSE risk of all work orders within the campaign at the Scope of Work (SOW) Stage	100%	Number of SOWs assessed for HSE risk divided by the total number of SOWs	Monthly - Current month score [Complete or not complete] EOY - Final result average [Complete or not complete]
Refurb Campaign Permit Reviews	Assess the HSE risk, of all work orders within the campaign. Review permits for all campaign work orders	100%	The number of Permits reviewed divided by the total number of campaign work orders	Monthly - Current month score [Complete or not complete] EOY - Final result average [Complete or not complete]
No. of HSE Workplace Inspections	The number of structured HSE Workplace Inspections using a checklist and conducted by the supervisor. E.g., Inspection Checklist, PTW Audit.	1 per supervisor per week	Total number of inspections done in the month divided by Total number of Supervisors/Leading hands offshore in that month	Monthly - Current month score [Complete or not complete] EOY - Final result average [Complete or not complete]
	The number of management visits to the site that include a structured HSE activity (HSE Assurance, Workplace			Monthly - [On track/Not on track] EOY - Final result %

No. of Management/ Coordinator HSE Visits	Inspection and Crew Engagement Session). Where the facility is unable to accommodate a management visit, contractor to provide evidence of the attempt	1 per Asset per year	Number of visits by Management or HSE Coordinator divided by Number of assets	[Complete or not complete]
No. of HSE Improvement s	The number of HSE Continuous Improvement initiatives that either improve HSE systems and processes and/or provide a specific reduction to risk. (On operating facilities only)	1 per quarter per Asset	Number of HSE improvements per quarter divided by Number of assets	Monthly - Current month score [On track/Not on track] Quarterly - Quarterly score [Complete or not complete] EOY - Final result % [Complete or not complete]
Percentage of Safe Supervisor Competency Program (SSCP)	SSCP training is to be completed to ensure all Supervisors, and Leading hands are trained.	100%	Number of team members who have been trained with SSCP (within 3 months for new supervisor/ leading hand) divided by Total number of required supervisors and leading hands	Monthly - YTD % [On track/Not on track] EOY - Final result % [Complete or not complete]
Process Safety Competency	Conformance to Process Safety competency requirements relevant to each trade. (E-Learning Platform)	100%	Number of offshore employees who have PSM divided by the total number of offshore employees	Monthly - YTD % [On track/Not on track/Complete] EOY - Final result % [Complete or not complete]

Appendix 12: Training Matrix

Following is the training matrix and key competencies for respective positions offshore, this competency matrix provides a comprehensive list of training that must be completed prior to mobilisation on site. An employee cannot be mobilised offshore until they have provided evidence of current licensing as well as completion of all competencies dependent on their assigned position.

Key:	✓	•	×
	Required	Only Required if Requested by Company, not mandatory	Not Currently Required

		Job Positions																			
		Supervisory					Trade												Non-Trade		
		Inlec Supervisor	Mechanical Supervisor	Paint Supervisor	Inlec Leading Hand	Mechanical Leading Hand	Surveyor	Habitat Technician	CSWIP Inspector	Resource Estimator Coordinator	Inlec Apprentice	Mechanical Apprentice	Boilermaker	Welder	Lagger/Insulator	Mechanical Fitter	Inlec Technician	HVAC Technician	Scaffolder (Adv)	Painter/Blaster	Rigger (Adv)
Site Inductions	**Offshore site A**	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Offshore site B	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Offshore site C	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Offshore site D	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Offshore site E	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Offshore site F	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
General	**Offshore Survival Courses – Basic Offshore Safety Induction & Emergency Training (BOSIET)**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Certificate of Medical Fitness- (AMSA)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Compressed Air Emergency Breathing System (CAEBS)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Maritime Security Identification Card (MSIC)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Health & Safety	**Common Safety Training Program (CSTP)**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Confined Space Entry	✓	✓	✓	✓	✓	✓	✓	✓	•	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Working at Heights	✓	✓	✓	✓	✓	•	✓	✓	•	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Low Voltage Rescue (LVR) & (CPR)	✓	×	×	•	•	×	×	×	×	✓	×	×	×	×	×	✓	✓	×	×	×
	Electrical Officer (external)	✓	×	×	•	•	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×
	RPA (Restricted Performing Authority) (external)	✓	✓	✓	✓	✓	✓	✓	✓	•	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PA (Performing Authority) (external)	✓	✓	✓	✓	✓		✓	✓	•	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Key:			
	✓	•	×
	Required	Only Required if Requested by Company, not mandatory	Not Currently Required

	Job Positions																			
	Supervisory					Trade												Non-Trade		
	Inlec Supervisor	Mechanical Supervisor	Paint Supervisor	Inlec Leading Hand	Mechanical Leading Hand	Surveyor	Habitat Technician	CSWIP Inspector	Resource Estimator Coordinator	Inlec Apprentice	Mechanical Apprentice	Boilermaker	Welder	Lagger/Insulator	Mechanical Fitter	Inlec Technician	HVAC Technician	Scaffolder (Adv)	Painter/Blaster	Rigger (Adv)
Work Party (Performing Authority) (external)	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WSA (Work Scope Authoriser)	✓	✓	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Own Isolations (Performing Authority) (external)	✓	✓	×	✓	✓	×	×	×	×	✓	×	×	×	×	✓	✓	✓	×	×	×
Personal Gas Monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Operate Breathing Apparatus (BA-Work Airline)	•	•	•	•	•	×	×	•	×	•	•	•	•	•	•	•	•	•	•	•
Plant and Machine Operations | Gas Test Atmospheres	×	×	×	×	×	×	✓	✓	×	×	×	✓	✓	×	✓	✓	✓	✓	✓	✓
Health and Safety Representative Training	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Provide First Aid	✓	•	•	✓	✓	×	•	•	×	•	•	•	•	•	•	✓	✓	•	•	•
Safe Supervisor Competence Program (SSCP)	✓	✓	✓	✓	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Medicals | FFW – Remote location Medical for Work & Travel	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Respiratory Fit Testing	•	✓	✓	✓	✓	•	✓	•	•	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Course Information (client specific e-learning)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Company Overview (client specific e-learning)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Our Values (client specific e-learning)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
HSEQ Process Safety (client specific e-learning)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Key:	✓	•	×
	Required	Only Required if Requested by Company, not mandatory	Not Currently Required

	Job Positions																			
	Supervisory					Trade												Non-Trade		
	Inlec Supervisor	Mechanical Supervisor	Paint Supervisor	Inlec Leading Hand	Mechanical Leading Hand	Surveyor	Habitat Technician	CSWIP Inspector	Resource Estimator Coordinator	Inlec Apprentice	Mechanical Apprentice	Boilermaker	Welder	Lagger/Insulator	Mechanical Fitter	Inlec Technician	HVAC Technician	Scaffolder (Adv)	Painter/Blaster	Rigger (Adv)
Continuous Improvement (client specific e-learning)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Risk Management (client specific e-learning)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Integrated Safe System of Work (client specific e-learning)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FPSO ISM Induction (client specific e-learning)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSM – 1a Process Safety Management Fundamentals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSM – 1b Process Safety Management Fundamentals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hazardous Substance Safety Training (e-learning)	✓	✓	✓	✓	✓	×	×	×	×	×	×	×	×	×	×	×	×	✓	✓	✓
Safe Lifting Operations Awareness (e-learning)	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	✓	×	×	✓	✓	✓
EEHA Basic Awareness (e-learning)	×	×	×	✓	×	×	×	×	×	✓	✓	×	×	×	×	✓	✓	✓	✓	✓
EEHA Selection, Installation, Inspection and Maintenance	✓	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	✓	✓	×	×	×
Scaffolding Induction	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×
Know your Standard-Electrical Safety Operating Procedure	✓	×	×	✓	×	×	×	×	×	×	×	×	×	×	×		×	×	×	×
Quality Awareness (e-learning)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Human Factors (e-learning)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Key:

✓	•	✗
Required	Only Required if Requested by Company, not mandatory	Not Currently Required

		Job Positions																			
		Supervisory					Trade												Non-Trade		
		Inlec Supervisor	Mechanical Supervisor	Paint Supervisor	Inlec Leading Hand	Mechanical Leading Hand	Surveyor	Habitat Technician	CSWIP Inspector	Resource Estimator Coordinator	Inlec Apprentice	Mechanical Apprentice	Boilermaker	Welder	Lagger/Insulator	Mechanical Fitter	Inlec Technician	HVAC Technician	Scaffolder (Adv)	Painter/Blaster	Rigger (Adv)
	Golden Safety Rules (e-learning)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Trade Certificate/Licences	Certificate IV Hazardous Areas- Elect Equipment Hazardous Areas (EEHA)	✓	✗	✗	•	•	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗
	Gyrolok (Prochem)	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗
	Certificate III Metals, Manufacturing and Services | Engineering – Mechanical	✗	✗	✗	•	•	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
	Certificate III Engineering Fabrication (Boilermaking/Welding) or Engineering- Mechanical	✗	✓	✗	•	•	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗
	Certificate III Air-Conditioning & Refrigeration	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗
	CSWIP level I, II, or III	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
	NACE I, II or III			✓						✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
	Welding Certification	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗
	Certificate IV Electrical Instrumentation	✓	✗	✗	•	•	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗
	WA Grade A Electrical Licence	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗
	AUSJET HPW Jetting Operator / Hydro Blasting Induction	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗
	Sheetmetal/Lagger/Insulator	✗	✗	✗	•	•	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗
	High Risk Work Licence (WorkSafe Certificate) | Rigging | RA – Advanced Rigging	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✓

Key:

✓	•	×
Required	Only Required if Requested by Company, not mandatory	Not Currently Required

		Job Positions																			
		Supervisory					Trade												Non-Trade		
		Inlec Supervisor	Mechanical Supervisor	Paint Supervisor	Inlec Leading Hand	Mechanical Leading Hand	Surveyor	Habitat Technician	CSWIP Inspector	Resource Estimator Coordinator	Inlec Apprentice	Mechanical Apprentice	Boilermaker	Welder	Lagger/Insulator	Mechanical Fitter	Inlec Technician	HVAC Technician	Scaffolder (Adv)	Painter/Blaster	Rigger (Adv)
	High Risk Work Licence (WorkSafe Certificate) | Scaffolding SA – Advanced Scaffolding	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	✓
	VOC RA Rigging Advanced	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	✓
	VOC SA Scaffolding Advanced	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	✓
	Rope Access IRATA Level I, II or III	•	•	•	•	•	×	×	•	×	•	•	•	•	•	•	•	•	•	•	•
Other related Competencies	**Passport**	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	VPOB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Contractor Verification Service (CVS)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Firewatch Training	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Stopaq	×	×	•	•	•	×	×	×	×	•	•	•	•	•	×	×	×	•	•	•
	Flange Management	×	✓	×	×	✓	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×
	Bolt Tensioning and Torquing	×	✓	×	×	✓	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×
	Humidur Application	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×

Appendix 13: HSE Management Plan Checklist

Integrated Best Practice HSE Management Plan Structure Checklist
☐ 1.1 Determining the scope of ISO 14001, ISO 45001, ISO 9001, AS 4801 and OHSAS 18001
☐ 1.1.1 Environmental Aspects
☐ 1.2 Legal and Other Requirements
☐ 1.3 Understanding the needs and expectations of interested parties
☐ 1.4 Communication, Participation and Consultation
☐ 1.5 HSE Policy
☐ 1.6 Objectives and Targets
☐ 1.7 Organisational Structure, Responsibility, Accountability and Authority
☐ 1.8 Hazard Identification, Risk Assessment and Risk Control
☐ 1.9 Operation Control
☐ 1.10 Emergency Preparedness and Response
☐ 1.11 Documentation Related to HSE Management Plan
☐ 1.12 Document Control
☐ 1.13 Record Control
☐ 1.14 Training, Awareness and Competence
☐ 1.15 Health Surveillance
☐ 1.16 Monitoring & Measurement, Evaluation of Compliance
☐ 1.17 Incident Investigation, Non-conformance and Corrective and Preventive Action
☐ 1.18 Management System Audits
☐ 1.19 Management Review

Offshore Contracting Company HSE Management Plan Checklist
☐ 1.1 Management Leadership and Commitment
☐ 1.2 Health and Safety Policies
☐ 1.3 Breach of Drug and Alcohol Policy
☐ 1.4 Health, Safety, and Environmental Objectives
☐ 1.5 Responsibilities and Accountabilities Organisation Chart
☐ 1.5.1 Responsibilities and Accountabilities
☐ 1.5.2 General Responsibilities
☐ 1.5.3 Client
☐ 1.5.4 Organisation Management
☐ 1.5.5 HSE Team and Training & Implementation
☐ 1.5.6 Project Manager/ Coordinator
☐ 1.5.7 Supervisor
☐ 1.5.8 Employee (Installation Team, Tradesperson, Apprentices)
☐ 1.5.9 Health and Safety Representatives (HSRs)
☐ 1.6 Training and Competency
☐ 1.7 Roles Specific Training
☐ 1.8 Subcontractors Management
☐ 1.9 Workforce Involvement
☐ 1.10 HSE Improvements
☐ 1.11 Toolbox Meeting
☐ 1.12 HSE Inspections
☐ 1.13 Induction
☐ 1.13.1 Induction (Service provider organisation)
☐ 1.13.2 Induction (Client)
☐ 1.14 Awareness Training
☐ 1.14.1 Process Safety Management (PSM) Fundamentals
☐ 1.14.2 Human Factors Awareness

□ 1.15 Consequence Management
□ 1.16 Risk Management
□ 1.17 Permit to Work/ISSOW
□ 1.17.1 Permit to Work
□ 1.18 HAZID
□ 1.19 Health and Safety in Design
□ 1.20 Persons with Control
□ 1.21 Product Lifecycle
□ 1.22 Systematic Risk Management
□ 1.23 Identify Hazards
□ 1.24 Assessing the Risks
□ 1.25 Control the Risks
□ 1.26 Monitor and Review
□ 1.27 No. Of High-End Risk Controls
□ 1.28 Knowledge and Capability
□ 1.29 Information Transfer
□ 1.30 Demonstration of ALARP
□ 1.31 Identify Risk Reduction Measures
□ 1.31.1 Evaluate Risk Reduction Measures
□ 1.31.2 Determine ALARP Options
□ 1.31.3 ALARP Demonstration
□ 1.32 Management of Change
□ 1.33 Health and Safety Planning, Performance and Management
□ 1.33.1 Regulatory Requirements
□ 1.33.2 Performance Indicators and Targets
□ 1.33.3 Reporting and Communications
□ 1.33.4 HSE Discussions
□ 1.33.5 Reporting Minor Hazard (Safe Card)
□ 1.33.6 Reporting Injury

☐ 1.34 Incident Investigation and Analysis
☐ 1.35 Medevac
☐ 1.36 Injury Management and Return to Work
☐ 1.37 Safe Work Procedures
☐ 1.38 Client Safety Rules
☐ 1.39 Working at Heights
☐ 1.40 Confined Space Entry
☐ 1.41 Lifting Operations
☐ 1.41.1 Lifting Gear
☐ 1.41.2 Rope Access
☐ 1.42 Plant and Equipment
☐ 1.42.1 Electrical equipment
☐ 1.42.2 Tools and equipment
☐ 1.43 Chemical Management
☐ 1.44 Personal Protective Equipment (PPE)
☐ 1.45 Health Management
☐ 1.45.1 Fitness for work
☐ 1.45.2 Fatigue Management
☐ 1.45.3 Noise
☐ 1.45.4 Health Monitoring
☐ 1.45.5 Medical Assessment
☐ 1.45.5.1 Remarks:
☐ 1.45.6 Employee Assistance Program (EAP)
☐ 1.46 Environmental Performance Management
☐ 1.47 Information Management
☐ 1.48 Management Review, Audit, and Improvement
☐ 1.48.1 Internal/ External Audits
☐ 1.48.2 Management System Review
☐ 1.48.3 Performance Risk/Reward KPI

Appendix 14: HSE Policy Template

WHS policy sample 1

<INSERT THE CONTRACTING COMPANY BUSINESS NAME>

WORK HEALTH AND SAFETY POLICY

Goals

This policy:

- demonstrates the complete commitment of (contracting company business name) as well as the management team and employees to health and safety
- Aims to, so far as is reasonably practicable eliminate or systematically reduce the risks to the health, safety and welfare of all direct employees, contractors, and visitors, as well as anyone else who may be affected by our business operations
- aims to ensure all work-related activities are conducted as safely as possible

Obligations

Management including all the managers and supervisors is accountable for providing and maintaining:

- a safe working environment
- safe systems of work
- plant and equipment, is kept in a safe condition
- adequate facilities for the welfare of all employees
- any relevant information, instruction, training, and supervision needed to ensure that all employees are free from injury and unnecessary risk to their health
- ANY OTHER BUSINESS HEALTH AND SAFETY RESPONSIBILITIES

Employees are responsible for:

- ensuring their own personal health and safety, and not endangering others
- complying with any reasonable health and safety managerial directions (such as company safe work procedures, wearing personal protective equipment)
- ANY OTHER HEALTH AND SAFETY OBLIGATIONS THAT WORKERS MAY HAVE.

The business expects visitors and contractors to:

- STATE HOW THE BUSINESS REQUESTS THESE PEOPLE TO FULFIL THIS POLICY AND THE PROCEDURES TO ENSURE HEALTH AND SAFETY IN THE WORKPLACE

Date: ....

Employer: ....

Employee: ....

Date to be reviewed: ....

Appendix 15: Original HSE Management Plan

CONTENTS

A) PURPOSE

The purpose of this procedure is to provide personnel a standard approach to the process of Occupational Health Management.

B) SCOPE

This document details the processes and requirements that employees are required to follow for Occupational Health management. As all works are performed on client sites and which are under the management of the client's systems and processes, all employees are required to participate in and adhere to the management processes and requirements of the client.

C) RESPONSIBILITY AND AUTHORITY

Managing Director	Ensure resources are available for the procedure to be implemented
Operations Director or delegate	Ensure that all managers and personnel are aware of and understand their responsibilities and commitment to the implementation of this procedure.
Senior Managers	Ensure personnel adhere to medical and OHS requirements prior to working on client sites
Personnel and contractors	Participate in and adhere to client requirements

D) IMPLEMENTATION

All personnel will have the responsibility to ensure they are fit to undertake their work and to not proceed if they have medical conditions that have the potential to become serious if they cannot access medical facilities immediately. If a person is on medication for an illness, they should advise their supervisor of the fact

Personnel health will be managed, and practices enforced to ensure operations are performed in the highest of safety performances.

In the event of any persons having concerns about the potential health effects arising from work activities or contact with any substances or chemicals, they shall immediately raise these matters with their Supervisor and / or Manager who shall ensure an appropriate response is made to the concern, and record the concern and responses.

a. Hours of Work

Hours of work shall comply with the following:

- the work time shall not exceed 14 hours per 24-hour period with a minimum rest period of 10 hours between shifts (except in an emergency);
- personnel who work between 12 to 14 hours per 24-hour period shall obtain the consent of the client's supervisor; and
- personnel shall work no longer than 28 consecutive days without a mandatory rest period or an equivalent arrangement as agreed with the Operations Director.

b. Medicals

All employees are to undertake a medical examination immediately prior to commencing employment. Where the client requires further medical assessment prior to engagement of services, employees are to participate in the required process. All medical information is to remain confidential to authorised persons. All medicals shall follow the requirements of the OGUK Offshore Medical which consists of the following:

- Completion of Patient Health History Questionnaire
- Urinalysis – routine urine test with immediate result
- BMI – measurement of height, weight and calculation of Body Mass Index
- Near, Distance and Colour Vision
- Pulse and Blood Pressure Measurement
- Lung Function Test (peak flow)
- Audiogram (hearing test)

The medical examination is valid for 2 years at which point employees are required to retake the medical examination. Should additional factors or health risks arise then the frequency and type of medical assessments for the employee may increase.

c. Illegal Drugs & Alcohol

Fitness for Work Policy prohibits the use, possession, distribution, purchase, or sale of any drug/controlled substance by any person while on Company premises, engaged in Company business, or while operating Company equipment. The use of any drug/controlled substance that causes or contributes to unacceptable job performance or unusual job behaviour is also prohibited.

Alcohol and illegal drugs are not permitted on any worksite. Persons shall not perform work activities with a blood alcohol concentration of greater than 0.00 mg/l and any personnel believed to be intoxicated shall not be allowed to go to their working area and may face disciplinary actions. Any illegal drug concentrations shall be aligned with current industry standards and client requirements. Employees are subject to pre-employment and random screening, and ongoing training and education. In the event that the client undertakes for cause or random drug and alcohol testing procedure onsite, all personnel are to participate in and adhere to the client's requirements and processes.

Resources are provided for counselling and rehabilitation if required. The use of prescription drugs for medicinal purposes must be reported to the Site Supervisor and if necessary alternative duties may be applied

d. Protection from Heat

Where continuous work is required in direct sun light, workers shall ensure the work area is shaded as much as possible. Personnel will be made aware of the risk of heat stroke and endeavour to remain cool. SPF 15+ sunscreen and add-on brims for safety helmets should be available at the work site.

Cool drinking water should be readily available at all work sites. Personnel are encouraged to take frequent small drinks to replace body fluid lost through sweating and remain as hydrated as possible.

e. First Aid

All employees are expected to have current first aid training and to assist in rendering initial first aid where required and within their capabilities. When on site, the client's first aid and medical facilities are provided to all personnel and processes for initial treatment and response should be adhered to.

All employees who require hospitalisation, or require the attention of a medical practitioner, will be transported and provided with the service as soon as possible under the processes. Serious Injuries and Medical evacuation are to be addressed by the Client. Ongoing medical assistance for employees is to follow HRM-PR-002 Injury Management.

f. Occupational Monitoring

All employees are required to participate in and adhere to any client occupational health monitoring processes that may be required subject to the client and site requirements. This may include noise and dust monitoring and any risk determined aspects related to the site.

E) RELATED DOCUMENTS

IMS-PY-006 Fitness for Work Policy

HRM-FM-004 Personal Details

HRM-FM-013 New Employee Checklist

HRM-PR-002 Injury Management

RAM-PR-001 Rope Access Work

IMS-RG-002 Audit and Inspection Schedule

Appendix 16: Comparison between original and newly integrated HSE plan

Comparison Between Original and Newly Integrated HSE Plan	
New Plan	**Old Plan**
1.1 Management Leadership and Commitment	1.0 Purpose
1.2 Health and Safety Policies	2.0 Scope
1.3 Breach of Drug and Alcohol Policy	3.0 Responsibility and Authority
1.4 Health, Safety, and Environmental Objectives	4.0 Implementation
1.5 Responsibilities and Accountabilities Organisation Chart	4.1 Medicals
1.5.1 Responsibilities and Accountabilities	4.2 Hours of Work
1.5.2 General Responsibilities	4.3 Illegal Drugs and Alcohol
1.5.3 Client	4.4 Protection from Heat
1.5.4 Organisation Management	4.5 First Aid
1.5.5 HSE Team and Training & Implementation	4.6 Occupational Monitoring
1.5.6 Project Manager/ Coordinator	
1.5.7 Supervisor	
1.5.8 Employee (Installation Team, Tradesperson, Apprentices)	
1.5.9 Health and Safety Representatives (HSRs)	
1.6 Training and Competency	
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1.26 Monitor and Review	
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1.30 Demonstration of ALARP	
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1.31.3 ALARP Demonstration	
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1.45.1 Fitness for work	
1.45.2 Fatigue Management	
1.45.3 Noise	
1.45.4 Health Monitoring	
1.45.5 Medical Assessment	
1.45.5.1 Remarks	
1.45.6 Employee Assistance Program (EAP)	

1.46 Environmental Performance Management	
1.47 Information Management	
1.48 Management Review, Audit, and Improvement	
1.48.1 Internal/ External Audits	
1.48.2 Management System Review	
1.48.3 Performance Risk/Reward KPI	